NATIONAL CENTER FOR GEOGRAPHIC INFORMATION AND ANALYSIS

A Proposal

By:

The University of California, Santa Barbara
The State University of New York at Buffalo
The University of Maine

to
Geography and Regional Science Program
National Science Foundation

Volume 11

Appendices

Submitted January 27, 1988

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Appendix A
List of Center Participants

Key Personnel: Principal Investigators

UCSB	*Department*	*U. Buffalo*	*Department*
David S. Simonett	Geography	Ross D. MacKinnon	Geography
Michael F. Goodchild	Geography	David M. Mark	Geography
Terence R. Smith	Computer Science	Barbara P. Buttenfield	Geography
Waldo Tobler	Geography		
John E. Estes	Geography	*U. Maine*	*Department*
		Andrew Frank	Surveying Engineering
		Earl Epstein	Surveying Engineering

Other Key Personnel: Additional Research Initiative Team Leaders

UCSB	*Dept.*	*U. Buffalo*	*Dept.*	*U. Maine*	*Dept.*
Frank Davis	Geography			Kate Beard	Surv. Eng.
Joel Michaelsen	Geography				

Other Center Participants

UCSB	*Department*	*U. Buffalo*	*Department*
Luc Anselin*	Geography	Barry Lentnek	Geography
Daniel Botkin	Biological Sciences	James E. McConnell	Geography
Richard L. Church*	Geography	Russ Miller	Computer Science
Helen Couclelis*	Geography	James R. Pomerantz	Psychology
Jeff Dozier	Geography	William J. Rapaport	Computer Science
Allen Gersho	Elec. and Comp. Eng.	Peter A. Rogerson	Geography
Reginald G. Golledge	Geography	Stuart C. Shapiro	Computer Science
Earl J. Hajic	Geography	David Sher	Decision Theory
Julia Allen Jones	Geography	Sargur N. Srihari	Computer Science
Hugo Loaiciga*	Geography	Deborah Walters	Computer Science
Bruce Luyendyk	Geological Sciences	Michael J. Woldenberg	Geography
John Michael Melack	Biological Sciences	David A. Zubin	Linguistics
Prakash V. Ramanan	Elec. and Comp. Eng.	Ezra Zubrow	Anthropology
Raymond C. Smith*	Geography	*U. Maine*	*Department*
Jeffery Star*	Geography	Renato Barrera	Surveying Eng.
Yaun-Fang Wang	Elec. and Comp. Eng.	Thomas B. Brann	Forest Eng.
U. Buffalo	*Department*	Thomas D. Duchesneau	Economics
Athol D. Abrahams	Geography	Manfred Ehlers	Surveying Eng.
Carl G. Amrhein	Geography	Robert Franzosa	Mathematics
Laurence E. Band	Geography	Raymond J. Hintz	Surveying Eng
Rajan Batta	Industrial Eng.	Laurence Latour	Computer Science
Wayne F. Bialas	Industrial Eng.	Alfred Leick	Civil Eng.
Gail A. Bruder	Psychology	George Markowsky	Computer Science
Hugh W. Calkins	Geography	Charles J. Mundo	Navigation Science
Shoshana L. Hardt	Computer Science	Harlan J. Onsrud	Surveying Eng.
James W. Harrington	Geography	Steven Sader	Forest Eng.

* Starred UCSB Geography Department faculty and staff obtained their Ph. D's in disciplines other than Geography as follows: Anselin, Regional Science; Church, Environmental Engineering; Couclelis, Urban Planning; Loaiciga, Civil Engineering; R. C. Smith, Physics; Star, Oceanography.

Appendix B
Biographical Information

B1. Department of Geography, University of California at Santa Barbara

Faculty and Staff Contributions to the NSF Center

In the following sections we give an overview of the Geography Department faculty to be involved in the NSF Center. Then follows the respective faculty vitae, for the geography faculty as well as anticipated cooperating faculty in other departments in the social and natural sciences and engineering.

Since its inception in 1975, the Geography Department at UCSB has grown to fifteen faculty, and has authorization to add four new positions, two in geographical information systems in addition to the four faculty already active in this area. The department has a very strong commitment to quantitative, analytical, and modeling research in human and physical geography, in spatial analysis, and in geographical skills, primarily in remote sensing, in geographical information systems and in computer cartography. The competencies of the faculty are given in the Table on the following page. The intersecting interests and skills of the faculty provide a strong web of shared understanding and approaches which pull the human and physical sides of the department together. This structure has been one of conscious design - of adding faculty in depth in a relatively small number of substantive areas who in addition have strong modeling and geographical skills - and is also expressed in the three-dimensional diagram, which accompanies the Table. Comparable tables and diagram accompany the equivalent material on Buffalo, and Maine.

Over seventy graduate students are engaged in MA and Ph.D. programs. These students actively contribute to ongoing research and participate in technical conferences as part of the department policy of educating trained scientists. This commitment to academic excellence has fostered high publication rates, substantial extra-mural funding, cross-disciplinary associations (e.g. Computer Science, Statistics, Psychology, Cognitive Science, Linguistics, Geological Sciences, Biological Sciences, Education, Environmental Studies) and a unique teaching curriculum which consists of coursework unavailable in most other university geography departments.

Operating as a collective enterprise with strongly shared goals, the Department now generates over two million dollars annually in research funds. Senior faculty have strong demonstrated research management skills and provide guidance to both junior faculty and graduate students in proposal preparation, and in co-proposing with them. We require graduate students to prepare research proposals in conjunction with faculty early in their career, and subsequently to initiate their own research proposals. Of the fifty graduate students who enrolled before Fall 1987 (twenty additional students enrolled then) thirty have either initiated or significantly participated with faculty in gaining funded research.

Relevant details are as follows:

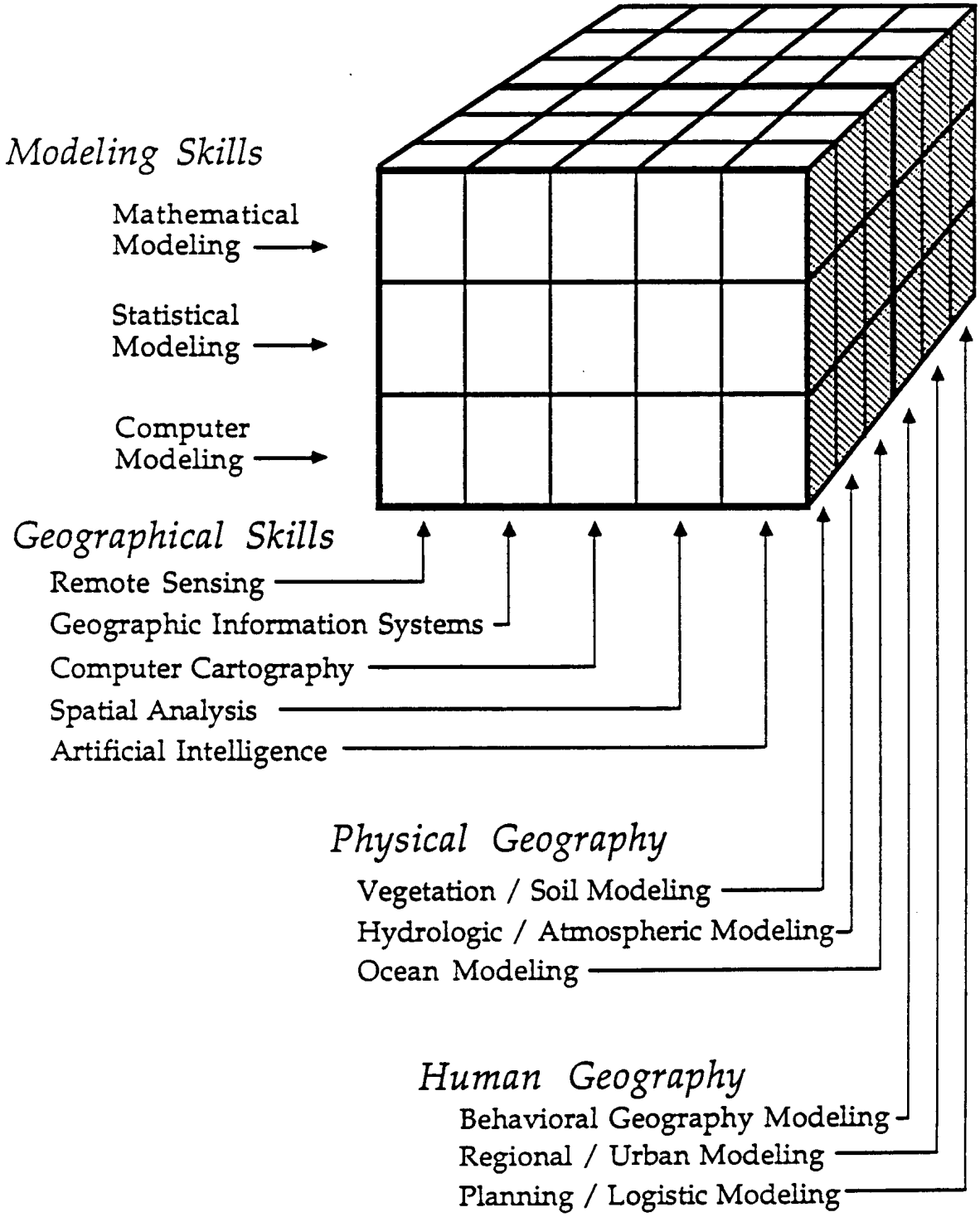
Editorships: Faculty and staff serve on editorial boards for thirteen geographical and related journals including: *International Journal of Geographical Information Systems, Geographical Analysis, Urban Geographer, Remote Sensing of Environment, The American Cartographer, Mathematical Population Studies, Water Resources Research, Journal of Electromagnetic Waves and Applications, Remote Sensing Series and Monographs, Mappae Munde, Geocarto International and Physical Geography.* Present and past editorships include: *Environment and Behavior, Geographical Analysis, Annals of the Association of American Geographers, Remote Sensing of the Environment, 2nd edition of Manual of Remote Sensing,* (volumes I and II). Book Review Editor for: *Geographical Analysis; Aerial and Space Imaging, Remote Sensing, and Integrated Geographical Systems.*

THE UNIVERSITY OF CALIFORNIA
SANTA BARBARA
DEPARTMENT OF GEOGRAPHY
EXISTING AND *AUTHORIZED* FACULTY FTE
1988-1991

Departmental Interests																				
Year of Commitment	*Actual and Liened FTE*	*Faculty*	*Geographical/ Spatial Skills*					*Modeling Skills*			*Physical Geography*			*Human Geography*			*Philosophical-Theoretical*		
			Remote Sensing	Geographical Information Systems	Computer Cartography	Spatial Analysis	Artificial Intelligence	Mathematical Modeling	Statistical Modeling	Computer Modeling	Hydrologic/ Atmospheric Modeling	Vegetation/ Soil Modeling	Ocean Modeling	Behavioral Geography Modeling	Regional/ Urban Modeling	Planning/ Logistic Modeling	Philosophical/ Theoretical		
	0.5†	T. Smith		X		X	X	X	X	X				*	X				
	1	W. Tobler		X	X	X		X	*	X				*	X		X		
	1	M. Goodchild		X	X	X		*	X	*				*	X	X			
	1	L. Anselin				X		*	X	*					X	X			
	1	R. Church		*		X		X	X	X	X				X	X			
	1	H. Couclelis				*		*	*	*				X	X	X	X		
	1	R. Golledge				X		*	X	*				X	X		X		
	0.5	D. Simonett	X	*					X		*	X							
	1	J. Dozier	X					X	*	X	X								
	1	H. Loaiciga						X	X	X	X					X			
	1	J. Estes	X	X					*			X							
	1	F. Davis	X	X				*	X	*		X					*		
	1	J. Michaelsen	*			X		*	X	*	X								
	0.5	J. Allen-Jones						*	*		X	X			*				
	1	R. Smith	X					X	X	X			X						
Authorized FTE (with start date): 1988 - 1991																				
		Geographic Information Systems																		
'88	1	Computer Cartography/ GIS/Decision Analysis		X	X	X			X	X					X	X			
††	0.5	GIS/Remote/ Sensing/Calspace	X	X			X	X	X	X		X							
'91	1	Cognitive Sci/AI/GIS		X	X		X	X	X	X					X				
		Ocean Modeling																	
'88	1	Physical Oceanography/ Remote Sensing	X					X	X	X	*		X						
'89	1	Physical Oceanography	X					X	X	X			X						
'90	1	Atmospheric	X					X	X	X	X		X						
		X	9	8	5	8	3	12	17	13	6	5	4	2	9	7	4		
		*	1	2		1		7	5	6	2			3	1		1		
	$\sum$ 19		10	10	5	9	3	19	22	19	8	5	4	5	10	7	5		

Key: X represents major interest.
* represents minor interest.
† T. Smith is presently full time in computer Science; he will return to 0.5 time in Geography when he finishes his term as Department Chairman in Computer Science.
†† Under consideration but not authorized at this time.

University of California
Santa Barbara
Department of Geography



Publications: Faculty have published over fourteen books, contributed chapters to fifty others, published over 500 articles in both refereed journals and conference proceedings, and numerous contract and grant reports.

Reviewing: Faculty have reviewed for the following journals: *The Annals of the Association of American Geographers, IEEE Transactions on Geoscience and Remote Sensing, Geographical Review, Professional Geographer, Transportation Research; Aerial and Space Imaging, Remote Sensing, and Integrated Geographical Systems; Environment and Behavior, Environment and Planning, Operations Research, Journal of Water Resources, Journal of Physical Oceanography, Monthly Weather Review, Journal of Geophysical Research, Optical Engineering, Geophysical Research Letters, Journal of Geography, Science, Environmental Psychology, Urban Geography, Canadian Geographer, Journal of Leisure 'Research, Economic Geography, Journal of Retailing, Mathematical Geology, Leisure Sciences, Cartographica, Canadian Journal of Earth Sciences, Annals of Regional Science, Physical Geography, Remote Sensing of the Environment, European Journal of Operations Research, IEEE Systems, Man, and Cybernetics; ASCE Journal of Environmental Engineering, and Health Services Research; Geocarto International, Photogrammetric Engineering and Remote Sensing, AI Applications in Natural Resources Management.*

Honors/Awards: Three faculty members (Tobler, Golledge, and Simonett) have been awarded the Meritorious Contributions to Geography Award of the AAG. Golledge has been the recipient of the Gamma Theta Upsilon/AAG Visiting Geographical Scientist Award, the AAG Geography Honors Award and a Guggenheim Foundation award. Tobler is a member of the National Academy of Science, and an Honorary Fellow of the American Geographical Society. Simonett is a two time recipient of the Presidential Citation for Meritorious Contributions to the American Photogrammatic Society, is Honorary Research Professor, Chinese Academy of Science, Peoples Republic of China, Distinguished Scientist/Lecturer of the National Science Foundation/American Society of Photogrammetry, and twice a Fulbright Scholar. John Estes has been twice awarded the Presidential Citation for Meritorious Contribution to the American Society of Photogrammetry, the National Merit Teachers Award, National Council on Geographic Education, the Notable Americans Award, NASA Group Achievement Award, Ford Bartlett Award (American Society of Photogrammetry), and a Certificate of Appreciation (American Society of Photogrammetry) and is currently a visiting senior scientist at NASA Headquarters, Washington D. C. Jeffery Dozier held a Senior Postdoctoral Research Associateship at N.O.A.A. from the National Academy of Science, has been a Visiting Scientist at NASA Headquarters, Washington D.C., and is presently project scientist for NASA for the High Resolution Imaging Spectrometer. Terence Smith has been awarded a Fulbright Travel Award. Jeffery Star received E. W. Fagan Memorial Award of the Scripps Institution of Oceanography; and has been visiting scientist at the USGS National Center.

National and International Committees: Faculty members serve on or have served on a variety of national and international committees and subcommittees, as follows:

1) **Dozier:** *American Geophysical Union*: Remote Sensing Committee, Hydrology Section; Snow, Ice and Permafrost Committee; Executive Committee, Hydrology Section; *National Academy of Sciences*: Committee on Glaciology, Polar Research Board; Chairman, Ad Hoc Committee on Remote Sensing, Polar Research Board, Committee on Opportunities in the Hydrological Sciences; *Jet Propulsion Laboratory*: Imaging Spectrometer Science Advisory Group; *National Aeronautics and Space Administration*: Committee on the High Resolution Multifrequency Microwave Radiometer (HMMR), Earth Observation Station Program; Committee on the First ISLSCP (International Satellite Land Surface Climatology Program) Field Experiment; Scientific Study Group on Snow, Soil Moisture and Precipitation; Working Group on Remote Sensing of Snow Properties; Working Group on Basic Research in Remote Sensing; Joint EOSAT/NASA Thermal Infrared Working Group.

2) **Estes*:*** *National Academy of Science/National Research Council*: Planetary Biology and Chemical Evolution Committee; Planetary Biology and Liaison to Data Management and Computation Committee: Member Committee on Data Management and Computation, National Mapping Advisory Committee; Earth Resources Committee, Space Applications Board*; National Aeronautics and Space Administration*: Earth Science and Applications Division/Information Systems Office Pilot Land Data System (PLDS) Science Working Group; Earth Observation Satellite (Eos) Data System Panel; Space Station User Working Group Data Panel; Space Station Science Operations Task Force Payload Selection and Resource Allocations Subpanel; *NASA/NOAA*: Chairman, Remote Sensing Education; *American Society of Photogrammetry and Remote Sensing*: Geography and Land Use Committee, Remote Sensing Applications Division; *Association of American Geographers*: Chairman, Remote Sensing Committee; Chairman, Awards Committee, Remote Sensing Specialty Group; Project and Development Committee, Survey and Synthesis Task Force.

3) **Golledge:** *Association of American Geographers*: Committee on the Status of Women in Geography; Program Committee; Honors Committee; Ad Hoc Committee on Research Development.

4) **Goodchild**: *Association of American Geographers*: Synthesis and Survey Task Force*; Canadian Association of Geographers*: Nominating Committee; *Canadian Cartographic Association*: Sub-committee on Professional Standing; *International Geographical Union*: Executive Committee, Large GIS/Data Base; Chairman, Scientific Committee; Chairman, Automation Interest Group Commission on Geographical Data Sensing and Processing.

5) **Simonett:** *Association of American Geographers*: Central Council; Chairman, Great Plains-Rocky Mountain Division; Committee on Instrumentation; *National Academy of Sciences/National Research Council*: Ad Hoc Information Management Panel Committee on Remote Sensing Programs for Earth Resource Surveys (CORSPERS); Committee on Remote Sensing for Economic Development; Committee on International Disaster Assistance; *Agency for International Development*: Division of Forestry; *International Geographical Union*: Board of Directors, Large GIS/Data Base Committee in conjunction with International Council of Scientific Unions; Chairman, Sub-Committee on Remote Sensing; Commission of Data Sensing and Processing; Commission on Data Sensing and Processing- Linking Remote Sensing and Geographical Information Systems; *Geological Society of America/Soil Science Society of America/ Association of American Geographers:* Joint Committee on the Inter-relations of Soil Science and Geomorphology; National Aeronautics and Space Administration: Geostationary Platform Committee; Space Imaging Radar Committee; Terrestrial Ecosystems Committee.

6) **T. Smith:** *Association of American Geographers*: Executive Committee; Quantitative Methods Specialty Group Chairman, Research Committee; *Association of Pacific Coast Geographers*: Chairman of Organizing Committee 1979 Meeting; Chairman of Program Committee 1979 Meeting.

7) **R. Smith:** *NATO*: Organizing Committee, The Effects of Solar UV-B Radiation in the Marine Ecosystem; *IAPSO/SCOR*: International Association of the Physical Sciences of the Ocean, Working Group on Ocean Optics; *SCOR/UNESCO*: Photosynthesis in the Sea, Working Group 15; *National Aeronautics and Space Administration*: Satellite Ocean Color Working Group; Pilot Ocean Data Systems (PODS), Science Steering Group; Chief Scientist, Color/Temperature Time Series Core Team; *Joint Oceanographic Institutions Incorporated*: Satellite Planning Committee; *National Academy of Science/National Research Council*: Committee on Earth Sciences, Space Science Board.

8) **Tobler:** *International Geographical Union*: Large GIS/Data Base, Scientific Committee; Committee on Data Sensing and Processing; *National Academy of Science/ National Research Council*: Committee on Behavioral and Social Sciences and Education, Board on Earth Sciences; *National Science Foundation/ESRC*: Bi-National Committee on Geographical Information Systems.

Consultancies: Faculty have served as consultants to over 100 agencies and corporations as follows:

1**) U.S. Federal Agencies:** Naval Training Command, Department of Agriculture, Environmental Protection Agency, Fish and Wildlife Service, Geologic Survey, Navy, Marine Corps, and U.S. Court System.

2) **Private Corporations** (U.S.): Aeronautics Division (McDonnell Douglas), American Technical Assistance Corporation, Ceasars World, Dames and Moore, Earth Satellite Corporation, EG&G, Farnsworth and Cannon, General Electric Tempo, Goodyear Aerospace Corporation, Henningson, Durham and Richardson, Kennecott Copper Corporation, Lockheed Aerospace Corporation, National Geographic Society, North Slope Borough Alaska, Oceanographic Services Incorporated, Operations Research Incorporated, Science Applications Incorporated, Southern Pacific Railroad, Texaco, Texas A&M, TRW Systems Incorporated, University of Arizona, Universities Space Research Association, United Technologies, Western Liquified Gas Terminal Associates, Westinghouse Aerospace Corporation. ’

3) **International Agencies:** UN/FAO, UN Development Program, World Bank, UN Environment Program.

4) **Foreign Countries: Australia:** Australian Water Resources Council, Australian Bureau of Mineral Resources (Canberra, Australia), City Planning Department (Frankston, Australia), State Department for Planning (Victoria), Town and Country Planning Board (Melbourne).

Canada: Alberta Department of Recreation, Parks and Wildlife, Bell Canada, Campbell Sharp Ltd., Canadian Forest Service, Comstat Consulting Services Ltd., Council on the Environment, Department of Energy, Mines and Resources,

Department of the Environment, Department of Regional Economic Expansion, Group West Ltd., Ontario Ministry of Natural Resources, Secretary of State, SMA Montreal, Statistics Canada, The Earth Technology Corporation, Tomlinson Associates, T.R.W. Systems Inc.

Other International: Government of Brazil, Government of Kenya, Government of Iran, Government of Morocco, Government of Nigeria, Government of Venezuela.

Research Grants/Contracts: Extra-mural grants for faculty research presently number 41 with an additional 15 pending. Allocation of research is broken down as follows; remote sensing (60% of total funds), geographical information systems (25% of total funds) and other, e.g. urban and regional modeling (15% of total funds). Per-annum funding averages over two million dollars and total lifetime research funds generated by the faculty exceeds thirty million dollars.

Education: Teaching experience of the faculty and staff includes a wide diversity of positions and backgrounds which include university teaching, extension, special seminars, and adult education for research and instruction in the U.S. and abroad. Estes and Star teach a course on Introduction to Geographic Information Systems for George Washington University's Continuing Engineering Education Program. Faculty have given substantial extra-mural courses as follows: *Adult education training*: University of Kansas, Northwestern, Washington, Harvard, Vienna, Karlsruhe, Nottingham, Sydney, Zurich; *International training courses*: Brazil, Canada, Italy, Venezuela, Greece, Iran, Nigeria; *Technical training course/lectures*: University of Michigan, Auckland, Alberta, Italy, Kansas, Sydney, George Washington University, Training of High School Teachers, Kansas. The faculty have presented over 200 seminar papers in the U.S. and abroad. There is a unified philosophy of integrating research with graduate and undergraduate teaching, and of training of graduate students in research, research management skills, and entrepreneurship. As noted earlier, thirty graduate students have actively participated in acquiring personal research funding through research grants. The Department has played a major role in creating and participating in campus-wide facilities that contribute to other disciplines on campus e.g. Map and Imagery Library, Center for Remote Sensing and Environmental Optics, Computer Systems Laboratory, Marine Sciences Institute, and will play the lead role in creating the Center for Geographic Information and Analysis.

Management: UCSB Geography Department faculty and staff have considerable depth of management experience, both in managing large research projects as previously mentioned, and institutional/departmental operations: **Simonett:** Dean, Graduate Division, UCSB; Department Chair, Sydney and UCSB; Associate Director, Remote Sensing Laboratory, Kansas; Director, Land Use and Agricultural Applications Division of Earth Satellite Corporation; **T. Smith**: Department Chair, Computer Science, UCSB; Associate Director, Community Organization Research Institute, UCSB; Chair Research Committee, UCSB; **Goodchild, Golledge, Church:** Department Chair; **R. Smith**: Director, Visibility Laboratory of the Scripps Institute of Oceanography; Director, Computer Systems Laboratory and Center for Remote Sensing and Environmental Optics, UCSB; **Estes:** Director, Geography Remote Sensing Unit, UCSB; Chair Research Committee, UCSB; **Star:** Manager, Geography Remote Sensing Unit, UCSB.

B2. Individual Vitae for UCSB Participants

Geography Department

Luc Anselin

Dr. Luc Anselin, Associate Professor at the University of California, received his undergraduate degree in Economics as well as a Master's degree in Statistics, Econometrics and Operations Research from the Vrije Universiteit, Brussels (Belgium). He continued his graduate education at Cornell University, where he obtained a Master's degree and a Ph.D. in Regional Science. In addition to his current faculty position in the departments of Geography and Economics at UCSB, Dr. Anselin has taught in the Department of City and Regional Planning at The Ohio State University. His academic interests include spatial econometrics, urban and regional modeling and peace research. His research has been funded by the National Science Foundation, the National Association of Regulatory Utility Commissions, the Ohio Board of Regents, the California Space Institute and the California Water Resources Center, and has appeared in many journal articles and conference proceedings. He recently completed a book manuscript on methods and models in spatial econometrics.

Dr. Anselin's current GIS-related research interests include methodological issues pertaining to spatial statistics, spatial econometrics and decision-support systems. Specifically, Dr. Anselin is investigating spatial aspects of

generation and propagation with respect to data assembly and manipulation in GIS, the use of large GIS systems in operational urban and regional modeling and the development of spatial statistical software.

Selected Publications:

Spatial Econometrics: Methods and Models, Dordrecht, Kluwer Publishing, 1988 (forthcoming).

Lagrange Multiplier Test Diagnostics for Spatial Dependence and Spatial Heterogeneity, *Geographical Analysis*, vol. 20, 1988, in press.

Estimation and Model Validation of Spatial Econometric Models Using the GAUSS Microcomputer Statistical Software, Discussion Paper, Department of Geography, University of California, Santa Barbara, (revised and updated) 1987, pp. 60.

Model Validation in Spatial Econometrics: A Review and Evaluation of Alternative Approaches, *International Regional Science Review*, vol. 11, 1987, forthcoming.

Some Further Notes on Spatial Models and Regional Science, *Journal of Regional Science*, vol 26 (4), 1986, pp. 799-805.

MicroQAP: a Microcomputer Implementation of Generalized Measures of Spatial Association, Working Paper, Department of Geography, University of California, Santa Barbara, Aug. 1986, pp. 35.

Non-Nested Tests on the Weight Structure in Spatial Autoregressive Models: Some Monte Carlo Results, *Journal of Regional Science*, vol. 26 (2), 1986, pp. 267-284.

Specification Tests and Model Selection for Spatial Interaction and the Structure of Spatial Dependence, Final Report to the National Science Foundation, The Ohio State University Research Foundation, 1985, p. 92.

Computer Routines for Estimation and Specification Tests in Spatial Autoregressive Models, The Ohio State University, Department of City and Regional Planning Working Paper W84-15, Sept. 1984, pp. 66.

A Decision Support Framework for Regulatory Evaluation of Electric Utility Performance, in *Proceedings of the Fourth NARUC Biennial Regulatory Information Conference*, R. Lawton ed., The National Regulatory Research Institute, Columbus, OH, 1984, pp. 997-1007.

Specification Tests on the Structure of Interaction in Spatial Econometric Models, *Papers, Regional Science Association*, vol. 54, 1984, pp. 165-182.

A Multicriteria Framework as Decision Support System for Urban Growth Management Applications: Central City Development, *European Journal of Operational Research*, vol. 13 (3), 1983, pp. 300-309.

A Note on Small Sample Properties of Estimators in a First Order Spatial Autoregressive Model, *Environment and Planning A*, vol. 14 (3), 1982, pp. 359-376.

Integration of Multiregional Models for Policy Analysis, with W. Isard, *Environment and Planning A*, vol. 14 (3), 1982, pp. 359-376.

Estimation Methods for Spatial Autoregressive Structures: A Study in Spatial Econometrics, Regional Science Dissertation and Monograph Series #8, Program in Urban and Regional Studies Publications, Ithaca, N.Y., 1980.

Richard L. Church

Dr. Richard L. Church, Professor and Chair of the Department of Geography at the University of California at Santa Barbara, received his B. S. degree in Mathematics and Chemistry from Lewis and Clark College in 1970. He received his Ph.D. degree (1974) from the Department of Geography and Environmental Engineering at The Johns Hopkins University for Environmental Systems Engineering. He has an extensive background in both operations research and systems engineering with research interests in urban and regional modeling, resource management, and optimization. He has taught courses in civil engineering, industrial engineering, management science and geography.

Over the past decade, Dr. Church has worked on a number of location, transportation, and energy and water resource models that utilize or are integrated with spatial geographic data structures. Dr. Church has worked on problems related to GIS systems including corridor routing and rights-of-way location, regional energy facility development, hazardous materials transportation modeling, and settlement pattern research. Dr. Church is currently

involved in incorporating GIS data structures (e.g., quadtree) in specialized location-allocation model algorithms, as well as building decision support systems with GIS.

Selected Publications:

Hazardous Materials Transportation Modeling, with R. Reeves, to be submitted to *Journal of Hazardous Materials*.

The Formal and Computational Relationship of The Supporting Median Problem to the P-Median Problem, with J. Weaver, to appear in *Transportation Research*.

A Hybrid FLEET Model for EMS System Design, with G. Bianchi, *Social Science and Medicine*, vol. 26 (1), 1988, pp. 163-171.

Late Horizon Regional Efficiency in the Northeastern Basin of Mexico: A Location-Allocation Perspective, with T. L. Bell, and L. Gorenflo, to appear in *Journal of Anthropological Archeology*.

Build-1: A Disaggregate Model of the U.S. Electric Utility Industry with E. L. Hillsman and D. R. Alvic, to appear in *European Journal of Operations Res*earch.

Hierarchical Location Analysis Utilizing Covering Objectives, with D. Eaton, in Gerald Rushton and Avijit Ghosh, eds., *Spatial Analysis and Allocation Modeling*, 1987, pp. 163-185.

Evolution of Geographic Information Systems as Decision-making Tools, with P. Parent, *Proceedings, Geographic Information Systems '87*, ASPRS, 1987, pp 87-98.

Theoretical Links Between Median and Coverage Location Problems, with J. Weaver, *Annals of Operation Research*, vol. 6, 1986, pp. 1-19.

Transmission Corridor Location Modelling, with D. Huber, *The Transportation Journal*, ASCE, vol. 3 (2), 1985

Modeling Spatial Allocation-Location Solutions for General Practitioner Medical Services in Cities: The Equity-Revenue Maximizing Conflict Cast, with R. Stimson, Regional Science and Urban Economics, vol. 13, 1983, pp. 161-172.

Computational Procedures for Location Problems on Stochastic Networks, with J. Weaver, *Transportation Science*, vol. 17 (2), May 1983, pp. 168-180.

A Comparison of Two Baseline Screening Approaches to Regional Energy Facility Siting, with T. L. Bell, *Geojournal*, Supplementary Issue 3, 1981, pp. 17-36.

Developing Solid Waste Planning Regions for the Tennessee Valley Authority: Modeling and Simulation, *Proceedings of the Eleventh Annual Conference on Modeling and Simulation*, vol. 2,1980.

ENCORE - A Test Application of an Environrnental/Economic Corridor Location System to the MAGI Data Base, Dept. of Civil Engineering Research Series No. 37, University of Tennessee, Knoxville, TN, 1980.

Applications of a Multiobjective Facility Location Model to Power Plant Siting in a Six State Region, with ReVelle, Eagles, Cohon and Eberhart, *Computers and Operations Research*, 1979, pp. 214-217.

Helen Couclelis

Dr. Helen Couclelis, Associate Professor of Geography at the University of California, Santa Barbara, received her Graduate Diploma (B. A.) for Architecture in Athens, Greece (1967), and her Post-Graduate Diploma (M. A.) for Urban and Regional Planning in Munich, Germany (1971). She was awarded her Ph.D. for Urban Modeling from Cambridge University in 1977. Dr. Couclelis' research interests include spatial theory and modeling, behavioral geography, planning and philosophy of science. She has eleven published articles in refereed journals, contributed chapters for seven books, participated in four invited lectures and has presented papers at thirteen major conferences and symposia. Funding for her research includes a grant from the National Science Foundation for research conducted with Dr. Reginald Golledge on mental maps and consumer behavior, and by the A. G. Leventis Foundation, Paris, for research concerning mathematical spatial theory and human affairs.

Having worked as a planner and policy advisor in Greece for several years, Dr. Couclelis has a unique background which touches on the practical as well as the theoretical side of geographical analysis. University research on GIS related issues conducted by Dr. Couclelis includes the development of a theoretical framework for alternative

models of spatial decision and behavior, the exploration of spatial dynamics using cellular automata models and research issues in spatial cognition.

Selected Publications:

Cellular Dynamics: How Individual Decisions Lead to Global Urban Change, *European Journal of Operations Research*, vol. 30, 1987, pp. 344-346.

Of Mice and Men: What Rodent Populations Can Teach Us About Complex Spatial Dynamics, *Environment and Planning A*, (in press)

A Theoretical Framework for Alternative Models of Spatial Decision and Behavior, *Annals of the Association of American Geographers*, 76, Mar. 1986, pp. 95-113.

Artificial Intelligence in Geography: Conjectures on the Shape of Things to Come. *The Professional Geographer*, 38, Feb. 1986.

Prior Structure and Spatial Interaction, in B. Hutchinson, P. Nijkamp, and M. Batty (eds), *Optimization and Discrete Choice in Urban Systems*, Springer, Berlin, 1985, pp. 162-179.

Cellular Worlds: A Framework for Modeling Micro-Macro Dynamics, *Environment and Planning A*, vol. 17, 1985, pp. 585-596.

Theoretical Framework of Urban Planning, chapters 1-5 of A. Aravantinos (ed.) *Urban Planning: Topics in Theory and Practice*, National Technical University Press, Athens (in Greek), 1984, pp 25-109.

The Notion of Prior Structure in Urban Modeling, *Environment and Planning A*, vol. 16, 1984, pp. 319-338.

On Some Problems in Defining Sets for Q-Analysis, *Environment and Planning B*, vol. 10, 1984, pp. 423-438.

Analytic Research, Positivism and Behavioral Geography, with R. G. Golledge, *Annals of the Association of American Geographers*. vol. 73, 1983, pp. 331-339.

Recent Experience with Large-scale Urban Development Models, with B. Hutchinson, Presented at 11AC Symposium on Theory and Application of Digital Control, New Delhi, India, 1982.

Frank Davis

Dr. Frank Davis, Assistant Professor at the University of California, Santa Barbara, received his B. A. in Biology (1975) at Williams College and his Ph.D. (1982) in Geography and Environmental Engineering from John Hopkins University. His research interests include plant ecology, quantitative biogeography, vegetation remote sensing, ecological applications of geographic information systems, and fire ecology. Dr. Davis has authored eleven articles for refereed journals (two of which are presently under review), eight technical reports, and has presented ten papers at various geographical and biological conferences.

Specializing in vegetation analysis and mapping (specifically in the areas of the western U.S. and the West Indies) combined with a remote sensing background, Dr. Davis brings to a GIS environment experience in analytical/ mathematical ecological modeling. GIS related research includes mapping dry tropical woodland in Tanzania using MSS data; multistage variable probability sampling of woodland biomass using Landsat MSS data and aerial photography; distribution of California oak woodlands using Thematic Mapper Simulator data; ecological modeling using TMS and ancillary environmental data in a GISS, and California condor habitat evaluation using a GIS.

Selected Publications:

A geographic information system for managing California Condor habitat (with J. Scepan, L. Blum), Proceedings of the 2nd Geographic Information Systems Conference and Workshops, San Francisco, California (in press).

Composition of maritime chaparral related to fire history and soil, Burton Mesa, California (with D. Hickson, D. Odion), Madroño (in press).

The analysis of class dispersion patterns using matrix comparisons (with L. E. Harvey, N. Gale), *Ecology* (in press).

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Non-pararnetric hierarchical models for analyzing ecological data (with J. Michaelsen, M. Borchert). *Coenoses*, vol. 1, 1986, pp. 39-48.

Performance Analysis of Image Processing Algorithms for Classification of Natural Vegetation in the Mountains of Southern California., with S. J. Yool, J. Star, J. Estes, D. Botkin, and D. Eckhardt, *Photogrammatic Engineering and Remote Sensing*, vol. 7 (5), 1986, pp. 683-702.

The use of digital satellite and elevation data in chaparral ecosystems research (with S. Goetz, J. Franklin). Proceedings of the Chaparral Ecosystem Research Conference, California Water Resources Center Report No. 62, 1986, pp. 19-27.

Notes on the diets of *Geotrygon montana* and *Columba caribaea* in Jamaica (with D. Steadman, W. Hilgartner). *Bulletin of the British Ornithological Club*, vol. 105, 1985, pp. 130-134.

Stratigraphic Evidence of Human Disturbance in an Estuary, with G. S. Brush, *Quarternary Research*, vol. 22, 1984, pp. 91-108.

Historical Changes in Submerged Macrophyte Communities of the Upper Chesapeake Bay, *Ecology*, vol. 66, 1985, pp. 981-993.

Jeff Dozier

Dr. Jeff Dozier, Professor of Geography at the University of California, Santa Barbara, received his B. A. degree in Geography in 1968 from California State University, Hayward, and the M. Sc. and Ph.D. degrees in Geography in 1969 and 1973, respectively, from the University of Michigan, Ann Arbor. In conjunction with his faculty position at U. C. Santa Barbara, Dr. Dozier is presently a part-time senior member of the technical staff at the Jet Propulsion Laboratory, California Institute of Technology, Pasadena, where he is Project Scientist for the High-Resolution Imaging Spectrometer (HIRIS), to be launched as part of the Earth Observing System in 1995. He is also an associate editor of *Water Resources Research*. In 1983-84 he served as the acting director of the Computer Systems Laboratory, and in 1980 he was a National Research Council Senior Postdoctoral Research Associate with NOAA/NESDIS. Dr. Dozier's research interests are in remote sensing, image processing, atmospheric radiation, energy balance modeling of snow processes in alpine terrain, and snow chemistry and runoff. While at UCSB, Dr. Dozier and his graduate students have developed software systems for image processing and for radiative transfer. He has 37 major publications in refereed journals (e.g. *Geographical Analysis, Water Resources Research, Photogrammetric Engineering and Remote Sensing, Journal of Glaciology, IEEE Transactions on Geoscience and Remote Sensing, Reviews of Geophysics*) and 26 additional published technical reports, book reviews, and mountaineering articles. At this time Dr. Dozier has seven projects being funded by major agencies (NASA, U.S. Forest Service, California Air Resources Board, and California Space Institute) and two proposals pending. Dr. Dozier serves on two committees of the National Academy of Sciences, the Committee on Glaciology of the Polar Research Board and the Committee on Opportunities in the Hydrologic Sciences of the Water Science and Technology Board.

GIS related research conducted by Dr. Dozier includes the development of algorithms for processing digital elevation data and other digitized terrain parameters, remote sensing data, including data with extremely high spectral resolution, and establishing a GIS and sampling base for the first field experiment of the International Satellite Land Surface Climatology Project (ISLSCP) on the Konza Prairie in Kansas.

Selected Publications (with relevance to GIS):

HIRIS – High-Resolution Imaging Spectrometry: Science Opportunities for the 1990s, Report of the HIRIS Instrument Panel, Earth Observing System, vol. 2c, National Aeronautics and Space Administration, Washington, DC, 1987.

A Component Decomposition Model for Evaluating Atmospheric Effects in Remote Sensing, with S. Li and Z. Wan, *Journal of Electromagnetic Waves and Applications*, vol. 1, 1987, pp. 323-347.

Snow Mapping and Classification from Landsat Thematic Mapper Data, with D. Marks, *Annals of Glaciology*, vol. 9, 1987, pp. 97-103.

The Image Processing Workbench - Portable Software for Remote Sensing Instruction and Research, with J. Frew, *Proceedings of the 1986 International Geoscience and Remote Sensing Symposium*, ESA SP-254, European Space Agency, Paris, 1986, pp. 271-276.

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Snow Reflectance from Landsat-4 Thematic Mapper, IEEE *Transactions on Geoscience and Remote Sensing*, vol. GE-22, 1984, pp. 323-328.

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Effect of Viewing Angle on the Infrared Brightness Temperature of Snow, with S. G. Warren, *Water Resources Research*, vol. 18, 1982, pp. 1424-1434.

Identification of Subresolution High Temperature Sources Using a Thermal IR Sensor, with M. Matson, *Photogrammetric Engineering and Remote Sensing*, vol. 47, 1981, pp. 1311-1318.

Landscape: an Introduction to Physical Geography, with W. M. Marsh, Addison-Wesley, Reading, MA, 1981, 653 pp.

A Faster Solution to the Horizon Problem, with J. Bruno and P. Downey, *Computers and Geosciences*, vol. 7, 1981, pp. 145-151.

Improved Algorithm for Calculation of UTM and Geodetic Coordinates, Technical Report NESS 81, National Oceanic and Atmospheric Administration, Washington, DC, 1980, 19 pp.

A Clear-Sky Spectral Solar Radiation Model for Snow-Covered Mountainous Terrain, *Water Resources Research*, vol. 16, 1980, pp. 709-718.

An Approach Toward Energy Balance Simulation Over Rugged Terrain, with S. I. Outcalt, *Geographical Analysis*, vol. 11, 1979, pp. 65-85.

John E. Estes

Dr. John Estes is a Professor of Geography and Director of the Geography Remote Sensing Unit at the University of California, Santa Barbara. Professor Estes has wide experience in both basic and applied research in the area of remote sensing and geographic information systems. The author of more than 250 publications, he has published on the need for improved information systems, the links between remote sensing and GIS, requirements for the implementation of large-scale GIS, and the use of GIS for environmental protection. Dr. Estes is also the editor for the applications volume of the *Manual of Remote Sensing* of the American Society of Remote Sensing.

In his research, Dr. Estes has worked on projects involving remote sensing and GIS technology for NASA, the Department of the Interior, the Environmental Protection Agency, the Department of Defense, and the Regione of the Veneto, Italy, among others.

Dr. Estes, along with Dr. Jeffrey Star, also teaches a class on GIS for the Continuing Engineering Education Series of George Washington University, and has presented a short course on GIS to EPA personnel at their Las Vegas National Environmental Research Center. Dr. Estes has also served on numerous committees and review panels, including chairman of the Gordon Research Conference on Remote Sensing and member of the Committee on Data Management and Computation of the National Academy of Science and the Planetary Biology and Chemical Evolution subcommittee of the Space Science Board of the National Academy of Science.

Selected Publications:

Coordinating Hazardous Waste Management Activities Using Geographic Information Systems, with K. McGwire, G. Fletcher and T. Foresman, *International Journal of Geographic Information Systems*, in press.

A Perspective on the Use of Geographic Information Systems for Environmental Protection, *Proceedings of the Workshop on GIS for Environmental Protection*, University of Nevada, Las Vegas, Nevada, 1986.

Requirements and Principles for the Implementation and Construction of Large Scale Geographic Information Systems, with T. R. Smith, S. Menon, and J. L. Star, *International Journal of Geographic Information Systems*, vol. 1 (1), 1987, pp. 13-32.

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Remote Sensing and Geographic Information Systems: An Unrealized Potential, with R. L. Shelton, *Geo-Processing*, vol. 1, 1981, pp. 395-420.

Integration of Remote Sensing and Geographic Information Systems with R. L. Shelton, *Proceedings of the 18th International Symposium on Remote Sensing of the Environment*, Environmental Research Institute, Ann Arbor, MI, 1979.

Reginald G. Golledge

Dr. Reginald G. Golledge, Professor of Geography at the University of California at Santa Barbara, pioneered the behavioral approach in Geography and has remained in the forefront of this movement for 20 years. Dr. Golledge received his B. A. (Honors, 1959) and his M. A. (1961) at the University of New England. Since receiving his Ph.D. at the University of Iowa (1966), Dr. Golledge has held academic positions at eleven universities in four countries (United States, Canada, Australia and New Zealand). Recipient of a 1987 Guggenheim Award, Dr. Golledge is a recognized authority on spatial cognition, human spatial behavior and spatial modeling. He is the author of ten books and contributor of 38 chapters to books in geography and related fields. His research has been published by refereed geographical journals as well as journals representing the disciplines of Psychology, Education, and Regional Science.

Dr. Golledge is currently on the editorial board for the *Annals of the Association of American Geographers, the Professional Geographer,* and *Tidjschrift,* and has previously been co-editor of *Urban Geography* and editor of *Geographical Analysis.* He has been a reviewer for all the aforementioned journals, as well as *Journal of Environmental Psychology, Economic Geography, Psychometrika,* and *the Journal of Classification.* Dr. Golledge is a member of six professional societies including the Association of American Geographers and the Regional Science Association.

An early participant of the quantitative revolution in geography, Dr. Golledge has personally broadened the scope of geographical analysis. From his seminal work on mental maps and spatial behavior, Dr. Golledge is presently expanding this research to study the spatial cognition of children, the mentally handicapped, and the visually impaired.

Selected Publications:

Behavioral Modeling in Geography and Planning, with H. Timmermans, Croom Heim Publishers, 1987.

Analytical Behavioral Geography, with R. J. Stimson, Croom Helm Publishers, in press.

Voice-Interactive Technology Helps the Visually Handicapped, with J. Peters, and K. Harp, *Hardcopy*, November 1986, pp. 119-123.

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Combinatorial Procedures for the Amalysis of Alternate Models: An Example from International Migration, with N. Gale, L. Hubert and W. Tobler, *Papers of the Regional Science Association*, vol. 53, 1983, pp. 105-115.

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Generalized Procedures for Evaluating Spatial Autocorrelation, with L. Hubert and C. M. Costanzo, *Geographical Analysis*, vol. 13, 1981, pp. 224-233.

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A Framework for the Analysis and Planning of Urban and Regional Transportation Systems, with D. Jeffery, in J. F. Schwar, et. al., *A Study of Highway Research Needs and Resources*, Ohio State University Transportation Research Center, Report EES 200, March 1963 (10 pp.).

Michael F. Goodchild

Dr. Michael F. Goodchild, soon to be Professor of Geography at the University of California at Santa Barbara, has diverse academic interests which touch upon both the human and physical sides of geographical analysis. The union of human and physical geography within a GIS environment is fundamental to many of Dr. Goodchild's academic pursuits. Since receiving his Ph.D. from McMaster University in 1969, Dr. Goodchild has had a major influence on the development of Geographical Information Systems. He has held faculty positions in Canada, the United States and Australia, and has published on a wide range of topics, including spatial statistics, GIS, location-allocation modeling, socioeconomic modeling, human spatial behavior and the simulation of geomorphological processes. An acknowledged authority on issues pertaining to data quality and manipulation, Dr. Goodchild is currently on the advisory editorial board for the *International Journal of Geographic Information Systems.*

Dr. Goodchild was appointed editor of Geographical Analysis in 1987. He is past Chairman of the Automation Interest Group of the Canadian Cartographic Association, and is currently a Councilor of the Canadian Association of Geographers. His publications have appeared in some 23 different journals, and he has acted as referee for 16. He was

Chair of the Department of Geography at the University of Western Ontario from 1982-85, a period of substantial expansion of the department's budget, faculty complement and student enrollment. He has built up an impressive record of extra-mural funding through research grants and contracts much of which pertain to GIS research and development. He has supervised 10 completed Ph.D. dissertations and 14 Master's theses, and has six Ph.D. dissertation students nearing completion, five on GIS related topics.

Selected Publications:

The Fractal Nature of Geographic Phenomena, with D. M. Mark, *Annals of the Association of American Geographers*, vol. 77, 1987, pp. 265-278.

Performance Evaluation and Workload Estimation for Geographic Information Systems, with B. Rizzo, *International Journal of Geographical Information Syst*ems, vol. 1 (1), 1987, pp. 67-76.

A Model of Error for Choropleth Maps with Applications to Geographic Information Systems, with O. Dubuc, *Proceedings, Auto Carto 8*, ACPRS/ACSM, Falls Church, Virginia, 1987, pp. 165-174.

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Geocoding and Geosampling, in G. L. Gaile and C. J. Willmott, eds., *Spatial Statistics and Models*, Reidel, Dordrecht, 1984, pp. 33-53.

On Enumerating All Feasible Solutions to Polygon Aggregation Problems, with C. M. Hosage, *Proceedings of the Fourteenth Annual Pittsburgh Conference on Modelling and Simulation, Modeling and Simulation*, vol. 14, 1983, pp. 591-595.

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Accuracy and Spatial Resolution: Critical Dimensions for Geoprocessing, in David H. Douglas and A. Raymond Boyle, eds., *Computer Assisted Cartography and Geographic Information Processing: Hope and Realism*, Canadian Cartographic Association, Ottawa, 1983, pp. 87-90.

Topologic Model for Drainage Networks with Lakes, with D. M. Mark, **Water Resources Research**, vol. 18, 1982, pp. 275-280.

Areal Interpolation: A Variant of the Traditional Spatial Problem, with N. Lam, *Geoprocessing*, vol. 1, 1980, pp. 297-312.

Fractals and the Accuracy of Geographical Measures, *Mathematical Geology*, vol. 12, 1980, pp. 85-98.

Statistical Aspects of the Polygon Overlay Problem, in Harvard Papers' on Geographic Information Systems, vol. 6, Addison-Wesley, Reading, Mass., 1977.

Earl J. Hajic

Earl J. Hajic is a Lecturer and Senior Development Engineer in the Department of Geography, University of California, Santa Barbara. He received his B. S. (1950) and M. S. (Highest Honors, 1951) in Electrical Engineering from the University of Illinois, Urbana, Illinois and his M. A. (1980) in Geography (emphasis in Remote Sensing) from the University of California, Santa Barbara. Earl Hajic has spent over 25 years in scientific research and development in the private sector and an additional 13 in academia. He has developed and lectured in courses featuring digital image

processing and analysis, geobased information systems, computer interpretation of Landsat and SPOT imagery, radar image sensing, and has developed extensive lab applications of computer image software. Research conducted at U. C. Santa Barbara includes soil moisture sensor data analysis, ocean oil slick detection analysis via transforms of Seasat SAR data, side scan sonar data mapping and mosaicking, and SIR-B data analysis. Current research includes optimizing spectral combinations of multichannel imagery, spectral curve interpretation techniques and UV floral-image perception by honeybees.

Selected Publications:

Band and Band-ratio Selection to Maximize Spectral Information in Color Composite Displays, with R. E. Crippen and J. E. Estes (in preparation).

Fundamentals of Image Analysis: Analysis of Visible and Thermal Infrared Data, Chapter 24 with J. E. Estes, L. R. Tinney in *Manual of Remote Sensing*, vol. 2, American Society of Photogrammetry, 1983.

Side-Scan Sonar and High Resolution Reflection Maps of the Santa Barbara Channel Seafloor, with B. P. Luyendyk, R. E. Crippen and D. S. Simonett, California Sea Grant College Program, Dept. No. T-CSGCP-006, 1983.

Side-Scan Sonar Mapping and Computer-Aided Interpretation in the Santa Barbara Channel, with B. P. Luyendyk, D. S. Simbnett, *Marine Geophysical Research*, vol. 5, 1983, pp. 365-388.

Multispectral Determination of Soil Moisture II, with B. M. Hilton and D. S. Simonett, Geography Remote Sensing Unit, University of California, Santa Barbara, 1982.

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A Digital Image Processing System for Remote Sensing Education, with J. R. Jensen and F. A. Ennerson, *Photogrammatic Engineering and Remote Sensing*, vol. 49 (11), 1979, pp. 28-31.

Mapping of Suspended Sediments from New Zealand Landsat Data, with G. R. Cochrane, *Proceedings of the Fifth Canadian Symposium on Remote Sensing*, Victoria, B. C., 1978.

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Space Radar Applications for Ocean and Ship Monitoring, with D. S. Simonett, in D. S. Simonett (ed.), *Applic ations Review for a Space Program Imaging Radar*, Geography Remote Sensing Unit, University of California, Santa Barbara, 1976.

Comparisons of Qualitative and Quantitative Image Analysis, with D. S. Simonett, in J. Lintz Jr. and D. S. Simonett (eds.), *Remote Sensing of the Environment*, Addison and Wesley Publishing Co., 1976.

Julia Allen Jones

Dr. Julia Allen Jones, Assistant Professor at the University of California, Santa Barbara received her B. A. (1977) in Economic Development from Hampshire College. She was awarded her M. A. in International Relations (1979) and her Ph.D. in Geography and Environmental Engineering (1983) from the Johns Hopkins University. Dr. Jones's interests include soil morphology, classification and mapping using geographical information; soil genesis; soil nutrient cycling; environmental analysis; and mathematical modeling. Her research in East Africa and California pertains to deforestation, soil degradation, forest management, and agriculture. She has authored eight articles for refereed journals with eight more currently under review, two abstracts, two discussion papers, six consultant reports (five for Resources for the Future and U. S. A. I. D., and one for the U.S. Department of Energy), and has presented 18 papers at various geographical symposia and conferences.

Her GIS-related research has focused on the use of geographical information for improved soil resources mapping in remote areas of East Africa and California. Projects include a computer-generated soils map of Santa Cruz Island, the development of a GIS to be used by the Nature Conservancy in their management of Santa Cruz Island, vegetation monitoring using satellite imagery and ground inventory in the Ethiopian highlands (Eritrea), and the use of soil survey, thematic maps, aerial photographs and satellite imagery to generate soil maps in semi-arid East Africa.

Selected Publications:

Morphology and Classification of Some Soils of Semi-Arid Central Tanzania, submitted for publication to *Soil Science Society of America Journal*.

Influence of Biota and Topography on Pedogenesis in Semi-Arid Central Tanzania, submitted for publication to *Soil Science Society of America Journal*.

Use of Landsat MSS Imagery and Geographic Information to Improve Map Accuracy in Semi-Arid Tanzania, submitted for publication to *Geoderma*.

An Evaluation of the Utility of Landsat MSS Data for Assessing Vegetation Diversity in Accordance with the Klamath National Forest Land Management Plan, with F. Evanisko, submitted for publication to *Forest Science.*

A Computer-Generated Soils Map of Santa Cruz Island, with D. Grice, *Proceedings of the Third California Islands Symposium*, Santa Barbara, CA, in press.

Soil Forming Factors, Morphology, and Classification - Santa Cruz Island, with J. Butterworth and S. Jones, *Proceedings of the Third California Islands Symposium*, Santa Barbara, CA. in press.

Progress in Mapping Vegetation of Santa Cruz Island and Preliminary Relationships with Environmental Factors, with S. Junak and R. J. Paul, *Proceedings of the Third California Islands Symposium*, Santa Barbara, CA, in press.

Use of Landsat MSS for Mapping Soils in Semi-Arid Tanzania, *Proceedings of Arid Lands: Prospects and Problems in the Sahel*, Institute of Terrestrial Ecology, Merlewood Research Station. Grange-over-Sands, Cumbria, England, 1986.

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Wood Energy and Preservation of Woodlands in Semi-Arid Developing Countries: The Case of Dodoma Region, Tanzania, *Journal of Development Economics*, vol. 19, 1985, pp. 59-84.

The Causes of Deforestation in Developing Countries, *Annals of the Association of American Geographers*, vol. 75, 1985, pp. 163-184.

Hugo Loaiciga

Dr. Hugo Loaiciga, currently Assistant Professor of Geological Sciences at Wright State University, has accepted an Assistant Professor position in Geography at UCSB beginning July, 1988. He received a B. S. in Civil Engineering from the University of Costa Rica in 1978, a M. S. C. E. from University of California at Davis in 1982 and a Ph.D. from U. C. Davis in Civil Engineering in 1985. Dr. Loaiciga is a water resources engineer with interests in both surface and groundwater modeling and management. He has expertise in statistical modeling, systems engineering and agricultural economics as well. Dr. Loaiciga plans to develop a research program at UCSB that involves groundwater management, modeling and contaminant transport. As such, potential research includes the use of GIS and the development of specialized models that operate in conjunction with a GIS system to estimate potential contamination of water supplies in agricultural and urban areas. Dr. Loaiciga has already established a strong publication record and serves as a reviewer for *Water Resources Research*, the American Society of Civil Engineers Publications *Journal of*

Water Resource Planning and Management and the Journal of Hydraulics, Mathematical Geology and *Water Resources Bulletins.*

Selected Publications:

Application of Linear Model Theory to the Estimation of Spatial Random Functions, with R. H. Shumway, submitted to *Journal of American Statistics Association*, 1987.

Assessment of Flood Frequency Methods, submitted to *Journal of Water Resources Planning Management Division*, ASCE, 1986.

Comment on Comparison of Gaussian Conditional Mean and Kriging Estimation in the Geostatistical Solution of the Inverse Problem by R. J. Hoeksema and P. K. Kitanidis, *Water Resources*, in press.

Parameter Estimation in Groundwater: Classical, Bayesian and Deterministic Assumptions and Their Impact on Management Policies, with M. A. Marino, *Water Resources Research*, in press.

Fitting Low-Flows by Maximum Likelihood, with M. A. Marino, *Journal of Water Resources Planning and Management Div.*, American Society of Civil Engineers, in press.

Simultaneous-Equation Systems: a Consistent Estimator of Unknown Parameters in Confined Aquifers, with M. A. Marino, *Water Resources Bulletin*, in press.

Long-term Feasibility Analysis of Irrigated Agriculture in the San Joaquin Valley, California, with M. A. Marino, *Proceeding of International Symposium on Water for the Future*, LA.HS and LAHR, University of Rome, Italy, April 6-11, 1987.

The Inverse Problem in Confined Aquifers: Identification and Estimation with Extensions, with M. A. Marino, *Water Resources Researc*h, vol. 23 (1), 1987, pp. 92-104.

Maximum Likelihood Estimation of Groundwater Flow Parameters, with M. A. Marino, *Mathematical Geology*, vol. 18 (7), 1986, pp. 677-692.

Risk Analysis for Reservoir Operation, with M. A. Marino, *Water Resources Research*, vol. 22 (4), 1986, pp. 483-488.

An Approach to Parameter Estimation and Stochastic Control in Water Resources with an Application to Reservoir Operation, with M. A. Marino, *Water Resources Research*, vol. 21 (11), 1985, pp. 1575-1584.

Dynamic Model for Reservoir Management: Application to the Central Valley Project, with M. A. Marino, *Water Resources Research*, vol 21 (5), 1985, pp. 619-630.

Multireservoir Management via Quadratic Programming, with M. A. Marino, *Proceedings of the International Symposium on Scientific Basis for Water Resources Management*, IAHS Publication No. 153, Jerusalem, Israel, September 19-23, 1985, pp. 231-239.

Planning Model for the Operation of a Multireservoir System, with M. A. Marino, *Proceedings of the 5th World Congress on Water Resources*, IWRA, Brussels, Belgium, June 9-15, 1985, pp. 933-942.

Joel Michaelsen

Dr. Joel Michaelsen, Assistant Professor of Geography at the University of California at Santa Barbara, received his B. A. in Geography (1969) and a Secondary Teaching Credential from University of California at Santa Barbara and the degrees of M. A. (1977) and Ph.D. (1982) for Geography from the University of California at Berkeley. Dr. Michaelsen's research interests include climatology, meteorology and marine resources. He is a reviewer for the *Journal of Physical Oceanography, Monthly Weather Review, Journal of Water Resources*, as well as for Prentice Hall and the National Science Foundation, Geography and Regional Science Division. A participant in over 25 conferences and symposia and author of eight published refereed articles, with another five under review, Dr. Michaelsen has focused his research primarily on large scale atmospheric and oceanic variability, air-sea interactions, statistical time and space series, linear statistical prediction models, climatic prediction, statistical analysis of remotely sensed data and dendroclimatology. Specific GIS related interests include spatial statistics, the application of computer intensive, nonparametric techniques for estimating error rates and remote sensing.

Selected Publications:

Statistical Models of Equatorial Pacific Sea Surface Temperatures. Part II, with N. Graham and T. P. Barnett, *Journal of of Geophysical Research (Oceans)*, in press.

400 Years of Central California Precipitation Variability Reconstructed from Tree-rings, with L. Hasten and F. W. Davis, *Water Resources Bulletin*, vol. 23(5), 1987, pp. 809-818.

Cross-Validation in Climate Forecast Models, *Journal of Climate and Applied Meteorology*, vol. 26, 1987, pp. 1589-1600.

Statistical Models of Equatorial Pacific Sea Surface Temperatures. Part 1: Predictor Field Characteristics, with N. Graham and T. P. Barnett, *Journal of Physical Oceanography*, in press.

Non-Parametric Methods for Analyzing Hierarchical Relationships in Ecological Data. Coenoses, vol. 1(2), 1987, pp. 97-106.

Problems in Calculating and Interpreting Climatic Response Functions for Proxy Climatic Variables, Invited Presentation, Third Workshop on Environmental Variability in the Eastern North Pacific and Western North America, Monterey, CA, 1986.

New Linear Statistical Models of Equatorial Sea Surface Temperatures, with N. Graham, Invited Presentation, AGU Chapman Conference of El Nino: An International Symposium, Guayaquil, Equador, 1986.

Spatial Pattern of Coniferous Forests Stands, with J. Franklin and A. H. Strahler, *Vegetatio*, vol. 64, 1985, pp. 29-36.

An Automated Method for Measuring Thickness of Layered Sediments, *Journal of Mathematical Geology*, vol. 17, 1985, pp. 729-742.

Estimation of Artificial Skill in Forecast Models, *Proceedings of the Ninth Conference on Probability and Statistics in Atmospheric Sciences*, Virginia Beach, VA, 1985, pp. 247-251.

Long-Period Modulation of El Nino, with J. T. Daily, *Proceedings of the Eighth Annual Climate Diagnostic Workshop*, Toronto, 1983, pp. 140-148.

A Statistical Study of Large-Scale, Long-Period Variability in North Pacific Sea Surface Temperature Anomalies, *Journal of Physical Oceanography*, vol. 12, 1982, pp. 694-703.

Multivariate Time-Series Analysis of Large-Scale, Long Period Ocean-Atmosphere Coupling, Colloquium, Department of Geography, UC Santa Barbara, 1982.

Fossil Charcoal from Varved Sediments in the Santa Barbara Channel: An Index of Wildlife Frequencies in the Los Padres National Forest (732 A. D. to 1520 A. D.), with R. Byrne, Forest Service Report PSW-47, 1979, pp. 69.

David S. Simonett

David Simonett, Professor of Geography and Dean of the Graduate Division at the University of California, Santa Barbara, brings a wide background of management in the academic and private field to this project. He received his Ph.D. degree from the University of Sydney (Australia) in 1954. He has been the head of the Department of Geography at the University of Sydney, Associate Director of the Remote Sensing Laboratory at the University of Kansas, Director of the Division of Land Use and Agricultural Applications for the Earth Satellite Corporation, and a Fulbright Scholar to Australia on Geographical Information Systems and Remote Sensing. Field work for soil and land use research has been conducted in more than ten countries including Kenya, Nigeria, Iran, New Guinea, Australia and the United States. His remote sensing experience ranges from the use of aerial trimetrogon photography in the 1940s for reconnaissance soil and natural vegetation mapping in the Southern Cape York Peninsula of North Queensland through radar remote sensing in the early 1960s to the present use of satellite imagery. His teaching experience includes such topics as climatology, geomorphology, soil geography, agricultural geography, regional geography (Tropics, Africa, Australia), field methods, air photo interpretation, remote sensing, geographical information systems, sampling and research design, environmental conservation, mathematical models in geography and remote sensing of vegetation. For his contributions in geography and remote sensing Dr. Simonett has received the American Association of Geographers Meritorious Contribution to Geography Award (1976), the Presidential Citation for Meritorious Contribution to the

American Photogrammatic Society (twice), and was recently elected Honorary Research Professor, Chinese Academy of Science, P. R. C. (1986).

Dr. Simonett is currently serving on the editorial boards of the *International Journal of Geographical Information Systems, Remote Sensing of Environment* (Founding Editor in Chief), and *Physical Geography*. He was editor for Volume I of the 2nd Edition of the *Manual of Remote Sensing* and is the author-editor of two chapters of the manual. Dr. Simonett is also a reviewer for *The Annals of the AAG, Science, Remote Sensing of Environment, Remote Sensing and Photogrammetry, IEEE Transactions on Geoscience and Remote Sensing, Geographical Review*, McGraw-Hill, Addison Wesley, and American Elsevier. He has published over 100 papers on remote sensing dealing with radar image analysis, agricultural sampling and evaluation with remote sensing, information systems and reconnaissance scale land use and vegetation mapping with spacecraft imagery, employing Gemini, Apollo, Skylab, Landsat, Thematic Mapper, and SIR-B radar imagery. Dr. Simonett has testified before Congress on Civil Land Remote Sensing, and is the Chairperson of the Sub-committee on Remote Sensing of the Commission on Data Sensing and Processing, International Geographical Union, and a member of the NASA Geostationary Platform Committee.

As founding chair of the Department of Geography at UCSB (1975-1980) Dr. Simonett developed a strong faculty and a very impressive record of extramural funding. Authorized to grant MA degrees in 1976 and Ph.D. degrees in 1980, the department now has over 70 graduate students comprising one of the largest Geography Departments in the U.S.

Selected Publications:

Simulation of L-Band HH Radar Backscattering from Coniferous Forests Stands: A Comparison with SIR-B Data, with G. Q. Sun, *International Journal of Remote Sensing*, in press.

Estimation of the Magnitude and Spatial Distribution of Combustible Materials in the San Jose Area, California, with T. N. Barret, S. Gopal, F. J. Holsmuller, G. Q. Sun, and H. Veregin, accepted for publication in *Fire and Materials*.

A Self-Learning Classification System for Remotely Sensed Images, with Zi-tan Chen, to be submitted for publication in *International Journal of Geographical Information Systems.*

L-Band Radar Backscatter Modeling for Forest Stands, with J. A. Richards and G. Q. Sun, *IEEE Transactions on Geoscience and Remote Sensing*, GE-25, no. 4, 1987, pp. 478-498.

Radar Forest Modeling: Potentials, Problems, Approaches, Models, with A. H. Strahler, G. Q. Sun and Y. Wang, *13th Annual Conference of the Remote Sensing Society*, University of Nottingham, England, 1987, pp. 187-203.

The Development and Principles of Remote Sensing, with S. E. Bertke, J. E. Estes, R. G. Reeves, and C. T. Sailer, in *Manual of Remote Sensing, Second Edition vol. 1*, American Society of Photogrammetry, 1983.

Interpretation of Microwave Remote Sensing Imagery, with R. Davis in D. Simonett, ed., *Manual of Remote Sensing, Second Edition, vol. 1*, American Society of Photogrammetry, 1983.

Optimizing the Time Stream of Benefits from State and Local Government Use of Landsat Data: An Application of Demand Revealing Processes, with R. T. Deacon and T. R. Smith, *Second Conference on the Economics of Remote Sensing Information Systems*, San Jose, CA, 1978, pp. 133-155.

Geobase Information System Impacts on Space Image Formats, Report of a Workshop at La Casa de Maria, Santa Barbara, Sept. 11-15, 1977, editor, Santa Barbara Remote Sensing Unit, SBRSU Technical Report 3, UC Santa Barbara, April, 1978.

Remote Sensing of Environment with co-editor J. Lintz, Advance Book Series, Addison-Welsey Publishing Co., Reading, Massachusetts, 1976. Author or Co-Author of Chapters 3, 9, 11, and 13.

Analysis of Information Systems for Hydropower Observations, with R. L. Sohn, L. Becker, J. Estes and W. Yeh, NASA RTOP 777-30-01, Jet Propulsion Laboratory, Pasedena California, 1976, pp. 1-231.

Data Extraction and Analysis of Remote Sensor Images, in J. Estes and L. W. Senger, eds., *Remote Sensing*, Hamilton Publishing Company, 1974, pp. 51-82.

Susceptibility of Environments to Low-Resolution Imaging for Land Use Mapping, with J. C. Coiner, in *Proceedings of the Seventh International Symposium on Remote Sensing of Environment*, ERIM, 1971, pp. 373-394.

Summary of Relevant Administrative Experience (1960-1988):

Dean, Graduate Division, UCSB (1981+). Initiated major changes in Division goals, actions and opportunities for: Affirmative Action, fellowship procedures, training in proposal preparation of graduate students in all disciplines, lacunae in graduate student services, improved admission procedures, reduced paper work, staff appointments and training. With the staff of the Division, grants for Affirmative Action Fellowships of $900,000 (June, 1982 - December, 1987) have been allocated to UCSB.

Chairperson, Department of Geography, UCSB (1975-1980). First tenured faculty member and chair of new Department, appointed January 1, 1975. Developed department of strong faculty. Extramural grant record $180,000 - $200,000 per faculty member/annum, now totals about $2.2 million. Department was authorized to grant M. A. (1976) and Ph.D. (1980); now more than 70 graduate students.

Director, Division of Land Use and Agricultural Applications, Earth Satellite Corporation, Washington, D. C. (1972-1975). Started Division and built it to 20 professionals and over $1,000,000 per annum business in two years. Worked with the Defense Community, USDA, USDI, Council on Environmental Quality, State and International agencies and foreign governments. Participated in research for USDA and NASA which was the precursor for Earthsat's present CropCast (TM) program.

McCaughey Professor and Head, Department of Geography, University of Sydney, Sydney, Australia (1970-1972). Administered substantial department of 300 freshman, 100 undergraduate majors, 50 graduate students, 10 faculty, and eight support staff. Joined with T. Langford Smith and J. Rutherford to initiate major changes in space, increasing department from 7,000 to 40,000 square feet of space by reclaiming old building.

Associate Director, Remote Sensing Laboratory, and Professor of Geography, University of Kansas (1900-1970). Joined R. K. Moore of Electrical Engineering in establishing a research group in radar remote sensing leading to joint research budgets of over $700,000 per annum in mid-late 1960's. Also joined with Moore and William Barr of Mechanical Engineering in bringing the 70,000 square foot Space Sciences Laboratory (funded by NASA) to the University of Kansas.

Raymond C. Smith

Dr. Raymond C. Smith, Professor of Geography and of Biological Sciences at the University of California, Santa Barbara, received his B.S. from Massachusetts Institute of Technology (1956) and his Ph.D. from Stanford University (1961). Both degrees were received for Physics. Dr. Smith's research interests include marine resources, physical oceanography and remote sensing of the oceans. He is currently a research associate for the Institute of Marine Resources (Scripps Institute of Oceanography, University of California at San Diego). Previously held positions include consultant for the Jet Propulsion Laboratory and Associate Director for the Visibility Laboratory (Scripps Institute of Oceanography, University of California at San Diego). Dr. Smith is an active member of several national and international committees, including the Earth Sciences Committee of the Space Science Board (National Academy of Sciences), the Satellite Planning Committee for Joint Oceanographic Institutions, the Color/Temperature Time Series Core Team for NASA, the Geostationary Platform Committee for NASA, and the Satellite Color Working Group (SWG) for NASA. Dr. Smith is also a member of the American Society of Photochemistry and Photobiology, the American Society of Limnology and Oceanography, the Optical Society of America, the American Geophysical Union, the American Association for the Advancement of Science and Sigma Xi.

Selected Publications:

Optical Characterization of Primary Productivity Across a Coastal Front, with R. R. Bidigare, B B. Prezelin, K. S. Baker, and J. M. Brooks, accepted *Marine Biol*ogy.

Oceanic Primary Production Estimates From Measurements of Spectral Irradiance and Pigment Concentration, with R. R. Bidigare, K. S. Baker and T. Marna, accepted *Journal of Biogeochemical Cycles.*

Multiplatform Sampling (Ship, Aircraft, and Satellite) of a Gulf Stream Warm Core Ring, with 0. B. Brown, F. E. Hoge, K. S. Baker, R. H. Evans, R. N. Swift, and W. E. Esaias, *Applied Optics.*

Distribution of Cetaceans and Sea Surface Chlorophyll Concentrations in the California Current, with P. Dustan, D. Au, K. S. Baker, and E. A. Dunlap, *Journal of Marine Biology*, vol. 91(3),1986, pp. 385-402.

Spatial and Temporal Patterns in Pigment Biomass in Gulf Stream Warm-Core Ring 82B and its Environs, with K. S. Baker, *Journal of Geophysical Resources*, vol. 90, no. C5, 1985, pp. 8859-8870.

The Analysis of Ocean Optical Data, with K. S. Baker, *Proceedings of the SPIE Ocean Optics VII*, vol. 489, 1984, pp. 119-126.

Middle Ultraviolet Irradiance at the Ocean Surface: Measurements and Models, with K. S. Baker, in J. Calkins (ed.), *The Role of Solar Ultraviolet Radiation in Marine Ecosystems*, Plenum Press, New York, 1982, pp. 79-91.

Bio-Optical Classification and Model in Natural WatersII, with K. S. Baker, *Limnological Oceanographer*, vol. 27(3), 1982, pp. 500-509.

Optical Properties of the Clearest Natural Waters (200-800nm), with K. S. Baker, *Applied Optics*, vol. 20(2), 1981, pp. 359-361.

Remote Sensing and the Depth Distribution of Ocean Chlorophyll, *Marine Ecology*, vol. 5, 1981, pp. 359-361.

Stratospheric Ozone, Middle Ultraviolet Radiation and Carbon-14 Measurements of Marine Productivity, with K. S. Baker, *Science*, vol. 208, 1980, pp. 592-593.

Penetration of UV-B and Biologically Effective Dose-Ratios in Natural Waters, with K. S. Baker, *Photochemical Photobiology*, vol. 29, 1979, pp. 311-323.

The Remote Sensing of Chlorophyll, with K. S. Baker, in E. A. Godby and J. Otterman, eds., *COSPAR: The Contribution of Space Observations to Global Food Information Systems*, Pergamon Press, Oxford and New York, 1978, pp. 161-172.

Structure of Solar Radiation in the Upper Layers of the Sea, in J. G. Jerlov, ed., *Optical Aspects of Oceanography* (Chapter 5), Academic Press, New York, 1974, pp. 61-119.

The Optical Characterization of Natural Waters by Means of an Extinction Coefficient, *Limnological Oceanographer*, vol. 13(3), 1968, pp. 423-429.

Plutonium in the Marine Environment, with K. C. Pillai and T. R. Folsum, *Nature*, vol. 203 (4945), 1964, pp. 568-571.

Terence Smith

As both Professor and Chair of the Department of Computer Science and Professor of Geography at the University of California at Santa Barbara, Dr. Terence Smith brings a combination of skills to his current GIS related research including expertise in spatial data handling, artificial intelligence and decision-making. Since receiving his Ph.D. degree from the Department of Geography and Environmental Engineering from Johns Hopkins University in 1971, Dr. Smith has held appointments as Research Fellow, Department of Physics, University of Rochester, Visiting Associate Professor of Psychology at Carnegie-Mellon University and Economist at the Federal Reserve Bank of New York.

Dr. Smith is a referee for The National Science Foundation, The Professional Geographer, Geographical Analysis, Environment and Planning, Transportation Research, and Economic Geography. At present, Dr. Smith is working, under a USGS/NASA grant, on a knowledge-based geographic information system (KBGIS-III) that will be capable of performing pattern recognition, decision analysis and learning. His professional interests include artificial intelligence, image understanding, cognitive process modeling, and decision-making processes. He is currently involved in research into path planning for robotic applications and is funded under a University of California MICRO research grant.

Dr. Smith has led many workshops and colloquia in the fields of GIS and artificial intelligence, including the IGU International Symposium on Spatial Data Handling at Zurich and the International Conference on Advanced Technology for Monitoring and Processing Global Environmental Information. He is on the editorial advisory board of The International Journal of Geographic Information Systems; is a member of the NAS/USGS committee organizing the 1988 Seminar on Applications of GIS in Earth Sciences; and was on the Science Committee of the International Geographic Information Systems Symposium (IGIS) held last November in Crystal City, VA_

Selected Publications:

Requirements and Principles for the Implementation and Construction of Large-scale GIS, with J. Estes, S. Menon, and J. Star, *International Journal of GIS*, vol. 1 (1), 1987, pp. 13-32.

KBGIS-II: A Knowledge-Based Geographical Information System, with D. Peuquet and S. Menon, *International Journal of Geographical Information Systems*, vol. 1 (2), 1987, pp. 149-172.

Multi-colored Quadtrees for GIS, with S. Menon and G. Peng, *Proceedings of the International Geographic Information Systems Symposium*, Crystal City, VA, 1987, in press. Also submitted to *Pattern Recognition Letters*, 1988.

Multi-component Object Search Using Spatial Constraint Propagation, with S. Menon, *Proceedings of the International Geographic Information Systems Symposium*, Crystal City, VA, 1987, in press. Also submitted to *PAMI, IEEE*, 1988.

A Family of Asynchronous, Interactive Parallel Procedures for Solving the Weighted Least Cost Path Problem, with G. Peng, University of California, Department of Computer Science Technical Report TRCS87-3, 1987. Also submitted to *Geographical Analysis*, 1988.

An Analysis of the Efficacy and Efficiency of Hierarchical Procedures for Computing Trajectories Over Complex Surfaces, with R. Parker, *European Journal of Operations Research*, vol. 30, 1987, pp. 327-338.

Using Iterative Relaxation Procedures to Label Occluded Regions in Oblique Languages, with T. Mileo, Submitted to *PAMI, IEEE*, 1988.

Control of Spatial Search for Complex Q Queries in a Knowledge-Based Geographical Information System, with D. P. Peuquet, *Proceedings of the International Conference on Advanced Technologies for Monitoring and Processing Global Environmental Data*, Remote Sensing Society, London, England, 1985, pp. 439-452.

Functional Invariance Under Spatial Aggregation from Continuous Spatial Interaction Models, with M. G. Schwab, *Geographical Analysis*, vol. 17, 1985, pp. 217-230.

Knowledge-Based Control of Search and Learning in a Large Scale GIS, With M. Pazner, in D. Marble and K. Brassel, eds., *Proceedings of the International Symposium on Spatial Data Handling*, Geographisches Institute, Zurich, 1984.

Artificial Intelligence and its Applicability to Geographical Problem-Solving, *Professional Geographer*, vol. 36, 1984, pp. 147-158.

Deriving and Testing Production System Models of Sequential Decision-Making Behavior, with W. A. V. Clark and J. W. Cotton, *Geographical Analysis*, vol. 16, 1984, pp. 191-222.

General Representational Formalisms and Search Procedures for Inferring Models from Categorical Data, in P. Nijkamp ed., *Measuring the Unmeasurable*, Nijhoff, Dordrecht, 1984. pp. 679-692.

The Implications of Computational Process Models for Spatial Behavior and Cognition, with J. W. Pellegrino and R. G. Golledge, *Geographical Analysis*, vol. 14, 1982, pp. 305-325.

Uncertainty, Diversification, and Mental Maps in Spatial-Choice Problems, *Geographical Analysis*, vol. 10, 1978, pp. 120-141.

Optimizing the Time Stream of Benefits from State and Local Government Use of LANDSAT Data: An Application of Demand-Revealing Processes, With R. Deacon and D. Simonett, *Proceedings of the 2nd Conference on the Economics of Remote-Sensing Information Systems*, San Jose, CA, 1978, pp. 133-155.

Jeffery Star

Dr. Jeffery Star is a Lecturer and Development Engineer in the Department of Geography, University of California, Santa Barbara. Dr. Star has extensive experience in the collection and analysis of spatial data, including both field-collected data and remotely sensed data. He received his undergraduate degree in Environmental Science from the Massachusetts Institute of Technology in 1975, and his doctorate in Oceanography from the Scripps Institute of Oceanography, University of California, San Diego (1980).

Dr. Star has served on a number of national committees, including the Architecture, Engineering and Construction Subcommittee for the National Bureau of Standards IGES activity, NASA's Earth Observing System Data Panel, and the Task Force on Geo-information of the Research Libraries Group. He participated in a CODMAC Summer Study of the Space Station Subcommittee, for the Space Sciences Board, National Academy of Sciences. He is on the Editorial Advisory Board in *Aerial and Space Imaging*, *Remote Sensing*, and *Integrated Geographical Systems*. Dr. Star also is a member of the Massachusetts Institute of Technology Educational Council.

Dr. Star's research interests revolve around the spatial distributions of environmental parameters. Current research contracts and grants which focus on GIS research and development have been funded by the National Aeronautics and Space Administration (remote access to large archives of spatial data, data-base standards for spatial data, multi-disciplinary manipulation of spatial data), the U.S. Navy (decentralized information systems for hazardous waste monitoring), the U.S. Geologic Survey (merging artificial intelligence and geoprocessing technologies), and the Italian Government (creation of a regional GIS for agricultural monitoring). Dr. Star's work for the private sector has included staff development and training for the non-renewable resource industry, and environmental impact assessment for the nuclear power industry.

Selected Publications:

Requirements and Principles for the Implementation and Construction of Large-scale Geographic Information Systems, with T. R. Smith, S. Menon and J. E. Estes, *International Journal of Geographical Information Systems*, vol. 1 (1), 1987, pp. 13-31.

Performance Analysis of Image Processing Algorithms for Classification of Natural Vegetation in the Mountains of Southern California, with S. R. Yool, J. E. Estes, D. B. Botkin, D. W. Eckhardt and F. W. Davis, *International Journal of Remote Sensing*, vol. 7 (5), 1986, pp. 683-702.

Geographic Information Systems: Questions to Ask Before It's Too Late, with M. J. Cosentino and T. W. Foresman, *Tenth International Symposium on Machine Processing on Remotely Sensed Data*, Purdue University, 1984, pp. 194-197.

Waldo R. Tobler

Dr. Waldo R. Tobler, Professor of Geography and of Statistics at the University of California at Santa Barbara, has been a leader in the field of computer cartography and spatial analysis for some 30 years. Since receiving his Ph.D. degree from the University of Washington in 1959, Dr. Tobler has taught and lectured worldwide, including England, France, Germany, Switzerland, China (PRC), Austria, and Australia. The author of many articles and publications, Dr. Tobler is a recognized authority on cartographic transformations and projections. A charter member of the Urban and Regional Information Systems Association, Tobler brings a wide background of research to the field of Geographic Information Systems.

A member of the National Academy of Sciences, Tobler is currently on the editorial boards of the *International Journal of Geographic Information Systems, Geographical Analysis, The American Cartographer,* and *Mathematical Population Studies*. He is also a member of various professional organizations such as the Association of American Geographers (Meritorious Contributor Medallion), the Association for Computing Machinery, the American Statistical Association, and the Institute of Electronic and Electrical Engineers.

Dr. Tobler has taught classes in Geographic Information Systems, Location Theory, Analytic Cartography, Cartographic Transformations, and Regional Analysis. A speaker much in demand at symposia, he has been a participant in the quantitative revolution in geography and has applied the techniques to modern geography.

Selected Publications:

A Quadtree for Global Information Storage, with Z. Chen, *Geographical Analysis*, vol. 18 (4), 1986, pp. 360-371.

Smooth Multidimensional Interpolation, with S. Kennedy, *Geographical Analysis*, vol. 17 (3), 1985, pp. 169-172**.**

Derivation of a Spatially Continuous Transportation Model, *Transportation Research*, vol. 19A, (2), 1985, pp. 169-172.

Applications of Image Processing Techniques to Map Processing, *Proceedings of the International Symposium on Spatial Data Handling*, Zurich, IGU, 1984, pp. 140-144.

Combinatorial Procedures for the Analysis of Alternative Models: An Example from Interregional Migration, with N. Gale, L. Hubert and R. Golledge, *Papers*, Regional Science Association, vol. 53, 1984, pp. 106-115.

Surveying Multidimensional Measurement, in R. G. Golledge and J. N. Rayner eds., *Proximity and Preference: Problems in the Multidimensional Analysis of Large Data Sets*, University of Minnesota Press, 1982, pp. 3-9.

Cartograms and Cartosplines, *Proceedings of the 1976 Workshop on Automated Cartography and Epidemiology*, Department of Health, Education and Welfare, Washington, DC, 1979, pp. 53-58.

Cellular Geography, in Gale and Olsson, eds., *Philosophy in Geography*, Riedel, Dortrecth, 1979, pp. 379-386.

Data Structures for Cartographic Analysis and Display, *Proceedings, Computer Science and Statistics: Eleventh Annual Symposium on the Interface*, Raleigh, North Carolina State University, Institute of Statistics, 1978, pp. 134-140.

Comparing Figures by Regression, *Computer Graphics*, vol. 12 (3), 1978, pp. 193-195.

Numerical Approaches to Map Projections, in E. Kretschmer ed., *Studies in Theoretical Cartography*, Vienna Deuticke, 1977, pp. 51-64.

Linear Operators Applied to Areal Data, in J. Davis and M. McCullagh, *Display and Analysis of Spatial Data*, J. Wiley, New York, 1975, pp. 14-37**.**

Mathematical Map Models, *International Symposium on Computer Aided Cartography*, Reston, American Congress of Surveying and Mapping, 1975, pp. 66-73.

Automation in the Preparation of Thematic Maps, *The Cartographic Journal*, June, 1965, pp. 1-7.

Automation and Cartography, *The Geographical Review*, vol. 48, (4), 1959, pp. 526-534.

Other Faculty

The following non-Geography faculty members will also be involved in the NSF Center. **Daniel Botkin**. (Biological Sciences); **Allen Gersho**, (Electrical and Computer Engineering); **Bruce Luyendyk**, (Geological Sciences); **John Michael Melack** (Biological Sciences); **Prakash V. Ramanan**, (Electrical and Computer Engineering); **Yaun-Fang Wang**, (Electrical and Computer Engineering). Additional faculty in Geological Sciences, the Social Sciences have expressed interest in being involved in center research. In the interests of brevity their summary vitae are not included at this time.

Daniel B. Botkin

Dr. Daniel Botkin is a Professor of Biological Sciences and Environmental Studies at the University of California at Santa Barbara. He received his B. A. (1959) from the University of Rochester, his M. A. (1962) from the University of Wisconsin, Madison, and his Ph.D. (1968) from Rutgers University. All three degrees were in Biological Sciences. Research interests related to a GIS environment include ecological modeling, ecosystem dynamics, simulation modeling, vegetation mapping, and biomass estimation. Much of Dr. Botkin's research is interdisciplinary involving Biological Sciences, Geography (Remote Sensing), and Statistics. Professional experience includes Associate Professorships at the University of Michigan Biological Station and at Yale University, Fellow of the Woodrow Wilson International Center for Scholars (Smithsonian Institute), and Chairman of the Environmental Studies Program, UC Santa Barbara (1978-1983). Dr. Botkin has been a consultant to the National Science Foundation and the World Wildlife Fund, and has been instrumental in 24 funded research grants from such agencies as the National Aeronautics and Space Administration, National Science Foundation, World Wildlife Fund, California Space Institute and the National Oceanographic and Atmospheric Administration. Dr. Botkin has served on the editorial boards of *BioScience* and *Ecology and Ecological Monographs* plus 17 other advisory panels and review boards (e.g., NASA, Earth Systems Sciences Committee; NASA, Chairman, Earth Sciences Steering Committee; NASA, Science Working Group on Land-Related Global Habitability; National Academy of Science, Space Science Board; National Advisory Committee, Andrews Forest Ecosystem Study). Author of four books (with two more in preparation) and over 70 journal and committee articles, Dr. Botkin has been active in the advancement and dissemination of literature not only for biological research but for geographical research as well.

Selected Publications:

Environmental Studies: Earth as a Living Planet, with E. A. Keller and E. Charles, Merrill Publishing Company, Columbus OH., 1987, 500 pages.

Observing and Perceiving the Biosphere: The Use of Remote Sensing in Global Ecology, Cambridge University Press, N. Y. (publication expected 1988).

Man's Role in Changing the Global Environment, with M. Caswell, J. E. Estes, and A. Orio, (eds.), vol. 3, Academic Press, N. Y. (publication expected 1987).

Dimension Analysis: New Developments in Models and Statistical Treatment, with K. D. Woods, *Ecological Society of America*, 1986, vol. 66, pp. 297.

Developing a Conceptual Framework for Remote Sensing Studies of Ecological Patterns, with K. D. Woods, 1986, vol. 66, pp. 144.

Performance Analysis of Image Processing Algorithms for Classification of Natural Vegetation in the Mountains of Southern California, with S. R. Yool, J. L. Star, J. E. Estes, D. W. Eckhardt, and F. W. Davis, *International Journal of Remote Sensing*, 1986, vol. 7, pp. 683-702.

Analysis of Image Processing Algorithms for Classifying the Forests of Northern Minnesota, with S. R. Yool, J. L. Star, and J. E. Estes, *Wm. T. Pecorar Memorial Remote Sensing Symposium*, 1985.

Adding Spatial Considerations to the JABOWA Model of Forest Growth, with T. E. Tevnales and K. D. Woods, *Machine Processing of Remotely Sensed Data Symposium*, 1985, pp. 141-148.

Studying the Earth's Vegetation from Space, with J. E. Estes, R. M. MacDonald, and M. V. Wilson, *Bioscience*, vol. 34 (8), pp. 508-514.

Simulation of Acid Precipitation Effects on Soil Nitrogen and Productivity in Forest Ecosystems, with J. S. Aber, G. R. Hendry, A. J. Francis, and J. M. Melillo, Broodhaven National Laboratory Publications BNL 28658, Associated Universities, Inc, N. Y.

Predicting the Effects of Different Harvesting Regimes on Forest Floor Dynamics in Northern Hardwoods, with J. S. Aber and J. M. Melillo, *Canadian Journal Forest Research 8*. 1978, pp. 306-315.

The Biota. and the World Carbon Budget, with G. M. Woodwell, R. H. Whittaker, W. A. Reiners, G. E. Likens, C. A. S. Hall, and C. C. Delwiche, *Science*, vol. 199, 1977, pp. 141-146.

Life and Death in a Forest Community: The Computer as an Aid to Understanding, C. Hall, and J. Day eds. *Models as Ecological Tools: Theory and Case Histories*, Wiley, N. Y., 1977.

Stability in Ecosystem : Semantics, Models and Reality, R. J. Sharma, J. D. Buffington, and J. T. McFadden eds., *New Directions in the Analysis of Ecological Systems*, Simulation Council Proceedings: Society of Computer Simulation. 1975.

The Assumptions and Rationale of a Computer Model of Phytoplankton Population Dynamics, with J. T. Lehman and G. E. Likens, *Limnology and Oceanography*, vol. 20, 1975, pp. 343-364.

Allen Gersho

Dr. Allen Gersho, Professor of Electrical and Computer Engineering at the University of California at Santa Barbara, received his B. S. degree from the Massachusetts Institute of Technology (1960) and his M. S. (1961) and Ph.D. (1963) from Cornell. All three degrees were for Electrical Engineering. Prior to being a University faculty member (1980-present), Dr. Gersho, was a member of the technical staff of the Mathematics and Statistics Research Center at Bell Laboratories (1963-80). Research interests related to GIS include spatial data base issues, e.g., encoding, compression, transmission, and signal recognition, as well as diffusion modeling, utilizing Markov Chain concepts for a quantitative model for muscle contraction, development of a new spectroscopic technique to explain the photoacoustic effect underlying photoacoustic spectroscopy, and adaptive quantization scheme analysis for a speech encoding derived key design equation.

He has written 42 articles in refereed journals, presented 59 conference papers and has contributed chapters in eight books. Recipient of the Guillemin-Cauer Prize Paper Award (1979), Dr. Gersho is also a member of IEEE and Sigma M. He is an Associate Editor for IEEE Transactions on Communications and has served as a referee for several journals. He was elected to the Board of Governers of the IEEE Communications Society (1982-85). Holder of two patents with two more pending, Dr. Gersho has been active in generating extramural funding for research via receiving ten grants between 1982-87.

Selected Publications:

Covariance and Autocorrelation Methods for Vector Linear Prediction, with J. H. Chen, *Proceedings of the International Conference on Acoustics, Speech and Signal Processing*, 1987.

Image Compression Based on Vector Quantization with Finite Memory, with R. Aravind, *Optical Engineering*, to appear in vol. 26 (7), 1987.

Classified Vector Quantization of Images, with B. Ramamurthi, *IEEE Transactions on Communications*, vol. COM-34 (11), 1986, pp. 1105-1115.

Low-Rate Image Coding with Finite-State Vector Quantization, with R. Aravind, *Proceedings of the IEEE International Conference on Acoustics, Speech and Signal Processing*, Japan, vol. 1, 1986, pp 265-268.

Principles of Quantization, in *Quantization*, P. Swaszek editor, Van Nostrand Reinhold Co., 1985, pp. 7-13.

Vector Quantization: A New Direction in Source Coding, in *Digital Communications*, E. Biglieri and G. Prati editors, Elsevier Science publishers B. V. (North Holland) 1985, pp 267-281.

Efficient Codebook Allocation for an Arbitrary Set of Vector Quantizers, with Y. Shoham, *Proceedings of the International Conference on Acoustics, Speech and Signal Processing*, 1985, pp. 43.7.1-43.7.4.

Adaptive Vector Quantization of Images by Progressive Code-vector Replacement. with M. Yano, *Proceedings of the International Conference on Acoustic, Speech and Signal Processin*g, 1984, pp. 4.6.1-4.6.4.

Edge-Oriented Spatial Filtering of Images with Application to Post-Processing of Vector- Quantized Images, with B. Ramamurthi, *Proceedings of the International Conference on Acoustics, Speech and Signal Processing*, 1984, pp. 48.10.1-48.10.4.

Image Vector Quantization with a Perceptually-Based Cell Classifier, with B. Ramamurthi, *Proceedings of the International Conference on Acoustics, Speech and Signal Processing*, 1984, pp. 32.10.1-32.10.4.

Fast Search Algorithms for Vector Quantization and Pattern Matching, with B. Ramamurthi, *Proceedings of the International Conference on Acoustics, Speech and Signal Processing*, 1984, pp. 911.1-911.4. .

Vector Quantization: A Pattern Matching Technique for Speech Coding, with V. Cuperman, V, *IEEE Communications Magazine*, vol. 21 (9), pp. 15-21**.**

Quantization, V. B. Lawrence, J. L. LoCicero, and L. B. Milstein eds., Computer Science Press, Rockville, Maryland, pp. 5-14.

Fast Nearest Neighbor Search for Nonstructured Euclidean Codes, with D. Y. Cheng (Abstract) *IEEE International Symposium on Information Theory*, 1983, pp. 88.

On the Structural Vector Quantization, *IEEE Transactions on Information Theory*, vol. 28,(2), 1982, pp. 157-166.

Bruce P. Luyendyk

Dr. Bruce Luyendyk is a Professor of Geological Sciences at the University of California, Santa Barbara. He received his B. A. (1965) for Geological/Geophysics from San Diego State College and his Ph.D. (1969) for Oceanography/Marine Geophysics from Scripps Institute of Oceanography. His main research interests include Marine geophysics, plate tectonics, paleomagnetism, paleo-oceanography and exploration geophysics. Interests in Geographical Information Systems is a result of Dr. Luyendyk's current research on tectonic rotations in Southern California. Coupled with extensive field data collection in this region, Dr. Luyendyk and others have been building a digital data base for statistical analysis of the parameters controlling inclination anomalies. Other recent research endeavors include structure analysis and mapping of the Hosgri fault zone offshore of Central California and paleomagnetic tests of tectonic models of New Zealand (NSF).

Dr. Luyendyk has served as a consultant for such organizations as the U. S. Geological Survey, California State Lands Commission, Hollister Ranch Associates involving testimony before the Federal Energy Regulatory Commission in Washington D. C. and the California Public Utilities Commission in connection with the seismic hazards analysis for a proposed Liguified Natural Gas terminal on the Santa Barbara coast, Texaco USA Incorporated, Gulf Oil Corporation, and the Board of Supervisors, Marin County, California. He has served as editor for three geological journals (*Marine Geophysical Researches, Geology,* and *Journal of Geophysical Research*), reviewed for ten others (e. g., *Tectonics, Nature, Journal of Geophysical Research, Geophysics,* etc.) and has reviewed proposals for the Earth Sciences and

Ocean Sciences Divisions for the National Science Foundation. Besides appearing in Who's Who in America Science and Technology, Dr. Luyendyk has lectured and presented papers at many institutions, conferences and universities. He has published 55 journal articles, three books and 60 abstracts and has contributed chapters to seven books.

Selected Publications:

Neogene Clockwise Tectonic Rotation of the Eastern Transverse Ranges, **California**, with J. Carter and R. R. Terres, *Bull. Geological Society of America*, vol. 98, 1987, pp. 199-206.

A Gravity Model of the Basement Structure in the Santa Maria Basin, California, with P. M. Kieniewicz, *Geophysics*, vol. 51, 1986, pp. 1127-1140.

Investigation of Faulting and Abyssal Hill Formation on the Flanks of the East Pacific Rise (21 degrees N) Using ALVIN, with K. C. Macdonald, *Marine Geophysical Researches*, vol. 7, 1985, pp. 515-536.

A Geological Transect Across the Crest of the East Pacific Rise at 21 degrees N latitude made from the Deep Submersible ALVIN, with K. C. Macdonald, **Marine Geophysical Researches**, vol. 7, 1985, pp. 467-488.

Neogene Tectonic Rotation of the San Gabriel Region, California, with R. R. Terres, *Journal of Geophysical Research*, vol. 90, 1985, pp. 12,467-12,484.

Paleomagnetism and Neogene Tectonics of the Northern Channel Islands, California, with M. J. Kamerling, *Journal of Geophysical Research*, vol. 90, 1985, pp. 12,48-5-12,502.

A Marine Seismic Refraction Study of the Santa Barbara Channel, California, with G. J. Crandell, M. S. Reichle, and W. A. Prothero, *Marine Geophysical Researches*, vol. 6(l), 1983, pp. 15-38.

Side-scan Sonar and High-Resolution Reflection Maps of the Santa Barbara Channel Seafloor, with E. J. Hajic, R. E. Crippen, and D. S. Simonett, California Sea Grant College Program, Report No. T-CSGCP-006, 1983.

Side-scan Sonar Mapping and Computer-aided Interpretation in the Santa Barbara Channel, California, with E. J. Hajic and D. S. Simonett, *Marine Geo- physical Researches*, vol. 5(4), 1983, pp. 365-388.

Hot Springs and Geophysical Measurements on the East Pacific Rise, with K. C. Macdonald, *Scientific American*, vol. 244(5), 1981, pp. 100-116.

Geophysical Survey in the Ivanpah Valley and Vicinity, Eastern Mojave Desert, California, with C. Carlisle and R. L. McPherron, in *Geology and Mineral of the California Desert*, D. L. Fife and A. R. Brown eds., South Coast Geological Society, 1980, pp. 485-494.

Geometric Model for Neogene Crustal Tectonics in Southern California, with M. J. Kammerling and R. Terres, *Bull. Geological Society of America*, vol. 91, 1980, pp. 211-217.

Magnetic Smooth Zones in the World's Oceans, with K. Poehls and J. Heirtzler, Jr. *Journal of Geophysical Research*, vol. 78, pp. 6985-6997.

Central North Atlantic Plate Motions, with J. D. Phillips and D. Forsyth, *Science*, vol. 174, 1971, pp. 845-846.

The Origin of Short Wavelength Magnetic Lineations Observed Near the Ocean Floor, *Journal of Geophysical Research*, vol. 74, 1969, pp. 4869-4881.

John Michael Melack

Dr. John Melack, Professor of Biological Sciences at the University of California, Santa Barbara, received his B. A. (1969) in Biological Sciences from Cornell University and his Ph.D. (1976) in Zoology (Limnology) from Duke University. In his 25 years of professional experience, Dr. Melack has served on 28 advisory boards/committees for the National Aeronautic and Space Administration, National Science Foundation, the U.S. Geologic Survey, and other agencies, and has served as a reviewer for 13 journals (e. g. *Science, Ecology, Limnology and Oceanography*, etc.), and for research proposals for the National Science Foundation, A. I. B. S., and NASA. He has presented over 50 papers at professional meetings, universities and government laboratories, and has helped generate over four million dollars of extramural research funding. Dr. Melack is a member of the editorial board for *Hydrobiologia* and has published 61 abstracts, 10 book reviews, and over 50 journal and conference articles. Present research interests with GIS applications

include watershed biogeochemistry (chaparral streams, mixed conifer forest streams, subalpine lake and streams, and tropical rain forest streams), floodplain ecology, and the limnology of high altitude lakes.

Selected Publications:

High-resolution Spaceborne Imaging Spectrometry: Science Opportunities for the 1990's. with K. Carder and M. Abbott, in Imaging Spectrometry Science Advisory Group's Science Plan, chapters 232, 2.C2, 2.E3, 4B, NASA-JPL, in press.

From Pattern to Process: The Strategy of the Earth Observing System, in Eos Science Steering Committee, chapters 4, 5, NASA Headquarters, in press.

Spatial and Temporal Distribution Patterns of Three Trophic Levels in a Saline Lake, with P. H. Lenz, S. D. Cooper, and D. W. Winkler, *Journal of Plankton Research*, vol. 8, 1986, pp. 1051-1064.

Aquatic Ecosystems and the Biosphere, with J. Walsh, E. Fee, L. Slobodkin, and J. Estes, in Space Science Board, Committee on Planetary Biology, *Remote Sensing of the Biosphere*, National Academy Press, 1986, pp. 80-92.

Major Solute Chemistry of Stream Water and Rain in a Southern California Chaparral Watershed, with J. 0. Sickman, Proceedings of the Chaparral Conference, Cal. Water Resources Center Report, vol. 62, 1986, pp. 81-87.

Chlorophyll Differences in Mono Lake Observable on Landsat Imagery, with E. Almanza, *Hydrobiologia*, vol. 122, 1985, pp. 461-470.

Major Ion Chemistry and Sensitivity to Acid Precipitation of Sierra Nevada Lakes, with J. L. Stoddard and C. A. Ochs, *Water Resources Research*, vol. 21 1985, pp. 27-32.

Amazon Floodplain Lakes: Shape, Fetch, and Stratification, *Verh. International Verein. Limnology*, vol. 22, 1984, pp. 1278-1282.

Inland Aquatic Resources and Biochemical Cycles, in Science and Mission Requirements Working Group Report, Earth Observing System, NASA, 1984, pp. A15-A17.

Responses of Phytoplankton to Experimental Nutrient Enrichment in an Amazon Lake, with F. V. Setaro, *Limnology Oceanography*, vol. 28, 1984, pp. 972-984.

Transport of Carbon, Nitrogen, Phosphorus and Major Solutes in the Gambia River, West Africa, with L. F. Lesack, R. E. Hecky, *Limnology and Oceanography*, vol. 28, 1984, pp. 816-830.

Diel Oxygen Variations and their Ecological Implication in Amazon Floodplain Lakes, with T. R. Fisher, *Archeological Hydrobiology*, vol. 98, 1983, pp. 422-442.

Large, Deep Salt Lakes: A Comparative Limnological Analysis, *Hydrobiologia*, vol. 105, 1983, pp. 223-230.

Transport of Organic Carbon in the World's Rivers, with W. H. Schlesinger *Tellus*, vol. 33, 1981, pp. 172-187.

Photosynthetic Rates in Four Tropical African Fresh Waters, *Freshwater Biology*, vol. 9, 1979, pp. 555-571.

Prakash V. Ramanan

Dr. Prakash Ramanan, Assistant Professor of Electrical Engineering at the University of California, Santa Barbara, received his B. E. (1980, Honours) in Electronics Engineering at Birla Institute of Technology and Science (India), and his Ph.D. (1984) in Computer Science at the University of Illinois. He is the recipient of two scholarships: National Merit Scholarship (India) and the IBM Graduate Fellowship (1983). His research interests include combinatorial algorithms, analysis of data in spatially addressed information, computational geometry and cryptography.

Selected Publications:

On-line Bin Packing in Linear-time, with D. J. Brown, *Proceedings of the 1984 Conference of Information Sciences and Systems*, 1984, pp. 328-332.

New Algorithms for Selection, with L. Hyafil, *Journal of Algorithms*, vol. 5, 1984, pp. 557-578.

Permutation Representation of K-ary Trees, with C. L. Liu, *Theoretical Computer Science*, accepted for publication.

A Personnel Assignment Problem, with J. S. Deogun and C. L. Liu, *Journal of Algorithms*, vol. 5, 1984, pp. 132-144.

Pushdown Permuter Characterization theorem, *SIAM Journal of Computing*, 1984, vol. 13, pp. 167-169.

A Counterexample to Shyamasundar's Characterization of Pushdown Permuters, *Theoretical Computer Science*, vol. 23, 1983, pp. 103-105.

Yaun-Fang Wang

Dr. Yaun-Fang Wang, soon to be a faculty member of Electrical and Computer Engineering at the University of California, Santa Barbara, received his B. S. (1981) at National Taiwan University, and his M. S. (1983) and Ph. D. (1987) at the University of Texas at Austin. All three degrees were in Electrical Engineering. Dr. Wang's research interests involve computer vision and graphics, artificial intelligence, expert systems, signal and image processing, robotics and recognition of objects in large data bases.

Selected Publications:

Line-Based Computation of Structure and Motion Using Angular Invariance, with A. Mitiche, S. Seida, and J. K. Aggarwal, *Pattern Recognition*, submitted for publication.

Integration of Active and Passive Sensing Techniques for Representing 3-D Objects, with J. K. Aggarwal, LEEE *Journal of Robotics and Automation*, accepted for publication.

Experiments in Computing Optical Flow with the Gradient-Based, Multiconstraint Method, with A- Mitiche and J. K. Aggarwal, *Pattern Recognition*, vol. 20 (2), 1987, pp. 173-179.

Computation of Surface Orientation and Structure of Objects Using Grid Coding, with A. Mitiche and J. K. Aggarwal, IEEE Transactions on PAMI, vol. PAM1-9 (2), 1987, pp. 173-179.

3-D Object Description from Stripe-Coding and Multiple Views, with J. K. Aggarwal, *5th Scandinavian Conference on Image Analysis*, 1987.

Analysis of a Sequence of Images Using Point and Line Correspondences, with J. K. Aggarwal, *IEEE International Conference on Robotics and Automation*, 1987, pp. 1275-1280(3).

On Modeling 3-D Objects Using Multiple Sensory Data, with J. K. Aggarwal, *Proceedings of the 1EEE International Conference on Robotics and Automation*, 1985, pp. 96-104.

Structure and Motion Computation from Point and Line Correspondences in Images, with J. K. Aggarwal, in *Advances in Image Processing and Pattern Recognition*, V. Cappellini and R. Marconi, eds., Elsevier Science Publishers B. V., North Holland, 1986, pp. 171-178.

Surface Reconstruction and Representation of 3-D Scenes, with J. K. Aggarwal, *Pattern Recognition*, vol. 19 (3), 1986, pp. 197-207.

Inferring Local Surface Orientation with the Aid of Grid Coding, with A. Mitiche and J. K. Aggarwal, *Proceedings of the Third Workshop on Computer Vision: Representation and Control*, 1985, pp. 96-104.

Construction of Surface Representation from 3-D Volumetric Scene Description, with J. K. Aggarwal, *Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition*, 1985, pp. 130-135.

Matching 3-Dimensional Objects Using Silhouettes, with M. J. Magee and J. K. Aggarwal, *IEEE Transactions on PAMI*, vol. PAMI-6 (4), 1984, pp. 513-518.

Three-Dimensional Volumetric Matching Using Silhouettes, with M. J. Magee and J. K. Aggarwal, *International Conference on Computer, Systems, and Signal Processing*, 1984.

B3. Department of Geography, State University of New York at Buffalo

Faculty and Staff Contributions to the NSF Center

Initially, five current members of the Geography Department at UB will be centrally involved with the NCGIA. We anticipate at least two new appointments in the GIA area this year. In addition other current members of the Department will, as the program develops, participate in research and educational initiatives of the Center.

Buffalo's Geography Department was established in the early 1960's and its Ph.D. program was initiated in 1974. During the 1970's the Department adopted an explicit plan to focus on four areas of concentration-automated cartography and geographic information systems, urban and regional analysis, physical geography, and international trade. Since that time, all faculty appointments and curriculum developments have been made within the context of this plan, as shown in the diagram and table following this page.

Editorships: Members of the Department have been particularly active in editing major journals in geography and related interdisciplinary areas. Current or past editorships include *Geographical Analysis, The Annals of the Association of American Geographers, The Professional Geographer*, and *The Papers of the Regional Science Association*. Members of the Department have served and continue to serve on editorial boards of these and other journals, including *Geomorphology* and *International Regional Science Review*.

Publications: During the 1980's, the Department has assumed a major position in publishing in the highest visibility journals of the discipline. The Department has consistently ranked among the top five geography departments in the US in publishing in the primary geography journals of the nation. In addition, current faculty have authored ten books, edited ten others, contributed chapters to 43 others, published over 300 papers in refereed journals and conference proceedings.

Reviewing: Members of the Department are frequently asked to review manuscripts for major national and international journals in geography and related fields as well as for major funding agencies. In recent years, reviews for papers submitted to the following journals have been provided by members of the Department: *The Annals of the AAG, The Professional Geographer, The American Cartographer, Annals of Regional Science, The Australian Geographer, The Canadian Geographer, Canadian Journal of Earth Sciences, Economic Geography, Environment and Planning A, Geographical Analysis, Geographical Review, Geomorphology, Geo-Processing, Geografiska Annaler, International Journal of Geographic Information Systems, International Regional Science Review, Journal of Regional Science, Journal of Geography, Journal of Geology, Journal of the Geological Society of America, Mathematical Geology, Papers of the Regional Science Association, Progress in Human Geography, Regional Studies, Transportation Science, Logistics and Transportation Review, Urban Geography, Demography, Water Resources Research, Arctic and Alpine Research, Association of Pacific Coast Geographers Yearbook, American Journal of Science, Bulletin of the Geological Society of America, Naval Research Logistics Quarterly, Computer Vision, Graphics and Image Processing* and *The IEEE Transactions on Pattern Analysis and Machine Intelligence.*

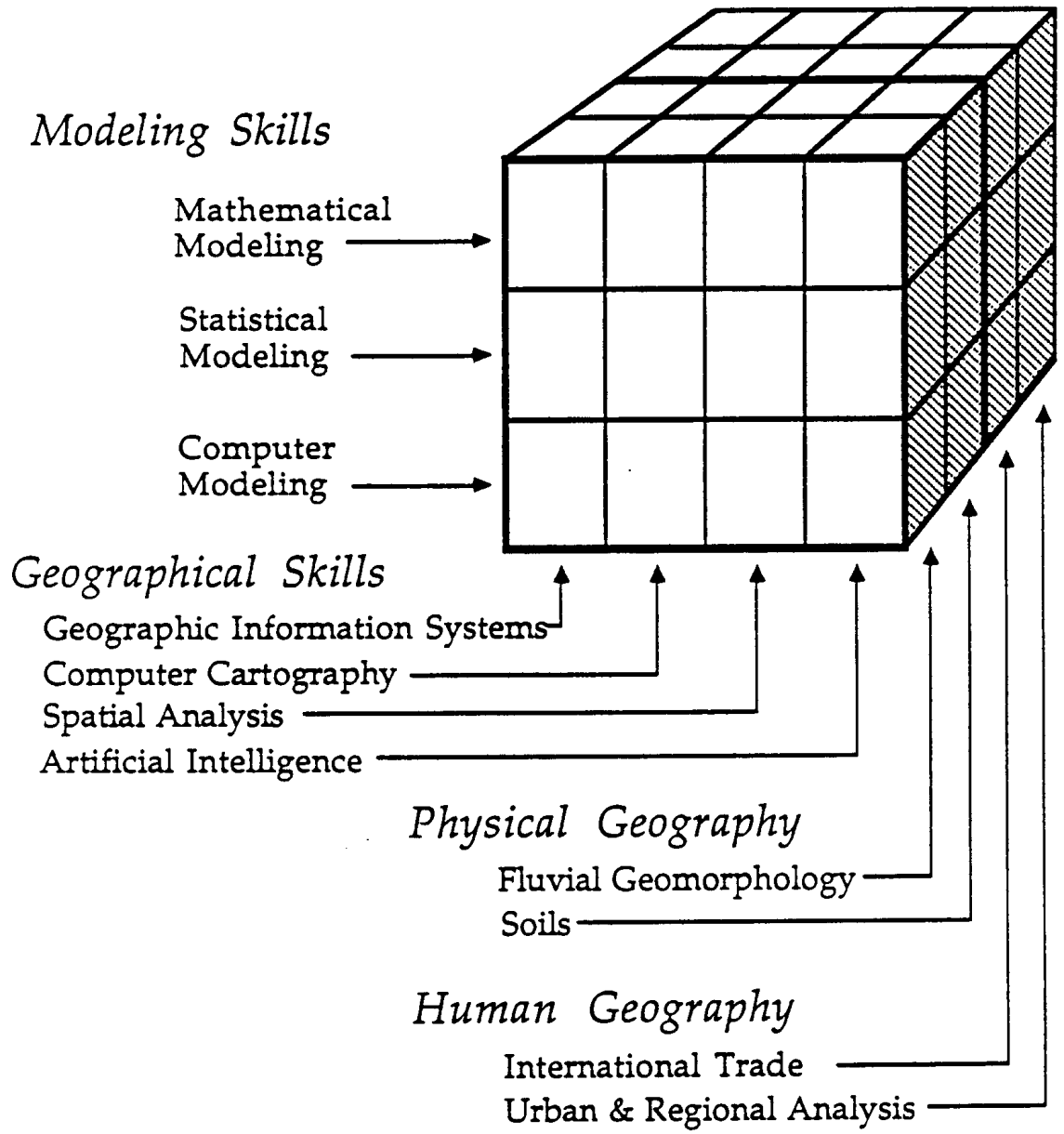
Honors/Awards: Two members of the Department, Ebert and McConnell, have received the SUNY Chancellor's Award for Excellence in Teaching. Abrahams has been the recipient of a Killam Fellowship, the Gladys W. Cole Research Award from the Geological Society of America and the G.K. Gilbert Award for Excellence in research from the AAG Geomorphology Specialty Group. MacKinnon is a former Woodrow Wilson Fellow and received a Canada Council Leave Fellowship. Rogerson received the Dorothy S. Thomas Award from the Population Association of America, the Warren J. Nystrom Award from the AAG, and the prestigious NSF Young Presidential Investigator Award.

THE STATE UNIVERSITY OF NEW YORK
BUFFALO
DEPARTMENT OF GEOGRAPHY
EXISTING AND *AUTHORIZED* FACULTY FTE
1988 - 1990

Departmental Interests															
Year of Commitment	*Actual and Liened FTE*	*Faculty*	*Geographical/ Spatial Skills*				*Modeling Skills*			*Physical Geography*		*Human Geography*	
			Geographic Information Systems	Computer Cartography	Spatial Analysis	Artificial Intelligence	Mathematical Modeling	Statistical Modeling	Computer Modeling	Fluvial Geomorphology/ Hydrology	Soils	Trade	Urban/ Regional
	1	D. Mark	X	X		*	*	*	X	X			
	1	P. Rogerson			X		X	X	*				X
	1	B. Buttenfield	*	X		*		*	*				
	1	H. Calkins	X	*									X
	0.25	R. MacKinnon			X		X		X			X	
	1	J. W. Harrington						X				X	X
	1	J. McConnell						X				X	*
	1	M. Woldenberg			X		X			X			
	1	C. Ebert									X		
	1	R. Mitchell						X					X
	1	A. Abrahams					X	X		X			
	1	D. Smith										*	*
	1	E. Conkling										X	*
	1	J. Haupert								*	*		
	1	B. Lentnek			X		*						X
[Adjunct]		C. Amrhein	*		X		X	*	*				X
[Adjunct]		L. Band	X		*		X	*	X	X			
Authorized FTE (with start date): 1988 - 1990													
'88	1	GIS Pos.	X	*		*			X				
'88	1	Trade Pos.						*				X	*
'88	1	Spatial/ Analysis	*		X		X	X	X				X
'89	1	Appointment Area/Rank Open											
'90	1	Appointment Area/Rank Open											
		X	4	2	6		7	6	5	4	1	5	7
		*	3	2	1	3	2	5	3	1	1	1	4
	$\sum$ 19.25		7	4	7	3	9	11	8	5	2	6	11

Key: X represents major interest.
* represents minor interest.

State University of New York
Buffalo
Department of Geography



National and International Committees: Members of the Department have been appointed and elected to a number of major national and international panels and committees in the discipline of geography and related fields. MacKinnon has twice been elected as a director of the AAG Quantitative Methods Specialty Group as well as the Transportation Specialty Group. He has also served as Secretary and is currently Co-Chairman of the International Geographical Union's Working Group on Mathematical Models. Mark has been elected as vice-Chair and Chair of the AAG Geographic Information Systems Specialty Group. Buttenfield is the Academic Director of the AAG Cartography Specialty Group. Abrahams has been elected as the Chair and the Secretary-Treasurer of the AAG Geomorphology Specialty Group. He is also the Chair of the AAG "Survey and Synthesis" Task Force. McConnell has been a member of the Geographic Education National Implementation Project, and he has served as a director and Secretary-Treasurer of the AAG Industrial Geography Specialty Group. Harrington was elected to the Board of Directors of the AAG's Industrial Geography Specialty Group and then elected Secretary-Treasurer of the same group.

Academic Programs: Enrollments in the Department of Geography are very healthy. There is of course a significant service function that is reflected in a high student-faculty ratio. More important, however, is the number of undergraduate majors, active graduate students, baccalaureate and graduate degrees granted. Buffalo typically has about 100 majors enrolled in its undergraduate programs. Current enrollments at the graduate level are 73, with about 18 estimated to have the Ph.D. as their terminal degree. In terms of the granting of masters degrees, Buffalo is one of the most productive departments in the nation. Although the Ph.D. program has been smaller, academic placements here are quite impressive. The first Ph.D. was granted in 1973; since then Ph.D's from Buffalo have been appointed in tenure track positions in Boston, Pennsylvania State, Kentucky, Toronto, Northwestern, Hawaii, SUNY Albany, Virginia Polytechnic, University of Montreal, University of Nebraska, and Duquesne University. Placements of our graduates in government agencies and private firms include Defense Mapping Agency, US Forest Service, Gulf Oil, Synercom, Department of Defense, UN Development Program, Wild Associates, Par Technology, Environmental Studies Research Institute, Computer Vision, etc.

Consultancies: Faculty members have served as consultants to local, national and foreign firms and agencies:

1) **Local Agencies:** Town of Amherst, Buffalo, Erie and Niagara Counties Planning Board, King County Housing and Community Development (Seattle), Upstate New York District Export Council.
2) **Private Corporations:** A.T. and T. Consumer Marketing, Applied Technology Division (TRW).
3) **National Agencies:** U.S. Forest Service, U.S. Army Corps of Engineers, U.S. Navy Engineering Research Office, U.S. Agency for International Development.
4) **Foreign Countries:** Instituto Geologico, Nicaragua and the Brazilian Institute for Geography and Statistics, Bell Canada.

Research Grants and Contracts: Members of the Department have obtained research and conference grants over the past five years averaging at about $100,000 per year.

Management: Senior management experience in the UB Geography Department can be summarized as follows: **MacKinnon:** Dean of the Faculty of Social Sciences since 1982 and former Chair of Department; **McConnell, Ebert, Mitchell and Conkling:** Department Chair; McConnell is Director-Designate of the Canadian-American Trade Center to be established at UB in 1988. Ebert has also served as Dean of Undergraduate Education.

B4. Individual Vitae for Center Participants from all Departments

Athol D. Abrahams

Dr. Athol Abrahams was born in 1946 in Sydney, Australia. He attended the University of Sydney and obtained a Bachelor of Arts with First Class Honors and the University Medal in Geomorphology in 1967 and a Ph.D. in 1971. From 1971 to 1973 he held a Killam Post-Doctoral Fellowship at the University of Alberta, Canada, but then returned to Australia to become a Lecturer at the University of New South Wales. In 1977 he moved to the State University of New York at Buffalo, where he is currently a Professor in the Department of Geography.

Dr. Abrahams's principal research interest is in channel networks. During the past 15 years in 25 articles in professional geology, hydrology, and geography journals, he has elucidated the factors that control the topological and geometric properties of such networks. For this research he was awarded the 1986 Carl Grove Gilbert Award by the Geomorphology Specialty Group of the Association of American Geographers.

Since 1982, Dr. Abrahams has become increasingly involved in the study of desert hillslopes and the hydrogeomorphic processes operating on these slopes. This research, which has made extensive use of simulated rainfall, has been supported by the USDA Agricultural Research Service and NATO. In 1985, Dr. Abrahams received the Gladys W. Cole Research Award from the Geological Society of America for the study of rock slopes in the Mojave Desert.

Dr. Abrahams has served the Association of American Geographers in a number of capacities: as the Associate Editor of the *Annals* and Director of a special issue of the *Annals* on Polar Physical Geography, as Secretary-Treasurer and Chair of the Geomorphology Specialty Group, and as Chair of the Survey and Synthesis Task Force.

In 1985, Dr. Abrahams organized the sixteenth Annual Geomorphology Symposium. The proceedings of the symposium, which he edited, were subsequently published by Allen & Unwin under the title Hillslope Processes.

Dr. Abrahams is a Fellow of the Geological Society of America, and a member of the Association of American Geographers, the American Geophysical Union, and the British Geomorphological Research Group.

Selected Publications:

Factor Analysis of Drainage Basin Properties: Evidence for Stream Abstraction Accompanying Degradation of Relief, *Water Resources Researc*h, vol. 8, 1972, pp. 624-633.

Topologically Random Channel Networks in the Presence of Environmental Controls, *Geological Society of America Bulletin*, vol. 86, 1975, pp. 1459- 1462.

Evolutionary Changes in Link Lengths: Further Evidence for Stream Abstraction, *Institute of British Geographers Transactions*, vol. 1 (New Series), 1975, pp. 225-230.

The Factor of Relief in the Evolution of Channel Networks in Mature Drainage Basins, *American Journal of Science*, vol. 277, 1977, pp. 626-646.

Channel Link Density and Ground Slope, *Annals*, Association of American Geographers, vol. 70, 1980, pp. 80-93.

Divide Angles and Their Relation to Interior Link Lengths in Natural Channel Networks, *Geographical Analysis*, vol. 12, 1980, pp. 157-171.

A Multivariate Analysis of Chain Lengths in Natural Channel Networks, *Journal of Geology*, vol. 88, 1980, pp. 681-696.

Geological Controls on the Topological Properties of Some Trellis Channel Networks, with J. J. Flint, *Geological Society of America Bulletin*, vol. 94, 1983, pp. 80-91.

Channel Networks: a Geomorphological Perspective, *Water Resources Research*, vol. 20, 1984, pp. 161-188.

Tributary Development Along Winding Streams and Valleys, *American Journal of Science*, vol. 284, 1984, pp. 863-892.

The Development of Tributaries of Different Sizes Along Winding Streams and Valleys, *Water Resources Research*, vol. 20, 1984, pp. 1791-1796.

Hillslope Gradient-particle Size Relations: Evidence for the Formation of Debris Slopes by Hydraulic Processes in the Mojave Desert, with A. J. Parsons and P. J. Hirsch, *Journal of Geology*, vol. 93, 1985, pp. 347-357.

Hillslope Processes, (editor,) Boston, Allen and Unwin, 1986, 416 p.

Resistance to Overland Flow on Desert Hillslopes, with A. J. Parsons and S. H. Luk, *Journal of Hydrology*, vol. 88, 1986, pp. 343-363.

Some Space-filling Controls on the Arrangement of Tributaries in Dendritic Channel Networks, with J. Updegraph, *Water Resources Research*, vol. 23, pp. 489-495.

Carl G. Amrhein

Dr. Carl Amrhein received his Bachelors from Pennsylvania State University (1978) and his Ph.D. from the State University of New York at Buffalo (1984), both in Geography. Before he became a member of the Department of Geography at the University of Toronto, he was an Assistant Professor in the Department of Geography at the University of Kentucky (1984 to 1986).

Dr. Amrhein has a wide scope of research interests and has published in the fields of spatial statistics, interregional labor market, micro-behavioral modeling and industrial dynamics. Having strong backgrounds in computer modeling, computer cartography and GIS, Dr. Amrhein approaches his research problems by building various types of computer simulation models which also provide information for planners and policy analysts. Currently, Dr. Amrhein is receiving research grants to develop large scale microsimulation models of the industrial economy.

Dr. Amrhein is also very active in terms of editorial activities. He was the software review editor of *The Professional Geographer* from 1985 to 1987, and from 1985 to 1986 he served as the editor of the *Newsletter* of the Mathematical Models and Quantitative Methods Specialty Group of the Association of American Geographers. Dr. Amrhein has reviewed papers for *Geographical Analysis, Regional Studies, The Professional Geographer, Environment and Planning A,* and *Papers of the Regional Science Association*.

Selected Publications:

An Evaluation of Correction Techniques for Boundary Effects in Spatial Statistical Analysis: Traditional Methods, with D. Griffith, *Geographical Analysis*, vol. 15, 1983, pp. 352-360.

The Effect of Random Thiessen Structure and Random Processes on the Measurement of Spatial Autocorrelation, with D. Griffith and J. Guevara, Proceedings of the Fourteenth Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, PA, University of Pittsburgh, School of Engineering, 1983, pp. 585-589.

The Effect of Spatial Structure on Interregional Labor Migration, with L. Leifer, Proceedings of the Fifteenth Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, PA, University of Pittsburgh, School of Engineering, 1984, pp. 511-515.

An Interactive Multi-Criteria Decision Model for Spatial Analysis, *East Lakes Geographer*, 1985, pp. 20-28.

Interregional Labor Migration and Information Flows, *Environment and Planning A*, vol. 17, 1985, pp. 1111-1126.

An Elementary Simulation Model of the Job Matching Process Within an Interregional Setting, with R. MacKinnon, *Regional Studies*, vol. 19, 1985, pp. 193-202.

Simulating Intraindustry Change and Migration, with J. W. Harrington, Proceedings of the Sixteenth Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, PA, University of Pittsburgh, School of Engineering, 1985, pp. 407-411.

The Effect of Job Advertising Policies on Interregional Labor Migration, *Geographical Analysis*, vol. 18, 1986, pp. 1-18.

Towards a Behavioral Model of a Spatial Labor Market, with R. MacKinnon, in D. Griffith and R. Haining eds. *Transformations Through Space and Time*, New York: Martinus Nijhoff, 1986, p. 247-272.

Technical and Locational Adjustment in a Heterogeneous Industry, with J. W. Harrington, *Papers of the Regional Science Association*, vol. 59, 1987, pp. 13-28.

A Geography of the Venture Capital Industry in the U. S., with T. Leinbach, *The Professional Geographer*, vol. 39, 1987, pp. 146-158.

A Micro-Behavioral Model of Labor Migration, with R. MacKinnon, *Annals of the Association of American Geographers*, forthcoming.

Interregional Location of a Heterogeneous Industry Facing Segmented Labor Markets, with J. Harrington, *Regional Studies*, forthcoming.

Lawrence E. Band

Dr. Lawrence Band is an Assistant Professor in the Department of Geography at the University of Toronto. He received his undergraduate degree in Geography from the State University of New York at Buffalo (1977) and his Masters (1979) and Ph.D. (1983) degrees in Geography from the University of California at Los Angeles.

Dr. Band was trained as a geomorphologist with a strong background in computer simulation. He is at the forefront in the effort to merge the analytical and modeling capabilities of a geographic information system with the analyses of geomorphic processes. His work focuses on computer simulation, spatial data processing, and graphic representation of watershed hydrological and geomorphological processes.

Trying to bridge the conceptual and methodological gap between models of small scale spatial systems, e.g. individual hillslope hydrologic processes, and larger scale systems, Dr. Band is currently exploring the behavior of small scale systems and methods to extend the simulation of their most important processes over larger scale complex terrain. This involves the development of automated techniques to capture and process spatial data for parameterization of the simulation. He uses image processing techniques applied to remotely sensed scenes and digital terrain models, combined with developing methods in geographic information systems, to accomplish this task.

Selection Publications:

Numerical Simulation of Hillslope Form and the Magnitude and Frequency of Overland Flow Erosion, in *Models in Geomorphology*, ed. M. J. Woldenberg, George Allen & Unwin, 1985.

Field Measurement of Sediment Transport by Overland Flow, *Catena*, vol. 12(4), 1985, pp. 282-290.

Topographic Partition of Watersheds with Digital Elevation Models, *Water Resources Research*, vol. 22(l), 1986, pp. 15-24.

Lateral Strewn Migration, Forthcoming, in *Catena*, 1986.

A Terrain Based, Watershed Information System, accepted with revisions in *Hydrological Processes*, 1987.

Strategies for Large Scale, Distributed Hydrologic Modeling, with E. F. Wood, forthcoming in *Applied Mathematics and Computation*, 1987.

Extraction of Channel Networks and Topographic Parameters From Digital Elevation Data, invited chapter for M. J. Kirkby and K. Beven, eds., *Channel Network Function*, John Wiley. Expected publication, Spring, 1988.

Extraction of Topographic Networks From Digital Elevation Models, Proceedings of the Sixteenth International Symposium of Remote Sensing of Environment, 1984.

Information-theoretic Analysis of the Cis-trans Link Problem in Stream Networks, with V. B. Robinson, *Modeling and Simulation*, Proceedings of the Pittsburgh Conference, vol. 15, 1984, pp. 87-91.

Potential Applications of SPOT Data for Sediment Pattern Detection in Chesapeake Bay, edited with H. L. McKim, Proceedings of the First Annual SPOT Symposium, Scottsdale, Arizona, 1984.

Development of a Distributed-components Database for Hydrologic Simulation, *Modeling and Simulation*, Proceedings of the Sixteenth Pittsburgh Symposium on Modeling and Simulation, vol. 16, part 4, 1985, pp. 325-330.

Construction of a Distributed Watershed Data-base from Digital Terrain Models, in Proceedings of the International Conference of the Remote Sensing Society and the Center for Earth Resources Management. *Advanced Technology for Monitoring and Processing Global Environmental Information*, London, England, 1985, pp. 201-207.

Syntactic Pattern Recognition of Pollutant Plumes, edited with H. L. McKim, Proceedings of the Fifth Army Corps of Engineers Remote Sensing Conference, Ann Arbor, Michigan, 1985.

Automated Construction of a Hydrologic Information System from Digital Elevation Data, with V. B. Robinson, forthcoming in the Proceedings of the Workshop on Geographical Information Systems for Environmental Protection, January 22-23, 1986, Environmental Research Center, University of Nevada, Las Vegas.

Analysis and Representation of Drainage Basin Structure with Digital Elevation Data, Proceedings of the Second International Conference on Spatial Data Handling, Seattle, Washington, 1986, pp. 437-450.

Effects of Spatial Variability and Scale with Implications to Hydrologic Modeling, with E. F. Wood, M. Sivapalan, K. Beven, forthcoming in the Proceedings of the USA-Japan Seminar on Hydrology, Honolulu, Hawaii, Jan. 1987.

Rajan Batta

Dr. Rajan Batta is an Assistant Professor in the Department of Industrial Engineering, State University of New York at Buffalo. He received his undergraduate degree in Mechanical Engineering from the Indian Institute of Technology (1980), New Delhi, India, and his doctorate in Operations Research from the Massachusetts Institute of Technology (1984).

Dr. Batta's research concerns developing and analyzing mathematical models for real world applications. In particular, he is interested in the creation of novel, innovative application areas for Operations Research techniques. Solid Engineering background, coupled with an excellent, in-depth knowledge over a broad range of Operations Research techniques, gives him the tools necessary for this kind of research.

Dr. Batta's scholarly accomplishments are represented by papers in the areas of:

1. Queuing-Location Problems: These problems combine ideas from queuing theory and location theory. The work is aimed primarily at urban emergency service systems, and has yielded advances in location theory, as well as rejuvenated interest in the analysis of otherwise less frequently encountered queuing systems.
2. Routing of Hazardous Materials: This area integrates risk measures with effective modeling techniques and analysis of the safe transportation of hazardous materials; in order to minimize the total exposure to the population at large.
3. Location Problems with Barriers and Forbidden Regions: This area examines location problems in a general context prevalent in most real-world applications, simultaneously considers barriers and for bidden regions. An analogy was developed between network location problems and planar location problems which use the Manhattan travel metric. Further work in exploiting this analogy for generating
efficient planar algorithms from their network counterparts is currently underway.
4. Mixed Planar/Network Location Problems: This area of research integrates results from planar and network location literature into a unified model.

Selected Publications:

Locating 2-Medians on Tree Network with Continuous Link Demands, with M. Brandeau and S. S. Chiu, *Annals of Operations Research*, vol. 6, 1986, pp. 223-253.

A Single Server Priority Queuing-Location Model, with R. C. Larson and A. R. Odoni, to appear in *Networks*.

Locating Facilities on the Manhattan Metric with Arbitrarily Shaped Barriers and Convex Forbidden Regions, with A. Chose and U. S. Palekar, to appear in *Transportation Science*.

Mixed Planar/Network Facility Location Problems, with U. S. Palekar, to appear in *Computers and Operations Research*.

Optimal Obnoxious Paths on a Network: Transportation of Hazardous Materials, with S. S. Chiu, to appear in *Operations Research*.

Location of Mobile Units in a Stochastic Environment, with 0. Berman, S. S. Chiu, R. C. Larson, and A. R. Odoni, to appear in Francis and Mirchandani, eds., *Discrete Location Theory*, John Wiley & Sons, New York.

Single Server Queuing-Location Models with Rejection, to appear in *Transportation Science*.

A Queuing-Location Model with Service Time Dependent Queuing Disciplines, submitted to *European Journal of Operational Research*.

Relaxing the Independence Assumption of a Maximal Expected Covering Location Model, with J. M. Squilla, submitted to *Transportation Science*.

On the Accuracy of Demand Point Solutions to the Planar, Manhattan Metric pMedian Problem, with L. F. Leifer, to appear in *Computers and Operations Research*.

The Discrete Choice Stochastic Queue Median Problem, submitted to *Operations Research***.**

On the Synthesis of Advertising and Relocation Decisions for a Facility, with W. V. Huang, submitted to *Computers and Industrial Engineering.*

The Traveling Server Problem , with D. M. Malon, submitted to Computers and Operations Research.

A Note on Covering Location Models Requiring Multiple Facilities, with N. R. Mannur, submitted *to Management Science.*

A Location Model for a Facility Operating as an M/G/k Queue, with 0. Berman, submitted to *Networks*.

Wayne F. Bialas

Dr. Wayne F. Bialas is an Associate Professor in the Operations Research Program in the Department of Industrial Engineering at the State University of New York at Buffalo. He has been a member of the SUNY faculty since 1976. He has also served as a visiting professor on the Civil Engineering faculties of Cornell University and the Massachusetts Institute of Technology. Dr. Bialas has published papers in leading journals on water resources, operations research, control theory and mathematical statistics. As a postdoctoral student at Cornell, he conducted research in Cornell's Program for Computer Graphics during its first years.

Dr. Bialas is an active industrial consultant. His recent projects include an interactive computer system to interconnect regional facilities of a large electronic component manufacturer and an automated system to monitor the reliability of early warning systems for nuclear power plants.

He is an active member of seven different professional societies, including the Association for Computing Machinery, the American Society of Civil Engineers and the Institute of Industrial Engineers, in which he is a senior member. He has been invited to give several tutorials on computer graphics techniques to members of the ASCE at their national conferences.

Selected Publications:

Structural Flood Control Planning, with M. o. Ball and D. P. Loucks, *Water Resources Research*, vol. 14 (1), 1978, pp. 62-66.

Nonstructural Floodplain Planning, with D. P. Loucks, *Water Resources Research*, vol. 14 (1), 1978, pp. 67-74.

Niagara River Ice Boom: Effects on environment, with R. Rumer, F. Quinn, R. Assel and D. Gaskill, *ASCE Journal of Technical Topics*, vol. 109 (2), 1983, pp. 105-116.

Two-Level Linear Programming, W. F. Bialas and M. H. Karwan, *Management Science*, vol. 30 (8), 1984, pp. 1004-1020.

A Hybrid Algorithm for the Three-Level Linear Resource Control Problem, with U. P. Wen, *Computers and Operations Research*, vol. 13 (4), 1986.

Gail A. Bruder

Dr. Gail Bruder is an Associate Professor of Psychology. She is currently one of two Co-Directors of the Graduate Group in Cognitive Science at the State University of New York at Buffalo. Dr. Bruder is also a member of the Institute for Computing and Computer Applications which oversees the undergraduate minor in Computing and Computer Applications, at SUNY Buffalo.

She is a member of the Cognitive Science Society, the Psychonomic Society, and the American and Eastern Psychological Associations.

Dr. Bruder's current research includes investigations of the role of spatial reference in narrative comprehension; the acquisition and retention of spatial information, specifically cognitive maps; and the psychological mechanisms responsible for distortions which occur in the use and reproduction of cognitive maps. She is currently the Project Director for an interdisciplinary cognitive science project on narrative comprehension supported by the National Science Foundation (IRI-8610517). A major part of this project is exploring the linguistic devices used to establish and move the "Deictic Center," which incorporates the spatial, temporal, and focal character information for a text currently being

processed. Dr. Bruder is particularly interested in the mental model of spatial locations which a reader builds and uses while comprehending a narrative.

Selected Publications:

Deictic Centers in Narrative Comprehension, with E. M. Segal and J. Daniels, *Psychonomic Society Meeting*, 1984.

Preposed Adverbials Signal Change in the Deictic Center, Psychonomic Society Meeting 1985.

Deictic Center in Narrative: an Interdisciplinary Cognitive Science Project, with J. Duchan, W. Rapaport, E. M. Segal, S. Shapiro and D. Zubin, Department of Computer Science, SUNY Buffalo, Technical Report TR-86-20, 1986.

Barbara P. Buttenfield

Dr. Barbara P. Buttenfield is an Assistant Professor and the Director of the Cartography Laboratory of the Department of Geography at the State University of New York at Buffalo. Dr. Buttenfield received her B. A. (1974) from Clark University, M. A. (1979) from the University of Kansas and her Ph.D. (1984) from the University of Washington. All three were Geography degrees. Dr. Buttenfield has extensive background in analytical cartography, computer graphics and quantitative analysis, and has taught courses in computer mapping, analytical cartography, map transformations, graphical analysis, and quantitative methods, as well as traditional cartographic design and production.

Dr. Buttenfield has attended training courses offered by the Defense Mapping Agency Aerospace Center and the Environmental Systems Research Institute in photogrammetry and ARC/INFO, respectively. Dr. Buttenfield is currently involved in research on automatic map feature recognition and generalization and on digital representations of scale-dependent geometry. Other research interests include computer animation and the development of expert systems for generalization.

Selected Publications:

Washington, coeditor with E. G. Kohlenberg, Seattle, Center for Social Science Computation and Research, 1983.

Land Records Modernization: Centers of Excellence from a Wisconsin Perspective, University of Wisconsin Land Information Report. No. 2, 1984.

Treatment of the Cartographic Line, *Cartographica*, vol. 22 (2), 1985, pp. 1-26.

Comparing Distortion on Sketch Maps and M. S Configurations, *The Professional Geographer*, vol. 38 (3), 1986, pp. 238-246.

Digital Definitions of Scale-Dependent Structure, Proceedings of AUTO-CARTO London, vol. 1, 1986, pp. 497-506.

Formatting Geographical Data to Enhance Manipulability, with G. L. Langran, Proceedings of AUTO-CARTO London, vol. 8,1987, pp. 201-210.

Automatic Identification of Cartographic Lines, *The American Cartographer*, vol. 14 (1), 1987, pp. 7-20.

Discriminant Analysis in Geography, with C. T. Thompson. monograph under preparation for the CATMOG Series.

An Equal Step Perceptual Gray Scale for Use with Laser Printers, with J. J. Leonard, submitted to *The American Cartographer*.

Hugh W. Calkins

Dr. Hugh Calkins, Associate Professor of Geography at the State University of New York at Buffalo, has broad experience in the development and use of geographic information systems. He received his graduate degrees (Master of Urban Planning and Ph.D. in Urban Planning) from the University of Washington at Seattle in 1965 and 1972, respectively. Professional positions held have been equally divided between academic appointments and governmental positions. Academic appointments have included Assistant Professor in Urban Planning at the University of Washington and Associate Professor of Geography at the State University of New York at Buffalo. While at the University of Washington, he conducted research and instruction in urban analysis and urban information systems, and served as the Associate Director of the Urban Systems Research Center (a major six-year research and training program in urban

transportation supported by the Urban Mass Transportation Administration, Department of Transportation). During the same time period, he was actively involved in the programs of the IGU Commission on Geographical Data Sensing and Processing, making major contributions to the early writings on GIS sponsored by this commission. As an Associate Professor of Geography, he has participated in the development and operation of the program in geographic information systems and the Geographic Information Systems Laboratory in Buffalo. His special interest has been the design and implementation of geographic information systems. In pursuit of these interests, he has established two long-standing community service programs in GIS - one with a town planning agency and another with the Buffalo area regional planning agency.

Dr. Calkins has also held positions in local, county, regional, state and federal agencies for the design and development of geographic information systems. This extensive practical experience has complemented his academic research interests. He has also served as a consultant on GIS design for the U. S. Bureau of the Census (TIGER System), the U. S. Forest Service, the United Nations Food and Agriculture Organization, the Government of Alberta, Canada, and the Rand-McNally Company.

Dr. Calkins' current research interests center on improving the quality of geographical analysis by using GIS. Local, regional, and state agency cooperative projects are being emphasized as vehicles for testing research results, monitoring effectiveness, and as real-world laboratory situations for training students.

Selected Publications:

Books:

Computer Handling of Geographic Data: An Examination of Selected Geographic Information Systems, with R. Tomlinson and D. Marble, Paris, UNESCO Press, 1976.

Geographic Information Systems, Methods and Equipment for Land Use Planning, with R. F. Tomlinson, U. S. Geological Survey, 1977.

Computer Software for Spatial Data Handling: Volume I - Full Geographic Information Systems, with D. Marble, U. S. Geological Survey, 1980.

Articles:

Perspectives on Urban Region Information Systems - Hard and Soft Technology, with E. M. Horwood, *Papers, Urban and Regional Information Systems Association*, 1970.

The Economics of Geographical Data Handling, with others, introduction and three chapters in R. Tomlinson ed. *Geographical Data Handling*, 2 vols., Ottawa, IGU Commission on Geographical Data Sensing and Processing, 1972.

Information System Developments in North America, in R. F. Tomlinson ed., Proceedings of the Commission on Geographical Data Sensing and Processing, Moscow, 1976. Moscow, 1977.

Creating Large Digital Data Files from Mapped Data, Proceedings of the UNESCO Conference on Computer Mapping of Natural Resources, Mexico City, 1978.

The Planning Monitor: An Accountability Theory of Plan Evaluation, *Environment and Planning A*, vol. 2, 1979, pp. 745-758.

Digital Cartography in the USGS National Mapping Division, with R. McEwen, *Cartographica*, *Summer 1982*.

Geographic Information Systems and Remote Sensing, with D. Marble and D. Peuquet, in D. Simonett, ed., Manual of Remote Sensing, Second Edition, American Society of Photogrammetry, 1983.

A Pragmatic Approach to Geographic Information System Design, Proceedings of Joint US/Australian Workshop on the Design and Implementation of Geographic Information Systems, International Geographical Union Commission on Geographical Data Sensing and Processing, 1983.

U. S. Geological Survey Circular 895-A, with R. McEwen and B. Ramey Reston, VA, 1983.

1:2,000,000-Scale Maps, with C. Hallam, U. S. Geological Survey Circular 895-D, Reston, V.A., 1983.

The Transition to Automated Production Cartography: Design of the Master Cartographic Database, with D. Marble, *The American Cartographer*, vol. 14 (2), 1987, pp. 105-119.

Methods for Specifying the Requirements for a Geographic Information System, to be submitted for publication to the *International Journal of Geographic Information Systems.*

Daniel A. Griffith

Dr. Griffith is no longer a faculty member at SUNY, Buffalo. His name is inserted here to acknowledge his contributions to earlier drafts of the section on Spatial Statistics in the Research Plan.

Shoshana L. Hardt

Dr. Shoshana Hardt is Assistant Professor of Computer Science at the University at Buffalo (SUNY). She was awarded a Ph.D. in Mathematics in 1980 by the Weizmann Institute of Science, Israel. From 1980 to 1982, she was a postdoctoral fellow at the Yale Artificial Intelligence project. She has been at her current position since 1982. Hardt's primary research interests are modeling common-sense reasoning and learning in the domain of naive physics, and exploring expert behaviors in domains such as psychiatric diagnosis and threat analysis. She has published extensively in these areas and has given numerous international presentations of her research results. Her book "Diffusion in Structured Media" which includes work on formal and intuitive reasoning about flow processes is scheduled for publication by Springer Verlag in 1988.

James William Harrington, Jr.

Dr. James Harrington is Assistant Professor of Geography at the University at Buffalo. Dr. Harrington is an industrial geographer whose research and teaching span the international business and the urban and regional analysis sections of the University's Geography Department. He has also been a regional planner for the Commonwealth of Massachusetts and for King County in Washington State.

Dr. Harrington's doctoral research on locational change in the US semiconductor-device industry has led him to further investigation of the evolution of corporate and business strategies among the companies in an industry, and the relationship between strategy, locational needs, and their impact on the composition and stability of local labor markets. Strategic concepts have also proved useful in the study of foreign direct investment, another of Dr. Harrington's areas of study.

The University's location on the U.S.-Canadian border has led Dr. Harrington to an investigation of border investment dynamics. With Mr. David Barnas, he is currently involved in a study of Canadian investment across New York State. Among his planned projects is an investigation of international producer-service provision among several Great Lakes cities on both sides of the border.

Dr. Harrington has received research funding from the National Science Foundation and from the SUNY Research Foundation. He serves as a Director and Secretary-Treasurer of the AAG's Industrial Geography Specialty Group. He is a corresponding member of the IGU Commission on the International Division of Labour and Regional Development. He has presented research findings at international conferences and workshops, and has been guest lecturer at several U.S. universities.

Selected Publications:

A Comparative View of US Government Subsidy to the Ocean- and Air-transport Industries, *Maritime Policy and Management*, vol. 9, 1982, pp. 23-28.

Corporate Strategy, Business Strategy and Activity Location, *Geoforum*, vol. 16, 1985, pp. 349-356.

Intraindustry Structural Change and Location Change: US Semiconductor Manufacturing, 1958-1980, *Regional Studies*, vol. 19, 1985, pp. 343-352.

Pitfalls and Possibilities of Industrial Geographic Theorizing, *Ontario Geographer*, vol. 25, 1985, pp. 55-66.

Simulating Intraindustry Change, with C. G. Amrhein, *Modeling and Simulation*, vol. 16, 1985.

Learning and Locational. Change in the US Semiconductor Industry. Chapter 6 in J. Rees, ed., *Technology, Regions, and Policy*. New Jersey, Rowman and Littlefield, 1986.

Market-Oriented Foreign Investment and Regional Development: Canadian Companies in Western New York, with K. Burns and M. Cheung, *Economic Geography*, vol. 62, 1986, pp. 155-166.

Technical and Locational Evolution in a Heterogeneous Industry, with C. G. Amrhein, *Papers of the Regional Science Association*, vol. 59, 1986, pp. 13-27.

The Heterogeneity of Industry Change, Competition, and Regional Impacts. in W. H. Berentsen, D. R. Donta, and E. Daroczi, eds., *Regional Development Processes and Policies*, Budapest, Center for Regional Studies, 1987.

Strategy Formulation, Organizational Learning, and Location, Chapter 4 in B. van der Knapp and E. Wever, eds., *Technology and Regional Development*, London, Croom Helm, 1987.

Interregional Location of a Heterogenous Industry Facing Segmented Labor Markets, with C. G. Amrhein, *Regional Studies*, 1987 (forthcoming).

Growth, Location, and Economic Role of Producer Services in Western New York, with J. Lombard, Faculty of Social Sciences Discussion Paper No. 1, State University of New York at Buffalo, 1987.

Foreign-owned Firms and Regional-Functional Specialization, with D. J. Barnas, *Environment and Planning A*, 1988 (forthcoming).

Barry Lentnek

Dr. Barry Lentnek is an Associate Professor of Geography and an Adjunct Professor of Economics at the State University of New York at Buffalo. Professor Lentnek is a specialist in regional economic development in Latin America and in location theory. He has edited two volumes of proceedings on Latin American Geography, written four chapters in other volumes of collected works, published twenty journal articles and presented dozens of papers. Central research themes have included commercial aspects or regional economic development, consumer behavior and economic theories of spatial demand.

Over the years, Dr. Lentnek has worked on projects sponsored by the National Science Foundation (two as principal investigator and project director), the Brazilian Institute of Geography and Statistics and the U. S. Bureau of the Census (International Statistical Cooperation Program), The University of the Andes (at the School of Geography, Merida, Venezuela) and the U. S. Agency for International Development (at the National Fund for Pre-Investment Studies in Quito, Ecuador). Most recently, he is serving as the Chairman of the Regional Economic Policy Advisory Group for the regional planning board of western New York.

Dr. Lentnek has taught courses at the undergraduate level in economic geography, urban geography, micro-economics, and urban economics. At the graduate level, he teaches courses in location theory, urban geography and urban economics.

Selected Publications:

Consumer Behavior in Different Areas, with S. Lieber and I. Sheskin, *Annals of the Association of American Geographers*, vol. 65 (4), 1975.

Commercial Factors in Regional Urban Development: A Mexican Case Study, with M. Charnews and J. Cotter, *Economic Geography*, vol. 54 (4), 1978.

Spatial Choice in Consumer Behavior: Towards a Contextual Theory of Demand, with M. Harwitz and S. C. Narula, *Economic Geography*, vol. 57 (4), 1981.

Do I Have to Go Shopping Again?: A Theory of Choice with Movement Costs in Time and Money, with M. Harwitz and S. C. Narula, *Journal of Urban Economics*, vol. 13. 1983.

Some Implications of National Income Distribution Policies for National Development in a Rapidly Changing Society, edited by Gill-Chin Lim, Princeton University Press, 1983.

Contemporary Issues in Latin American Geography, Proceedings of the Conference of Latin Americanist Geographers, vol. 9, Ball State University Press, Muncie, Indiana, 1983.

A Contextual Analysis of the Journey-to-Shop with Uncertain Prices, with S. C. Narula and M. Harwitz, *Journal of Regional Science*, vol. 27, 1987.

Ross D. MacKinnon

Dr. Ross MacKinnon, Dean of Social Sciences and Professor of Geography at the State University of New York at Buffalo, has a varied background in teaching, research and academic administration. He received his Ph.D. from Northwestern University in 1968. After serving in research and teaching positions at the University of Toronto for nine years, Dr. MacKinnon moved to the University at Buffalo as Professor and Chair of the Department of Geography. Under his leadership, the Department accelerated its drive towards national prominence, and was rated as the "most improved" graduate department in the 1982 CBRAC study. After serving as Chair for five years, Dr. MacKinnon has served as Dean of Social Sciences since 1982. In this capacity, he is responsible for 11 departments as well as for coordinating multidisciplinary initiatives with the other arts and sciences deans and, as appropriate, deans of the full complement of professional schools at UB. Dr. Mackinnon serves as Director of the Buffalo Organized Research Center on Geographic Information and Analysis.

In addition to his long term appointments at Buffalo and Toronto, Dr. MacKinnon has held temporary appointments at Northwestern and at the International Institute for Applied Systems Analysis. Academic awards made to Dr. MacKinnon include the Woodrow Wilson Fellowship and the Canada Council Leave Fellowship. He served as editor of *Geographical Analysis* from 1978 until 1984 and has served on the editorial boards of *Geographical Analysis* and *The Professional Geographer*. He has served as reviewer for the *Annals of the AAG, Economic Geography, Environment and Planning A, The Canadian Geographer*, Kluwer-Nijhoff, McGraw Hill and Addison-Wesley. He is currently Co-Chairman of the International Geographical Union's Working Group on Mathematical Models. In this and other capacities, Dr. MacKinnon has been responsible for organizing a number of national and international symposia.

Dr. MacKinnon's research interests have included transportation network modeling, urban development, dynamic spatial models of migration and job markets and microcomputer simulation models.

Selected Publications:

Dynamic Programming and Geographic Systems, *Economic Geography*, vol. 45, 1970, pp. 350- 366.

Optimal Transportation Networks: A Came Study of Highway Systems, with M. J. Hodgson, *Environment and Planning*, vol. 2, 1970, pp. 267-284.

Aggregative Dynamic Urban Models Oriented Towards Policy, with L. Curry, External Research Report C.75.12, Ministry of State for Urban Affairs, Ottawa, 1974, 419 pp.

Lag Regression Models of the Spatial Spread of Highway Improvements, *Economic Geography*, vol. 50, 1974, pp. 368-374.

Controlling Migration Models of a Markovian Type, *Environment and Planning A*, vol. 7, 1974, pp. 781-792.

Non-Linear Programming Approaches to National Settlement System Planning, with Y. Evtushenko, *Environment and Planning A*, vol. 8, 1976, pp. 637-653.

Exploratory Analyses of the 1955-1971 Austrian Migration Table, with A. M. Skarke, *Regional Studies*, vol. 11, 1977, pp. 99-111.

Optimization Models of Transportation Network Improvement, with G. Barber, *Progress in Human Geography*, vol. I, 1977, pp. 387-412.

Vacancy Chains, Information Filters, and Interregional Migration, with P. Rogerson, *Environmental and Planning A*, vol. 12, 1980, pp. 649-658.

Dynamic Spatial Models, ed. with D. A. Griffith, Alphen aan den Rijn, Netherlands, Sijthoff and Noordhoff, 1981, 443 pp.

Geographical Models of Job Search, Migration and Unemployment, with P. Rogerson, *Papers, Regional Science Association*, vol. 48, 1981, pp. 89-112.

Interregional Migration Models with Interaction and Source Information, with P. Rogerson, *Environment and Planning A*, vol. 14, 1982, pp. 445-454.

An Elementary Simulation Model of the Job Matching Process within a Interregional Setting, with C. Amrhein, *Regional Studies*, vol. 19, 1984, pp. 193-202.

Toward a Behavioral Model of a Spatial Labor Market, with C. Amrhein, in D. Griffith and R. Haining eds., *Transformation Through Space And Time*, The Hague, Martinus Nijhoff, 1986, pp. 247-272.

A Micro-Simulation Model of a Spatial Labor Market, with C. Amrhein, *Annals of the Association of American Geographers*, forthcoming.

David M. Mark

Dr. David Mark received the degrees of B. A. (1970) and Ph.D. (1977) from Simon Fraser University, and M. A. (1974) from the University of British Columbia.

All of these degrees were in Geography. Between 1978 and 1981, he was Assistant Professor of Geography at the University of Western Ontario. Since 1981, Dr. Mark has been a member of the Department of Geography at the State University of New York at Buffalo, where he holds the rank of Professor. In 1983, he spent six weeks as a Visiting Scientist at the CSIRO Division of Computing Research in Canberra and Townsville, Australia.

Dr. Mark's current research interests include cognitive science, human navigation, artificial intelligence, quadtrees, digital elevation models, geographic information systems, and theoretical geomorphology. He is currently conducting research on strategies for ordering two-dimensional space, with support from the National Science Foundation. He is also addressing questions of spatial relations in natural language, and on the representation of cartographic lines.

Dr. Mark is the Vice-Chair/Chair-elect of the Geographic Information Systems Specialty Group of the Association of American Geographers, and Chairman of the Cartographic Technology Interest Group, Canadian Cartographic Association; he also has been proposed as Deputy Chair of a Working Group on Land Vehicle Navigation Systems, to be established under the International Cartographic Association's Commission on Advanced Technology. He is currently a member of the Biological Facilities Centers program panel of the National Science Foundation, and also of the editorial boards of *Geographical Analysis* and of *The American Cartographer*.

Selected Publications:

Phenomenon-based Data-structuring and Digital Terrain Modeling. *Geoprocessing*, vol. 1, 1979, pp. 27-36.

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James E. McConnell

Dr. James McConnell is a Professor and the Chairman in the Department of Geography at the State University of New York at Buffalo and Director of the International Trade Concentration (ITC). His area of research and teaching are international business, industrial location, and regional growth and development. His publications include research on export development for small and medium-sized manufacturing companies, international trade and industry policy, Canadian-American trade and investment transactions and policy, foreign ownership and trade of U.S. high-technology manufacturing, the adjustment behavior of firms in import-impacted industries, and the locational strategies of foreign-owned subsidiaries in the United States.

External financial support for Dr. McConnell's research has been received from the New York State Institute for Public Policy Alternatives, the National Oceanic and Atmospheric Administration of the U.S. Department of Commerce, the National Science Foundation, the Economic Development Administration, and the Secretary's Office of the U.S. Department of Commerce. Since Geography's ITC program was created in 1974, he has supervised over 60 graduate students, most of whom have gone on to establish international careers in government, industry, and academia.

Selected publications:

The Export Decision: An Empirical Study of Firm Behavior, *Economic Geography*, vol. 55 ,1979, pp. 171-183.

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Geography of International Trade, *Progress in Human Geography*, vol. 10, 1986, pp. 471-483.

Russ Miller

Dr. Russ Miller, Assistant Professor of Computer Science at the State University of New York at Buffalo, received his Ph.D. (1985) in Computer Science from the Department of Mathematical Sciences at the State University of New York at Binghamton. He is interested in developing parallel algorithms and architectures to solve problems from fields such as image processing, computational geometry, graph theory, and data structures. Dr. Miller has published extensively in the field of parallel computing. He has been awarded the Best Presentation Award at the 1987 International Conference on Parallel Processing, and is publishing a book, *Parallel Algorithms for Regular Architectures*, with The MIT Press in 1988.

James R. Pomerantz

Dr. James R. Pomerantz, Professor and Chair of Psychology at the State University of New York at Buffalo, received his Ph.D. (1974) from Yale University. Research interests include human image interpretation (including shape, color, texture, motion and depth perception), computational vision, and multidimensional graphical communication. Dr. Pomerantz is on the editorial board of the *Journal of Experimental Psychology* (both *General* and *Human Perception*

and Performance) as well as on the Basic Behavioral Processes review panel at the National Institute of Mental Health. His research has been supported by NSF, NIMH and the Air Force.

William J. Rapaport

William J. Rapaport is Assistant Professor of Computer Science, Associate Director of the SNePS Research Group, co-director of the Graduate Group in Cognitive Science, and Interim Director of the Graduate Studies and Research Initiative in Cognitive and Linguistic Sciences at SUNY Buffalo. He received a Ph. D. in Philosophy from Indiana University in 1976, and was an Associate Professor of Philosophy at SUNY Fredonia before receiving an M. S. in computer science and joining the Buffalo faculty.

Dr. Rapaport's research interests are in cognitive science, knowledge representation, and computational linguistics. He is a member of the American Association for Artificial Intelligence, the American Philosophical Association, the Association for Computational Linguistics, the Association for Computing Machinery, the Association for Symbolic Logic, and the Cognitive Science Society, among others. He is on the editorial boards of the journals *Computational Linguistics* and *Computers and Translation*, and of the D. Reidel book series "Studies in Cognitive Systems".

Dr. Rapaport has received grants and fellowships from NSF, NEH, and the Research Foundation of SUNY, for interdisciplinary work on cognitive and computer systems for the conceptual space-time understanding of narrative text, the logical foundations of belief representation, and natural-language semantics.

Selected Publications:

How to Make the World Fit Our Language: An Essay in Meinongian Semantics, *Grazer Philosophische Studien*, vol. 14, 1981, pp. 1-21.

Unsolvable Problems and Philosophical Progress, 1982 Prize Essay, *American Philosophical Quarterly*, vol. 19, 1982, pp. 289-98.

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Peter A. Rogerson

Dr. Peter A. Rogerson, Associate Professor of Geography at the State University of New York at Buffalo, has published widely in the field of spatial analysis.

Dr. Rogerson's area of expertise is the analysis and forecasting of demographic-economic changes at the national, interregional, and metropolitan levels. His research has applications in decision making for both the public and private sectors: urban planning, public facility location, and the distribution of government funds among different locations, as well as the location, job expansion, and marketing strategies of private firms and industries. Dr. Rogerson's research requires competence in diverse disciplines, including geography, demography, mathematics and statistics, economics, and the planning of urban systems. He combines strength in quantitative methods and mathematical models with depth in empirical applications.

Dr. Rogerson is a recipient of the National Science Foundation's Presidential Young Investigator Award. In addition, he has been recognized for his achievements by three separate disciplines. He received the Dorothy S. Thomas Award from the Population Association of America in 1982, the Dissertation Competition Award from the Regional Science Association in 1982, and the Warren J. Nystrom Award from the Association of American Geographers in 1983.

Dr. Rogerson is currently coeditor of the *Papers of the Regional Science Association*, and is on the editorial board of the *International Regional Science Review*. He also serves as a reviewer for *Geographical Analysis*, *Environment and Planning A*, *Journal of Regional Science*, *Regional Studies*, *the Annals of the Association of American Geographers* and *The Professional Geographer*.

Selected Publications:

A Geographical Model of Job Search, Migration, and Unemployment, with Ross MacKinnon, *Papers of the Regional Science Association*, vol. 48,1981, pp. 89-102.

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Changes in U. S. Mobility Levels, *The Professional Geographer*, vol. 39, 1987, pp. 344-51.

Probabilities of Choosing the nth Best in the Secretary Problem, *Journal of Applied Probability*, vol. 24, 1987, pp. 527-533.

Stuart C. Shapiro

Dr. Stuart Shapiro, Professor and the Chair in the Department of Computer Science at the State University of New York at Buffalo, received his undergraduate degree in Mathematics from the Massachusetts Institute of Technology (1966), and his Master's (1968) and Ph. D. (1971) degrees in Computer Sciences from University of Wisconsin.

Dr. Shapiro's research themes are artificial intelligence and related subjects such as cognitive science, computational linguistics, knowledge representation, semantic networks, natural language understanding and generation, expert systems for medical diagnosis and maintenance.

Currently, Dr. Shapiro is involved in the NSF research program on "Cognitive and Computer Systems for Understanding Narrative Text" (NSF: 1ST-8610517). He is also one of the co-principal investigators of the project under the Northeast Artificial Intelligence Consortium (NAIC). The project is research on a Versatile Maintenance Expert System for digital circuits. Dr. Shapiro is a also a member of the planning committee and steering committee of the Graduate Studies and Research Initiative in Cognitive and Linguistic Sciences.

Selected Publications:

A Net Structure Based Relational Question Answerer: Description and Examples, with G. H. Woodmansee, *Proceedings of the International Joint Conference on Artificial Intelligence*, Morgan Kaufmann, Inc., Los Altos, CA, 1969, pp. 325-346.

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SNePS Considered an a Fully Intensional Propositional Semantic Network, with W. J. Rapaport, in G. McCalla and N. Cercone, eds., *The Knowledge Frontier: Essays in the Repreaentation of Knowledge*, Springer-Verlag, New York, 1987, pp. 262-315.

A Model for Belief Revision, with J. P. Martins, *Artificial Intelligence*, in press.

David Sher

Dr. David Sher is an assistant professor at the State University of New York at Buffalo. He is expert at applying decision theory to perception problems. He has published papers on edge detection, evidence combination, and estimation. Work is currently in progress on applying Markov Random field models to edge and object detection. David Sher's thesis, completed at the University of Rochester, is entitled "A Probabilistic Approach to Low Level Computer Vision." He successfully defended his thesis in July 1987.

Sargur N. Srihari

Dr. Sargur N. Srihari is Professor and Acting Chairman of the Department of Computer Science, SUNY at Buffalo. He did graduate work at the Ohio State University in Columbus, completing his a Ph.D. in 1976 with a dissertation on the topic of Statistical Pattern Recognition. Dr. Srihari currently is directing several research projects in AI and Pattern Recognition, more specifically involving diagnostic expert systems, blackboard control, and topics in pattern recognition. Recently-completed projects include *Contextual algorithms for text recognition, Advanced character recognition,* and *Advanced address block location*. In 1987, Dr. Srihari presented a paper on "Spatial Knowledge Representation" at the Institute of Mathematics School of Information, in Novosibirsk (Novosibirsk), USSR. He received a best paper award at the Seventh International Workshop on Expert Systems held in Avignon, France in 1986. Dr. Srihari has published papers in the IEEE Transaction on Pattern Analysis and Machine Intelligence, Journal of Artificial Intelligence, and the Artificial Intelligence magazine (published by AAAI). He is a member of the American Association of Artificial Intelligence and is listed in Who's Who in Artificial Intelligence.

Deborah Walters

Dr. Deborah Walters is an Assistant Professor of Computer Science, at the State University of New York at Buffalo. She received her B. S. degree (1973) in Mathematics and Physics (double major) from Guilford College, and her M. Sc. (1977) and Ph. D. (1979) in Neurocommunications from the University of Birmingham, England.

Deborah Walters has had fifteen years of experience in computer vision, medical image processing and communications theory. She has over forty scientific publications in these areas, and has delivered over 50 presentations at technical conferences and universities. Dr. Walters has participated in vision research projects sponsored by. DRPA Image Understanding, and has procured and administered eleven scientific grants from NSF, AFOSR, NIH, and other such agencies.

Dr. Walters' research has included the development of interactive military target detection algorithms for use on vidicon and SAR images which are severely degraded by noise, leading to a patented intensity modulation technique. In the field of medical image processing, Dr. Walters developed image analysis techniques for pulsed Doppler ultrasound data from transcutaneous noninvasive detectors of blood flow.

Dr. Walters currently manages a computer vision research lab of 14 members. Current projects include an NSF Information Science and Technology grant to study the selection of image features for low level computer vision modules; a project dealing with low level image processing in connectionist networks; a project applying general-purpose computer vision algorithms to color separation; and the development of new representations for edge data.

Two aspects of Dr. Walters' research are applicable to problems in GIS. First, research which explores visual perception in humans aide in the design of efficient techniques for communicating GIS information in visual media. Secondly, research to develop computer vision algorithms for the perception of boundary images consistent with the known neurophysiology and psychophysics of the human visual system, is of value in creating systems capable of automatically digitizing and vectorizing maps, especially hand-drawn maps and technical drawings.

Selected Publications:

The Use of Natural constraints in Image Segmentation, Proceedings of the International Society for Optical Engineering Applications of Artificial Intelligence, II, vol. 548, 1985, pp. 27-34.

A Computer Vision Model Based on Psychophysical Experiments, in H. C. Nusbaum. eds., *Pattern Recognition by Humans and Machines*, Academic Press, 1986, pp. 88-120.

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The Representation of Variables in Connectionist Networks, Proceedings of First International Conference on Computer Vision, June 1987, pp. 698-702.

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Perceptual Significance Hierarchy: A Computer Vision Theory for Color Separation, with G. Krishnan, Proceedings of the American Association of Artificial Intelligence, July 1987, pp. 767-771.

Biological vs. Artificial Representations of Variables in Fine-Grain Parallel Systems, Proceedings of the IEEE Computer Vision Workshop, pp. 298-300, 1987.

The Syntax and Semantics of Contours, Proceedings of the IEEE Asilomar Conference of Signals, Systems and Computers, November 1987.

Michael J. Woldenberg

Dr. Michael Woldenberg is an Associate Professor of Geography at the State University of New York at Buffalo. He received the B. S. and M. S. degrees in Geology in 1956 and 1957 from the University of Wisconsin at Madison, and the Ph.D. in Geography from Columbia University in 1968.

From 1967 to 1972, Dr. Woldenberg was a research associate at the Laboratory for Computer Graphics and Spatial Analysis at Harvard University, one of the first places to synthesize computer graphics and spatial analysis. Several references listed below summarize salient features of Woldenberg's work there. In one area of direct relevance to computer mapping, he created a currently used typology for defining varieties of junctions and of ridges and course lines at peaks, passes, pales, and pits. From 1972 to 1975 (his arrival at Buffalo in 1972), Dr. Woldenberg was a member of the Department of City and Regional Planning at Harvard.

Dr. Woldenberg's research centers on hierarchical spatial systems, primarily in tree-like structures. He pioneered the application of geographical techniques of spatial analysis to anatomy, introducing both the widely used Strahler order system of stream morphometry and central place theory from economic geography to the description and explanation of the hierarchical structure of arteries and airways and brain cells. He also introduced the Weber model of factory location as a tool in evaluating the optimality principle governing the location of blood-vessel and airway junctions. He is currently involved in research on global optimality in arteries and airways. In addition to continuing this work, he is collaborating with others in using stream network analysis to understand the growth and decline of river and brain-cell trees.

In addition to being supported by ONR and NSF grants to the Harvard Laboratory for Computer Graphics and Spatial Analysis, Dr. Woldenberg has received several grants from Harvard, the American Philosophical Society, SUNY at Buffalo (two) and NATO (three).

Selected Publications:

Concepts and Applications-Spatial Order, with W. Warntz, Harvard Papers in Theoretical Geography, No. 1, 1967, pp. 95-189, (AD 653464).

Spatial Order in Fluvial Systems: Horton's Laws Derived from Mixed Hexagonal Hierarchies of Drainage Basin Areas, *Geological Society of American Bulletin*, vol. 80, 1969, pp. 97-112.

Law and Order in the Human Lung, with G. Cumming, K. Horsfield, K. Harding, K. Prowse and S. Singhal, Harvard Papers in Theoretical Geography, No. 41, 1970, 58 pp. (AD 709602).

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A Generalization of the Optimal Models of Arterial Branching, with A. G. Roy, *Bulletin of Mathematical Biology*, vol. 44, 1982, pp. 349-360.

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Relation of Branching Angles to Optimality for Four Cost Principles, with K. Horsfield, *Journal of Theoretical Biology*, vol. 122, 1986, pp. 187-204.

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David A. Zubin

Dr. David Zubin is Associate Professor of Linguistics, Co-Principal Investigator on the Cognitive Science "Deictic Center" project, and a former Director of the Cognitive Science Graduate Group at the State University of New York at Buffalo. As a Linguist and Psycholinguist, Professor Zubin has a strong background in Cognitive Linguistics, with a focus on the mapping between cognitive representation of space in language. His interests in spatial representation have led him to interact with Geographers on such topics as mental maps, spatial and geographic descriptions, the use of language in navigation, and reference frame problems.

In addition to his spatial/geographic interests in language structure, Dr. Zubin has published in a number of areas, including grammatical case theory, grammatical gender, and grammatical cohesion in discourse.

Selected Publications:

Perceptual Schemata in the Spatial Lexicon: A Cross-Linguistic Study, with S. Svorou, in D. Testen, V. Mishra, and J. Drogo, eds., *Lexical Semantics*, Chicago, Chicago Linguistic Society, 1984, pp. 346-358.

Orientation and Gestalt: Conceptual Organizing Principles in the Lexicalization of Space, with S. Chei, in D. Testen, V. Mishra and J. Drogo eds., *Lexical Semantics*, Chicago, Chicago Linguistic Society, 1984, pp. 333- 345.

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Ezra Zubrow

Dr. Ezra Zubrow is an Associate Professor of Anthropology at the State University of New York at Buffalo. He is Director of the Anthropology Geographic Information Systems Laboratory and of the Northeastern Anthropological Laboratory and Co-coordinator of the Archaeometry Research Group. He is a member of two international commissions and of the editorial board of two major anthropological journals, and is the author and editor of more than forty publications. Previous research has involved remote sensing for the estimation of small and inaccessible populations, as well as anthropological and archaeological work in the Philippines, Scandinavia, Mexico and the Southwestern United States. A GIS data base has been constructed for parts of the Philippines including most of the province of Sorsogon. Most of his work develops analytical or quantitative models for estimating the changing size and structure of small populations. At present he is using GIS to provide a spatial dimension for his demographic models. In addition, he is exploring the use of GIS at microscopic levels of resolution. This research is being done in cooperation with the Faculty of Engineering's Scanning Electron Microscopy facility, as well as with their Real Time Image Processing Laboratory. A secondary research interest has been the application of pattern analysis to the evolution of settlement systems.

Dr. Zubrow teaches a series of courses which consider the spatial implications of demographic phenomena. During the spring semester she and Dr. Hugh Calkins will begin teaching courses in GIS applications.

Selected Publications:

Population, Climate and Contact in the New Mexican Pueblos, University of Arizona Anthropological Papers No. 24, University of Arizona Press, Tucson, AZ, 1974.

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Spatial Relativism and Perception: The Site Distribution of Western New York,.ul Ontario Archaeology, vol. 38, 1982, pp. 51-68.

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An Interactive Growth Model Applied to the Expansion of Upper Paleolithic Populations in *The Pleistocene Perspective*, vol. 1, 1985, Allen & Unwin-World Anthropological Conference Proceedings.

The Problem of Patterns: A Frontier in Archeological Methodology, *American Archeology*, vol 5(l), 1985, pp. 2-4.

Fractals, Cultural Behavior, and Prehistory, *American Archeology*, vol. 5(l), 1985, pp. 63-76.

The Use of Computer Aided Geographic Information Systems for the Solution of Archaeological Problems, I Conferencia. Latinoamericana Sobre Informatica en Geografia, International Geographic Union and the Editorial Universidad Estatal a Distancia, San Jose. Costa Rica, pp. 647-676, 1987.

B5. The University of Maine, Surveying Engineering Group

The Surveying Engineering Program, housed in the Department of Civil Engineering but conceived as a completely independent four year program was initiated in 1977. It was designed as a four year, high quality academic program, leading to a B. Sc. in surveying engineering, and has been accredited by the accreditation board of engineering and technology (ABET) as a full engineering program (one of five in the U. S.). It introduces a student into the mathematical, technical, and social aspects of surveying and mapping. It stresses the interdisciplinary effort needed to collect and assess relevant information useful for land resource decisions. We maintain high intellectual standards and graduates from the program are in high demand with large private surveying companies and government agencies; they typically are quickly promoted to leadership positions.

The program was designed as a 'Center of Excellence in Land Information Studies' by the Land Information Institute under the condition that a Ph. D. program is formalized (expected for 1988). The concept of understanding land related information and spatial information systems as a central aspect of surveying, has attracted the attention of the most successful surveying programs in other countries (University of New Brunswick, University of Calgary, University of Melbourne, etc.) and faculty members from traditional parts of surveying engineering (photogrammetry, adjustment calculation, etc.) An agreement to formalize cooperation between the Surveying Engineering Group at the University of New Brunswick, Universite' de Laval (Quebec), and the University of Maine is under preparation. A student exchange program with the surveying and photogrammetry program at the University of Hanover (Federal Republic of Germany) is also close to signing.

The Surveying Engineering Program was designed as a program of national prominence for the University of Maine and has since received additional funds for operating expenses and seen an increase in faculty positions. The Surveying Engineering Group, though not yet formally organized as a separate department, manages its own budget. The faculty of the Surveying Engineering Program increased from four to seven FTE in 1987, by adding three young, but already experienced faculty; one a lawyer with a surveying engineering undergraduate degree, one a mathematician with experience in digital image processing and remote sensing, and the other a photogrammetrist. We have also attracted a recent Ph. D. in land resources with research interests in computer mapping.

The Surveying Engineering Group has always promoted interdisciplinary work and has formed a strong coherent research and teaching group, integrating specialists from different disciplines. In addition to the members mentioned above, a geodesist, a surveying engineer with a strong interest in computer science and another lawyer, with interests in economics and social science round out the team. A large number of recent research proposals have included faculty from other disciplines (economics, anthropology, and geology). One faculty member has an additional adjunct appointment with the computer science department. The interdisciplinary nature of the program is embedded in a strongly focussed design which is shown in the table and illustration on the following two pages.

The graduate program is rapidly gaining momentum. Five years after the first graduate student was accepted, we have 12 graduate students (6 M. Sc. and 6 Ph. D.). Students come from the U. S., Canada, Australia, Central Europe, and Asia.

The Group has published in a wide array of journals and conference proceedings. Members of the faculty are often invited by professional organizations, universities, and industry for presentations on various aspects of GIS.

Members of faculty are current or past editors of the two surveying journals: the American Society of Civil Engineering's *Surveying Engineering*, and the American Congress on Surveying and Mapping's *Surveying and Mapping*, and have acted as consultants to Plan Graphics Inc., and Digital Equipment Corporation.

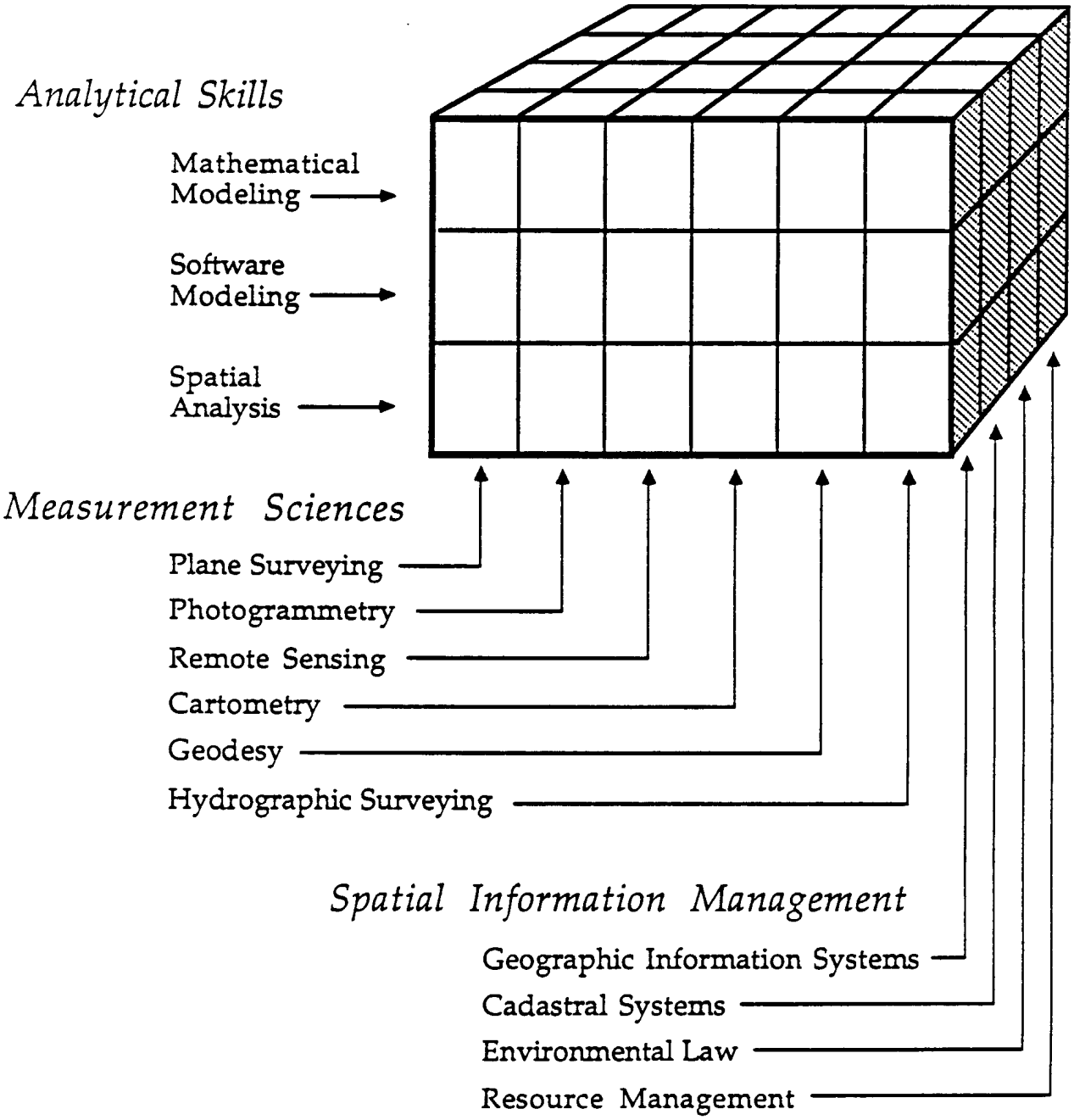
Members of the Surveying Engineering Group are often asked to review manuscripts for journals as well as proposals for the National Science Foundation. One faculty member is currently on the program committee for the Third International Symposium on spatial data handing. Faculty members have organized national conferences and advanced workshops and there is a regular summer workshop in advances in GIS technology organized in cooperation with the Universities of New Brunswick and Laval.

THE UNIVERSITY OF MAINE
ORONO
DEPARTMENT OF SURVEYING ENGINEERING
EXISTING FACULTY FTE
1988 - 1990

Departmental Interests															
Actual FTE	*Faculty*	*Measurement Sciences*						*Analytical Skills*			*Spatial Information Management*				
		Plane Surveying	Photogrammetry	Remote Sensing	Cartometry	Geodesy	Hydrographic Surveying	Mathematical Modeling	Software Engineering	Spatial Analysis	Geographic Information Systems	Cadastral Systems	Environmental Law	Resource Management	
1	A. Frank	*	*		X			X	X	*	X				
1	E. Epstein									X	X	X	X		
1	H. Onsrud	X	*							X	*	X	X	X	
1	K. Beard				X			X	*	*	X	*X			
1	A. Leick	*				X	*	X	X	*	*				
1	R. Hintz	X	X	*		*		X	X	*	*	*			
1	M. Ehlers		*	X				X	X	X	X		*		
1	C. Mundo						X	X	X		*				
	X	2	1	1	2	1	1	6	5	3	4	2	2	2	
	*	2	3	1		1	1		1	4	4	1		1	
$\sum$ 8		4	4	2	2	2	2	6	6	7	8	3	2	3	

Key: X represents major interest.
* represents minor interest.

University of Maine
Orono
Department of Surveying Engineering



B6. Individual Vitae for Center Participants from Surveying Engineering and Cooperating Departments

Renato Barrera

Renato Barrera is Director of the Computer Aided Network and a Technical Support Person for the College of Engineering at the University of Maine. Mr. Barrera received an undergraduate degree in Mechanical/Electrical Engineering from the Instituto Tecnologico de Monterrey (Mexico) and a Master's and Ph.D. from the Massachusetts Institute of Technology (NUT). After completing his degrees, Mr. Barrera was an assistant professor in the School of Engineering, University of Mexico, where he worked on developing a simulator for hydroelectric systems. He was employed for several years at the Institute for Applied Mathematics and Systems at the National University of Mexico, where he worked on data bases, airport simulation, satellite image distortion and computer network design. Most recently, he has been a consultant to the Government of Mexico on implementation of a geographical data base system. Most recently he has been employed as designer and software leader for the Mexican microwave network under the Ministry of Communications. His current research interests are in computational geometry and include digital terrain models and navigation on polyhedral surfaces. Mr. Barrera is co-founder of the Mexican Association of Automatic Control and founding member of the National Academy of Engineering, Mexico. He is also a member of ACM and IEEE Computer Society.

Selected Publications:

Compression Methods for Terrain Relief, with A. Hinojosa, *International Colloquium in Progress in Terrain Modeling*, Copenhagen, May 20-22, 1987.

Data Structure Support for a Geographic Database System, with A. Saboya, *Proceedings of the Third CAPAIDM Workshop*, Miami, Florida, November 1985, pp. 359-365.

A Hierarchical Method for Representing Terrain Relief, with A. M. Vazquez, *Ninth Pecora Conference Proceedings*, 1984, pp. 87-93.

Design of a High Level Language (L) for Image Processing, with T. Radhkrishnan, A. Guzman, and A. Jinich, in J. B. Duff and S. Levialdi, eds., *Languages and Architectures for Image Processing*, Academic Press, 1981.

Schema Definition and Query Language for a Geographical Database System, with A. Buchmann, *Proceedings of the CAPAIDM Workshop*, IEEE, Hot Springs, VA, November 1981**.**

An Architecture for Geographical Database Systems, with T. Radhkrishnan and A. Buchmann, *Proceedings of Informatics 91*, New Delhi, India, February 1981.

An Information System and a Model for the Mexican Construction Industry, with C. Carvajal, *Memorias del Congreso de la Industria de la Construccion*, Monterrey, NL, Mexico, 1975.

Kate Beard

Dr. Kate Beard is Assistant Professor in Surveying Engineering at the University of Maine. She holds a M. S. and Ph.D. (1987) from the Institute for Environmental Studies, Land Resource Program, University of Wisconsin-Madison. Her dissertation focused on automated generation of multiple representations from a single detailed database and the reduction of errors in this process.

As a research assistant at University of Wisconsin, she worked on the Dane County Land Records Project, a cooperative project between federal, state, and local agencies and the University to modernize, integrate and analyze land records held by several different agencies in order to develop a soil erosion control plan, determine farmland conservation reserve eligibility, and perform land valuation for tax assessment. Dr. Beard also served as research assistant on a research contract from the National Ocean Service to develop Nautical Chart Accuracy Standards. Her work on this project involved examination of errors due to scale reduction and generalization in nautical chart production.

Her research interests cover applications of GIS, spatial distribution of environmental variables, map error, and computer cartography. She teaches courses on use of GIS for engineering and environmental applications. She is a member of the ACSM and URISA.

Selected Publications:

Data Descriptions for Automated Generalization, *Proceedings of the International Geographic Information Systems Symposium (IGIS)*, Crystal City, VA, November, 1987, in press.

Zipping: A Localized Approach to Edge-Matching, with N. R. Chrisman, to appear in *American Cartographer*.

How to Survive on a Single Detailed Database, *AUTO-CARTO 8*, Baltimore, MD, 1987, pp. 211-220.

Integrating Data for Local Resource Planning: A Case Study of Sand and Gravel Resources, with N. R. Chrisman and T. D. Patterson, in *Geographic Information Systems: A Survey*, American Society for Photogrammetry and Remote Sensing, 1987.

National Charting Quality Standards, with N. R. Chrisman and R. Gurda, Report for National Ocean Service, National Oceanographic and Atmospheric Administration, United States Department of Commerce, Washington, D. C., 1986.

Potentials and Pitfalls of an Automated Overlay Process for Resource Planning, in *Papers from Seminar III on the Multipurpose Cadastre: Modernizing Land Information Systems in North America*, Institute for Environmental Studies, Madison, Wisconsin, 1985.

Multipurpose Land Information Systems: Institutional Innovation, Technological Trends, Implications for Landscape Architecture Education, with J. G. Sullivan, J. Sonza-Novera, N. R. Chrisman and B. J. Niemann, *Proceedings of the Annual Conference of Educators in Landscape Architecture*, Urbana, Illinois, 1984, pp. 10-13.

Some Speculation on the Development and Implementation of a Multipurpose Land Information System to Improve Routine and Non-Routine Functions in State Agencies, in *Papers from Seminar II on the Multipurpose Cada8tre: Modernizing Land Information Systems in North America*, Institute for Environmental Studies, Madison, Wisconsin, 1984.

Thomas B. Brann

Dr. Thomas Brann is Associate Professor of Forest Engineering in the College of Forest Resources at the University of Maine. He received both his B. S. and M. S. in Forest Management from the University of New Hampshire and his Ph.D. in Forest Biometrics in 1969 from the Virginia Polytechnic Institute and State University. He received both his M. S. and B. S. in Forest Management from the University of New Hampshire. Dr. Brann created and manages the Resource Information Management and Statistical Analysis Laboratory (Graphics Lab) at the University of Maine.

Dr. Brann has been involved in a variety of research projects using the GIS he developed for the Graphics Lab. These projects include the digitization of the coast of the Peoples Republic of China and comparing it to the coast in the Gulf of Maine and a major mapping project for the Maine Department of Conservation's spruce budworm research.

Dr. Brann's current research interests lie in forest inventory, growth and yield of forest stands, applications of computer science to forestry problems, modeling forest population dynamics and field practices in forest inventory. He teaches courses in forest biometrics and forest engineering.

Selected Publications:

MAPMAKER: Interactive Map Design Software (User's Manual), with D. Erker, Maine Agricultural Experiment Station Miscellaneous Publication #693, 1986.

A Database Management System for Maine's 1980 USFS Forest Survey Data, (User's Manual), with T. Newcomb, Maine Agricultural Experiment Station Miscellaneous Publication #690.1986.

Computer Assisted Mapped Data Analysis for the Assessment of Taxes to Support Spruce Budworm Suppression Activities, with D. Hankinson and J. Morin, Paper presented at the In-Place Resource Inventories Principles and Practices National Workshop, Society of American Foresters, 1981.

Forest Devastation Mapping and Computer Planning of Optimal Strategies, with W. Phillips and T. Corcoran, Paper presented to the Summer Meeting of the Canadian and American Society of Agricultural Engineering, 1979.

Forest Resource Data Base Mapping and the Optimization of Wood Flow Eventualities, with W. Phillips and T. Corcoran, Paper presented at the Conference of the International Federation of Automatic Control, Varna, Bulgaria, 1979.

Optimum Road and Transport Planning for Forests Under Insect Attack, with W. Phillips and T. Corcoran, *Transactions of ASAE*, vol. 24 (2), 1979.

Thomas D. Duchesneau

Dr. Thomas Duchesneau is Chair and Professor of the Department of Economics at the University of Maine. He received his A. B. from St. Anselm's College and his Ph.D. in 1969 from Boston College. His major areas of interest lie in industrial organization, economics of technological change and microeconomic theory.

Dr. Duchesneau worked as a Policy Analyst for the Division of Policy Research and Analysis of the National Science Foundation from 1977 to 1978 and served as a consultant to them for the following three years. He has worked with the Surveying Engineering Program at the University of Maine on a NOAA grant, 'Use and Value of Spatial Information' and a Federal Geodetic Control Committee grant, 'Use and Value of Geodetic Information'. His current research includes a study estimating the value of information for public good and another on innovation processes and technological change.

Dr. Duchesneau is a peer reviewer for Journal of Industrial Economics, a member of peer review panels for NSF (Science and Technology) and the Small Business Administration. He is a member of the Executive Committee of the Maine State Health Coordinating Council, and a Staff Economist and consultant for the Bureau of Economics of the Federal Trade Commission, Washington, D. C.

Selected Publications:

The Use and Value of a Geodetic Reference System, with E. Epstein, Federal Geodetic Control Committee, Washington D. C., April 1984.

The Innovation Performance of the U.S. Economy: Conceptual Issues and Evidence, Papers Commissioned as Background for Science Indicators- 1980, Volume IV The Measurement of Industrial Innovation, The National Science Foundation, Washington, DC, August 1980**.**

The Meaning and Significance of Seller Concentration in the Coal Industry, prepared for the U.S. Department of Energy by CRA Inc., Boston, Massachusetts, February, 1980.

A Study of Innovation in Manufacturing - Determinants, Processes, and Methodological Issues: Vol. 1 A Panel Study of the Determinants of Innovation in the U.S. Footwear Industry, with S. Cohn and J. Dutton, The Social Science Research Institute, Orono, Maine, December 1979.

A Study of Innovation in Manufacturing - Determinants, Processes, and Methodological Issues: Vol. lEl Cam Studies of Innovation Decision Making in the U.S. Footwear Industry, with S. Cohn and J. Dutton, The Social Science Research Institute, Orono, Maine, December 1979.

Competition in the U.S. Energy Industry, Cambridge, Ballinger Publishing, 1975.

Energy Industries Structure, in Hans H. Lanserg, ed., *Energy and the Social Sciences: An Examination of Research Needs*, Resources for the Future Inc., Washington, DC, July 1974.

Barriers to Entry and the Stability of Market Structures: A Note, *Journal of Industrial Economics*, June 1974.

The Costs of Pollution Abatement, with Savage et al, in *Economics of Environmental Improvement*, Boston, Houghton Miflin Co., 1974.

Nonmnarket Solutions to Environmental Problems, with Savage et al, in *Economics of Environmental Improvement*, Boston, Houghton Miffin Co., 1974.

The Critical Level of Concentration: An Empirical Analysis, with James W. Meehan Jr., *Journal of Industrial Economics*, November 1973.

Interfuel Substitutability in the Electric Utility Sector of the U.S. Economy, Staff Report to the Federal Trade Commission, Washingon, D. C., U.S. Government Printing Office, 1972.

Manfred Ehlers

Dr. Manfred Ehlers is Associate Professor of Surveying Engineering at the University of Maine. He received a B. Sc. from the University of Marburg, a M. Sc. in mathematics from the University of Kiel, and a Ph.D. in

photogrammetry, remote sensing and digital image processing (1983), Summa. Cum Laude, from the University of Hanover, Federal Republic of Germany. His dissertation was entitled *Investigation of Digital Correlation Techniques for the Rectification of Remote Sensing Imagery*.

Dr. Ehlers was a research associate and assistant research scientist, including co-principal investigator on shuttle imagery radar projects, at the University of Georgia from 1984 to 1987. In addition, he has worked on projects for the Jet Propulsion Lab, NASA, SPOT Image Corporation and Bell South. He was co-recipient of a fellowship award from Control Data Corporation for a project on 'Parallel Computing for Mapping Applications' and is a member of the American Society for Photogrammetry and Remote Sensing, German Society for Photogrammetry and Remote Sensing, German Association for Surveys, Institute of Electrical and Electronic Engineers and the Remote Sensing Society.

Dr. Ehlers research interests cover a wide range of topics including advanced techniques for image processing and pattern recognition, quantitative remote sensing, digital photogrammetry, GIS and data fusion concepts.

Dr. Ehlers has teaching experience in digital image processing and numerical methods in geodesy. He will teach courses in digital image processing and digital photogrammetry.

Selected Publications:

Stereocorrelation of Landsat TM Images, with R. Welch, submitted *to Photogrammetric Engineering and Remote Sensing*.

Merging Multiresolution SPOT HRV and Landsat TM Data, with R. Welch, *Photogrammetric Engineering and Remote Sensing*, vol. 53 (3), 1987, pp. 301-303.

Comparative Evaluations of the Geodetic Accuracy and Cartographic Potential of Landsat-4/-5 TM Image Data, with R. Welch and T. R. Jordan, *Photogrammetric Engineering and Remote Sensing*, vol. 51 (9), 1985, pp. 1249-1262.

The Effects of Image Noise on Digital Correlation Probability, *Photogrammetric Engineering and Remote Sensing*, vol. 51 (3), 1985, pp. 357-365.

Satellite Remote Sensing Data as Input to Geographic Information Systems, with R. Welch, *Proceedings of the Eleventh International Symposium on Machine Processing of Remotely Sensed Data*, Purdue University, West Lafayette, Indiana, 1985, p. 219.

Digital Image Processing Techniques for Deriving Terrain Coordinates from Satellite Image Data, with R. Welch, *Technical Papers, Fifty-first Annual Meeting of the ASPRS*, vol. II, Washington, D. C., 1985, p. 875.

Comparative Evaluations of the Geodetic Accuracy and Cartographic Potential of Landsat-4/-5 TM Image Data, with R. Welch and T. R. Jordan, /fITechnical Papers, 1985 ACSM-ASPRS Fall Convention, Indianapolis, Indiana, pp. 874-875.

SIR-B Image Data for Cartographic Applications, with R. Welch, *Digest of the 1985 International Gcoscience and Remote Sensing Symposium* (IGARSS '85), vol. 1, Amherst, Massachusetts, p. 378.

Large Format Raster Scanners for the Geosciences, in *International Yearbook of Cartography*, 1985, pp. 37-50.

The Automatic DISCOR -System for Rectification of Space-Borne Imagery as a Basis for Map Production, *Proceedings of the 15th International Congress of ISPRS*, Rio de Janeiro, Brazil, IAPRS XXV/A4, 1984, pp. 135-147.

Non-Recursive Filter Techniques in Digital Processing of Remote Sensing Data, with E. Dennert-Moeller, D. Kolouch and P. Lohmann, *Proceedings of the 15th International Congress of ISPRS*, Rio de Janeiro, Brazil, IAPRS XXV/A4, 1984, pp. 163-175.

Methods and Possibilities of Remote Sensing in Coastal Areas, with G. Konecny, E. Dennert-Moeller, D. Kolouch and P. Lohmann, *Proceedings of the 15th International Congress of ISPRS*, Rio de Janeiro, Brazil, IAPRS XXV/A4, 1984, pp. 281-284.

AIMS: A System for Automatic Image Matching, with T. Luhmann, *Proceedings of the Eighteenth International Symposium on Remote Sensing of Environment*, Paris, France, 1984, pp. 971-979.

Requirements and Performance of Raster Scanning Devices in Geoscientific Data Processing, Invited Paper, *Proceedings of the EURO-CARTO III*, Graz, Austria, 1984.

Earl Epstein

Dr. Earl Epstein is Professor of Surveying Engineering at the University of Maine. Dr. Epstein holds a B. S. degree in Chemical Engineering, a Ph.D. in Physical Chemistry and a J. D. from the University of Wisconsin Law School, and is one of the foremost national authorities on the economic, legal, and institutional issues associated with the modernization of land records information.

Dr. Epstein has served on two National Academy of Science panels for the modernization and implementation of multipurpose cadastres. He also serves on the National Geodetic Survey Advisory Committee of NOAA and as advisor to the National Geodetic Survey on land data systems related to the National Geodetic Reference System. He is a member of the Wisconsin Bar Association, the American Bar Association, American Congress on Surveying and Mapping and Urban and Regional Information Systems Association.

Dr. Epstein has been Principal Investigator for grants from NOAA on the use and value of a geodetic reference system and the use and value of nautical chart information. Additional awarded research contracts include grants for designing a geo-information system for the city of Boston, a study of the base map and cadastral overlay in a multipurpose cadastre, and the role of the Land Registration and Information Service and the Maritime Resource Management Service in the collection and dissemination of land information in the Canadian Maritime provinces.

His current research interests lie in determining the use and value of spatial information and in the legal conflicts over land data and information. Dr. Epstein teaches courses in cadastral systems and in the legal aspects of Land Information Systems. He has been invited on numerous occasions to present workshops on Land Information Systems.

Selected Publications:

Compatible Data for Land Decisions, *Proceedings of the Conference on Compatible Data for Decision-Making*, National Governor's Association, to be published.

Litigation Over Information, The Use and Misuse of Maps, Proceedings of the International Geographic Information System Symposium, Crystal City, VA, 1987, in press.

Liability for Information, with H. Roitman, *Proceedings of the Urban and Regional Information Systems Association*, Ft. Lauderdale, FL, 1987, vol. IV, pp. 115-125.

The Use and Value of Nautical Chart Information: A Case Study of the Use and Value of Maps, with T. Duchesneau, Report submitted in fulfillment of NOS/NOAA research grant, January, 1987.

Legal Conflict Over Land Data and information: The Basis for the Profession of Land Information Specialist, *Proceedings of the Urban and Regional Information Systems Association*, Denver, CO, August 1986, vol. IV, pp. 197-203.

The Meaning of Efficiency for Surveying and Mapping, *Surveying and Mapping*, vol. 46 (2), 1985, pp. 137-139.

Legal Issues in the Development of Land Information Systems, in W. A. Chatterton. ed., *Seminar on the Multipurpose Cadastre: Modernizing Land Information Systems in North America*, IES Report 1234, Institute for Environmental Studies, University of Wisconsin-Madison, December 1984.

Spatial Data Integration in the Information Era, The Decisionmaker and Land Information Systems, with Y. Bedard, in A. C. Hamilton and J. D. McLaughlin, eds., *Proceedings of the Federation Internationale Des Geometres (FIG) Symposium*, Edmonton, Alberta, October, 1984, pp. 104-113.

The Use and Value of a Geodetic Reference System, with T. Duchesneau, Federal Geodetic Control Committee, National Oceanic and Atmospheric Administration, US Department of Commerce, HD108. 6. E67, April 1984.

The Cost and Value of Land Records, *Proceedings of the Workshop on Alternative Land Registration Policies*, Land Tenure Center, University of Wisconsin-Madison, October, 1983.

Procedures and Standards for a Multipurpose Cadastre, Member of Panel, National Research Council, National Academy Press, Washington, DC, 1982.

Analysis of Land Data Resources and Requirements for the City of Boston, with others, Office of Property Equalization, Boston, MA, March, 1981.

Land Information Systems for the Twenty-First Century, with W. A. Chatterton, *Real Property, Probate, and Trust Journal*, American Bar Association, Chicago, Illinois, vol. 15, 1980, p. 890.

Need for a Multipurpose Cadastre, Member of Panel, National Research Council, National Academy Press, 1980.

The Cost of Land Records in Wisconsin, *Proceedings of the Second MOLDS Conference*, North American Institute for Modernization of Land Data Systems, Washington, D. C., October 5-7, 1978, p. 189.

Concepts of a Multipurpose Cadastre: Problems of Design and Implementation, with J. L. Clapp, *Proceedings of the Land Records Symposium*, Orono, Maine, August 25-27, 1976.

Andrew Frank

Dr. Andrew Frank is Associate Professor of Surveying Engineering with a cooperating associated faculty appointment in the Computer Science Department at the University of Maine. He received a Diploma from the Swiss Federal Institute of Technology, Zurich, Switzerland in 1978 and a Ph.D. from the same institute in 1982. His dissertation was entitled *Data Structures for Land Information Systems: Semantical, Topological, and Spatial Relations in Data of Geo-sciences.*

His research interests include the treatment of geometry in computer systems, the modeling potential of database management systems and the improvement of the human interface. He is currently studying problems of software engineering and the use of methods of artificial intelligence as they apply to GIS. He has been the recipient of several grants including a National Science Foundation grant to develop a formal model for the presentation and manipulation of spatial subdivisions in information systems; a grant from U.S. Bureau of Census to investigate lattice-based automated systems; and a grant from Digital Equipment Corporation to develop a locational SQL definition.

Dr. Frank has developed a working prototype of an object-oriented, spatial database management system (PANDA), which is being used as a vehicle for further investigation. This system is also being developed by a commercial software house as a base for GIS development. He has built and continues to direct the computer cartography lab used for graduate and undergraduate teaching teaches courses in spatial database design, interactive query languages, computer graphics and interactive land information systems.

Dr. Frank has served as chair and member of a number of technical committees of professional societies. Currently he is Corresponding Member to the IUG GIS committee and serves on the Program Committee for the Third International Spatial Information Data Handling Conference. He regularly reviews for NSF and for a number of scientific and professional journals. He is a member of ACSM, ASPRS and ACM.

Selected Publications:

Expert Systems for Geographic Information Systems, with V. Robinson, *Photogrammetric Engineering and Remote Sensing*, 1987, pp. 1435-1441.

Integrating Mechanism for Storage and Retrieval of Data, *Surveying and Mapping*, vol. 46 (2), 1986.

An Introduction to Expert Systems, with V. Robinson and M. Blaze, *ASCE Journal of Surveying Engineering*, vol. 112 (3), October, 1986.

An Assessment of Expert System Applied to Problems in Geographic Information Systems, with V. Robinson and M. Blaze, *ASCE Journal of Surveying Engineering*, vol. 112 (3), October 1986.

Cell Graphs: A Provable Correct Method for the Storage of Geometry, with V. Kuhn, in D. Marble, ed., *Second International Symposium on Spatial Data Handling*, Seattle, Washington, July 1986.

Formal Methods for Accurate Definition of Some Fundamental Terms in Physical Geography, with B. Palmer and V. Robinson, in D. Marble, ed., *Second International Symposium on Spatial Data Handling*, Seattle, Washington, July 1986.

LOBSTER: Combining Database Management and Artificial Intelligence Techniques to Manage Land Information, Eighteenth International Congress of International Federation of Surveyors, Invited Paper 301.1, Toronto, 1986.

Distributed Databases for Surveying, *ASCE Journal of Surveying Engineering*, vol. 111 (1), March 1985.

Computer Education for Surveying Engineers, *The Canadian Surveyor*, vol. 39 (4), 1985, pp. 323-331.

About Different Kinds of.Uncertainty in Collections of Spatial Data, with V. Robinson, *Proceedings of Auto-Carto Seven*, Washington, DC, March 1985.

Integrating Mechanism for Storage and Retrieval of Data, in H. J. Onsrud, ed., *Workshop on Fundamental Research Needs in Surveying, Mapping, and Land Information Systems*, Virginia Polytechnic Institute and State University, Blacksburg, VA, 1985. Also published in Surveying and Mapping, vol. 46 (2).

Computer Assisted Cartography: Graphics or Geometry?, *ASCE Journal of Surveying Engineering*, vol. 110 (2), 1984, pp. 159.

Extending a Network Database with Prolog, in L. Kerschberg, ed., *Proceedings of the First International Workshop on Expert Database Systems*, Kiawha Islands, South Carolina, October 25, 1984.

Requirements for Database Systems Suitable to Manage Large Spatial Databases, in D. Marble et al, eds., *Proceedings of the International Symposium on Spatial Data Handling*, Zurich, Switzerland, August 20, 1984.

MAPQUERY: Database Query Language For Retrieval of Geometric Data and Their Graphical Representation, in D. Bergeron, ed., *Proceedings of SIGGRAPH '82: ACM Computer Graphics*, vol. 16 (3), 1982.

PANDA: A Pascal Network Database Management System, in W. Gorsline, ed., *Proceedings of the Fifth Symposium on Small Systems, ACM SIGSMALL*, Colorado Springs, CO, August 1982.

Robert Franzosa

Dr. Robert Franzosa. is Assistant Professor of Mathematics at the University of Maine. He received his B. S. from the Massachusetts Institute of Technology, his Master's from the University of Wisconsin, and his Ph.D. in 1984 from the same institution.

Dr. Franzosa's research work has centered on developing and studying topologically based index theories for the qualitative study of invariant sets in a flow (e.g., stationary and periodic solutions in a system of differential equations). He has researched extensions of Conley's index theory and developed the connection matrix theory, an index that provides information about the existence of orbits connecting invariant sets in a flow (e.g., solutions connecting stationary solutions in a system of differential equations). He has also developed a generalization of Fuller's index for periodic orbits in a flow.

Dr. Franzosa has recently become interested in the application of mathematical GIS theory to spatial problems. He has conducted a seminar on combinatorial topology specifically for graduate students interested in GIS topics.

Selected Publications:

The Connection Matrix Theory for Morse Decompositions, to appear *in Transactions of the American Mathematical Society*.

The Connection Matrix Theory for Semiflows on (Not Necessarily Locally Compact) Metric Spaces, with K. Mischaikow, to appear in *The Journal of Differential Equations*.

The Continuation Theory for Morse Decompositions and Connection Matrices, to appear in *The Transactions of the American Mathematical Society*.

An Homology Index Generalizing Fuller's Index for Periodic Orbits, submitted to *The Journal of Differential Equations*.

Index Filtrations and the Homology Index Braid for Partially Ordered Morse Decompositions, *Transactions of the American Mathematical Society*, November, 1986.

Raymond J. Hintz

Dr. Raymond J. Hintz is Assistant Professor in Surveying Engineering at the University of Maine. He received his B. S., M. S. and Ph.D. from the University of Wisconsin-Madison.

Dr. Hintz's research interests cover a wide range of applications of photogrammetric techniques, satellite surveying and data quality accuracy evaluation. His awarded research contracts have included the compilation and ordering of geographic data in studying agrarian collapse in coastal Peru, the development of cultural complexity in Southwest Florida, construction and evaluation of a computerized photologging system for identification and measurement of pavement cracking and the use of satellite surveying technology to expand geodetic control along a primary road system.

Dr. Hintz has had several years of experience in teaching photogrammetry and plane surveying. He is a member of ASPRS and ACSM and reviews regularly for the Journal of Surveying and Mapping.

Selected Publications:

Automated A Priori Blunder Detection in Horizontal Control Networks, with A. P. Vonderohe, *Journal of Surveying and Mapping*, tentatively accepted for publication.

The Integration of Total Station Observation with GPS Positioning, with W. J. Blackham and R. L. Shrestha, Fall Technical Meeting of the American Congress on Surveying and Mapping, September 1987.

Quantification and Presentation of Archaeological Data: Agricultural Collapse in Peru, with C. O. Clement and M. E. Moseley, *Fifty-third Annual Meeting of the American Society for Photogrammetry and Remote Sensing*, March 1987.

Automatic Generation of Approximations for Horizontal Control Networks, with A. P. Vonderohe, *Journal of Surveying and Mapping*, vol. 46 (4), 1986, pp. 311-322.

Sine Curve Fitting of Tidal Data in Estimation of Mean High Water, with D. W. Gibson, *Journal of Surveying and Mapping*, vol. 46 (3), 1986, pp. 201-208.

The Status of Blunder Detection and Artificial Intelligence in Data Clarification in Surveying and Mapping, *Journal of Surveying and Mapping*, vol. 46 (2), 1986, pp. 157-161.

Laurence Latour

Dr. Laurence Latour is Assistant Professor of Computer Science at the University of Maine. He received his B. B. A. in Statistics at Bernard M. Baruch College, CUNY, his M. S. in Operations Research at the Polytechnic Institute of New York, and his Ph.D. in Computer Science at Steven's Institute of Technology in 1985.

Dr. Latour has research interests in multiple user databases and software engineering environments. He teaches courses in software engineering and database management systems, and has taught classes in statistics and computer information systems. He is a member of the Association for Computing Machinery, SIGADA and SIGMOD.

Selected Publications:

A Knowledge-based Retrieval System for Reusable Software Modules, with E. Johnson, paper to be presented at the Third International IEEE Conference on ADA applications and Environments, May, 1988.

An ADA Tasking Implementation of an Iterator for Quadcodes, accepted for the Sixth Annual National Conference on ADA Technology, Arlington, VA, March, 1988.

Towards an Expert/Novice Learning System with Application to Infectious Diseases. with M. Brody and D. Kopec, paper to be presented to the CAIA-88 and AAAI Mini-Symposium on AI in Medicine, Stanford University, March 1988.

The Role of Explicit Type Management Schemes in the Implementation of Abstract Data Types in ADA, *Joint ADA Conference on ADA Technology*, Washington, D. C., March 1987.

A Model of Transaction Semantics-Working Paper, with R. Tindell, Internal Report for the Workshop on Engineering Databases at Orono, Surveying Engineering Program, Department of Civil Engineering, June 30 - July 3, 1986.

A Formal Analysis of Schedules of Multiple User Reads and Writes on a Shared Centralized Database, Ph.D. Dissertation, Steven's Institute of Technology, April 1985.

Alfred Leick

Dr. Alfred Leick is Associate Professor of Civil Engineering at the University of Maine. He received his Ph.D. in Geodetic Science in 1977 from the Ohio State University. He was Chair of the Committee on the Multipurpose Cadastre of the American Society of Civil Engineers (ASCE) from 1984 to 1987 and Chair of the ASCE Specialty Conference 'Integrated Geographic Information Systems-A Focal Point for Engineering Activities', San Diego, February

1986. From 1980 to 1985, he was the editor of ASCE's *Journal of Surveying Engineering* and Chair of the Publications Committee. He has been a member of the Board on Hydrographic Surveying Certification for the American Congress on Surveying and Mapping (ACSM) since 1982.

Dr. Leick has been involved with GPS research for about five years. During the summer of 1982 he joined Prof. C. Counselman at M. I. T. in testing a prototype Macrometer GPS receiver. Dr. Leick computed the first GPS geodetic network densification in the U.S. (Montgomery County, Pennsylvania), and carried out the first millimeter survey with GPS (Stanford Linear Accelerator Project). He has constructed a set of algorithms and software to process GPS carrier phase observations with the option of GPS satellite orbit determination. Other research includes the use of gravity to compute geoid undulations and the application of GPS to dynamic platform positioning.

He teaches courses in adjustment computations, geodetic models, and integrated geodesy and satellite geodesy.

Dr. Leick has received fellowships from NASA, the European Space Research Organization (ESRO), the National Research Council (NRC), and the Alexander von Humboldt Foundation in Germany.

Selected Publications:

Positioning 2001, *Surveying and Mapping*, vol. 47 (3), 1987.

Processing GPS Carrier Phase Observations for Station and/or Orbital Adjustments, *Proceedings of the ASPRS/ACSM Annual Meeting*, Baltimore, MD, March 29 to April 3, 1987.

GPS Network Adjustment with a Priori Information and Orbital Determination Capabilities, with J. Eren, *Proceedings of the Fourth International Geodetic Symposium on Satellite Positioning*, Austin, TX, 28 April - 2 May, 1986.

Mathematical Models within A Geodetic Frame, *Surveying Engineering*, vol. 11 (2), 1985.

GPS and Related Matters - A Challenge Paper, *Proceedings of a Workshop on Fundamental Research Needs in Surveying, Mapping, and Land Information Systems*, Virginia Polytechnic Institute and State University, Blacksburg, Vih-ginia, November 18 - 20, 1985.

Application of GPS in a High Precision Engineering Survey Network, with R. Ruland, *Proceedings of the First International Symposium on Precise Positioning with the Global Positioning System*, Rockville, Maryland, April 15 - 19, 1985.

Analysis of Macrometer Networks with Emphasis on The Montgomery County Survey, with J. Collins, *Proceedings of the First International Symposium on Precise Positioning with the Global Positioning System*, Rockville, Maryland, April 15 - 19, 1985.

Montgomery County (PA) GPS Survey, with J. Collins, *Proceedings of the ASPRS/ACSM Annual Meeting*, Washington, D. C., March 10 - 15, 1985.

St. Croix Region Crustal Strain Study, in W. B. Thompson and J. T. Kelly, eds., *Investigations of Recent Movements in Maine During Fiscal Year 1983* Maine Geological Report to U.S. Nuclear Regulatory Commission, 1985, pp. 93-115.

GPS Surveying and Data Management, *Proceedings of the Twenty-Second Annual Conference of the Urban and Regional Information Systems Association (URISA)*, Seattle, August 12-15. 1984.

Macrometer Satellite Surveying, *Surveying Engineering*, vol. 110 (2), 1984.

Minimal Constraints in Two-Dimensional Networks, *Surveying Engineering*, vol. 108 (2), 1982.

Potentialities of Lunar Laser Range-Differencing for Measuring the Earth's Orientation, *Bulletin Geodesique*, vol. 54 (1), 1980.

Defining the Celestial Pole, with I. I. Mueller *Manuscripta Geodetica*, vol. 4 (2), 1979.

George Markowsky

Dr. George Markowsky is Professor and Chairman of the Computer Science Department at the University of Maine. He received his B. A. and M. S. in Mathematics at Columbia University and Harvard University, respectively and his Ph.D. from Harvard University in Mathematics in 1973.

Dr. Markowsky has worked as a researcher for IBM at the T. J. Watson Research Center. As the technical assistant to the Director of the Computer Sciences Department he worked on a variety of research projects, including ordered sets, the analysis of the behavior of a hash function scheme, computational geometry, data security, voice recognition, and the analysis of stochastic processes. Recently, he has worked on the use of combinatorics and partially ordered sets in biological applications. While at IBM he also taught courses in graph theory, combinatorics, algebra and partially ordered sets at the Watson Research Center.

Dr. Markowsky is a member of the Mathematical Society of America, the American Mathematical Society and the American Association for the Advancement of Science, and the New York Academy of Science where he served on the Advisory Committee of the Instrumentation Section. He has also served on the editorial board of *Mathematical Social Sciences* and has been an active technical journal referee.

Selected Publications:

Analysis of a Universal Class of Hash Functions, with Carter and Wegman, *Proceedings of the Seventh Symposium on the Mathematical Foundations of Computer Science*, Zakopane, Poland, published as Vol. 64 in the Springer Verlag 'Lecture Notes in Computer Science' series, 1987, pp. 345-354.

Generation of Solid Models From Two-Dimensional and Three-Dimension Data, with Wesley, in M. S. Pickett and J. W. Boyse, eds., *Solid Modeling by Computers*, Plennum Publishing, 1984, pp. 23-51.

On Sets of Boolean n-Vectors with All k-Projections Surjective, with Chandra, Kou, and Zaks, *Acta Informatic*, Vol. 20, 1983, pp. 103-111.

Intersection-Union Systems, with Wholgemuth, *Discrete Applied Mathematics*, Vol. 6, 1983, pp. 255-262.

Best Huffman Trees, *Acta Informatica*, vol. 16, 1981, pp. 363-370.

A Fast Algorithm for Steiner Trees, with Kou and Berman, presented at the Tenth Southeastern Conference on Combinatorics, Graph Theory and Computing, Boca Raton FL, 1979. Also appears in *Acta Informatica*, Vol. 15, 1981, pp. 141-145.

A Motivation and Generalization of Scott's Notion of Continuous Lattice, *Proceedings of the 1979 Bremen Conference on Topological and Categorical Aspects of Continuous Lattices*, Springer Verlag 'Lecture Notes in Mathematics', No. 871, 1980, pp. 298-307.

Free Completely Distributive Lattices, *Proceedings of the American Mathematical Society*, Vol. 74, 1979, pp. 227-228. and Development, 1979, pp. 934-954.

Fleshing Out Projections, with Wesley, *IBM Journal of Research and Development*, 1979, pp. 984-954.

Subprojective Lattices and Projective Geometry, with Petrich, *Journal of Algebra*, Vol. 48, 1977, pp. 305420.

Multidimensional Bin Packing Algorithms, with Kou, *IBM Journal of Research and Development*, Vol. 21, 1977, pp. 443-448.

Lower Bounds on the Length of Node Sequences in Directed Graphs, with Tarjan, *Discrete Math*, Vol. 16, 1976, pp. 329-337.

Charles J. Mundo

Dr. Charles J. Mundo is Adjunct Professor of Navigation Science and Hydrographics at the University of Maine. He received his D. Sc. in Physics from Carnegie-Mellon University in 1952. Dr. Mundo worked in industry on navigation and guidance for space and military systems. He has served on advisory committees for NASA and the Services, and has participated in a two-year leave of absence spent at IDA, the NASA-MIT Summer Study on Oceanography and Solid Earth Physics at Williams College and the Navy Nuclear Deterrence Study-

Dr. Mundo has worked in the area of transportation policy with the Transportation Systems Center of the Department of Transportation where he became versed in economics and operations research. His research at the Center included studies on the impact of deregulation on the airlines and trucking industry for Congressional Committees, airline service to small remote communities, and the feasibility of remote towers for small airports.

Dr. Mundo's current research interests are concerned with efficient computer storage and retrieval of marine chart information for CRT presentation to navigators and precision marine surveying. He teaches courses on hydrographic surveying and signal processing for hydrographic surveying.

He has served as the Associate Editor for Guidance and Control of the *AIAA Journal*, as Chair of the 1963 MIT/AIAA Guidance and Control Symposium, as a member of the AIAA Committee on Guidance and Control and on the IEEE Navigation Standards Committee. He is presently active as a representative for IEEE on the International TC-80 panel on Navigation of the IEC.

Selected Publications:

Interaction Between Terminal Economics of Utilization and Network Size in Motor Carriers, TIMS/ORSA Joint Meeting, April 18, 1982

Guidance and Control, editor, New York, Academic Press, 1964

Theory and Design of Gyroscopes, New York, McGraw Hill, 1961.

Analysis of Air Service to Small Remote Communities, Transportation Systems Center Document TSC-2-31.

Cost Allocation of Federal Airways Services as a Basic for User Charges, Department of Transportation Document.

Harlan J. Onsrud

Dr. Harlan Onsrud is Assistant Professor and Coordinator for the Surveying Engineering Program at the University of Maine. He received his B. S. and M. S. degrees in Civil Engineering from the University of Wisconsin-Madison and his Doctor of Law in 1982 from the University of Wisconsin Law School.

Dr. Osrud is a licensed attorney, land surveyor, and engineer. He is one of the very few people in the United States to address the legal issues involved in the conversion of present public land records systems to automated environments. He is Chair of the 'Improvement and Modernization of Land Records Committee' of the American Bar Association Real Property section, and Chair of the 'Commission on Legal Requirements of the Institute for Land Information'. In 1985, Dr. Onsrud hosted a NSF-funded workshop entitled 'Fundamental Research Needs in Surveying, Mapping, and Land Information Systems.' He also received funding for a project entitled 'Development and Implementation of Prototypes for an Experimental Infrastructure Data Management System'. His current research involves the development of methods for restructuring legal and administrative frameworks to allow the more efficient transfer of technology to public agencies and private industry.

Dr. Onsrud teaches courses in cadastral systems, environmental law and resource regulation, property line law, and land development design. He currently chairs the Publication Committee of ACSM and the Editorial Review Board for Surveying and Mapping.

Selected Publications:

Technical Standards for Boundary Surveys: Developing a Model Law, with M. C. Swanson and S. D. Johnson, *Journal of Surveying Engineering*, scheduled for publication in 1988.

Research for Validating Cadastral Data, *Proceedings of the International Geographic Information Systems Symposium*, Crystal City, VA, November, 1987, in press.

Approaches to Teaching Engineering Ethics, *Civil Engineering Education*, vol. 9 (2), 1987.

The Education of Surveyors and Cartographers in an Information Age, *Technical Papers of the Twelfth Surveying Teachers Conference*, July, 1987.

Challenge to the Profession: A Formal Legal Education for Surveyors, *Surveying and Mapping*, vol. 47 (1), 1987, pp. 31-36.

Research Needs in Surveying, Mapping, and Land Information Systems, **Technical Papers of the Annual Meeting of the American Congress on Surveying and Mapping**, Falls Church, VA, March, 1987

Adverse Possession in Boundary Disputes, with A. J. Moraco, *Surveying and Mapping*, vol. 46 (1), 1986, pp. 209-217.

Land Information System Research Needs, *Papers of the 1986 Annual Conference of the Urban and Regional Information Systems Association*, Denver, CO, August, 1986.

State Technical Standards for Field Surveys: A Time for Change and a Model for the Future, with M. C. Swanson and S. D. Johnson, *Technical Papers of the ACSM-ASPRS Annual Convention*, Washington, DC, March, 1986.

First Steps in Modernizing Local Land Records, *Surveying and Mapping*, vol. 45 (4), 1985, pp. 305-311.

The Legal Education of Surveyors, Colloquium on Surveying and Mapping, University of New Brunswick, Fredericton, Canada, June, 1985. **Land Surveys - What a Lawyer Needs to Know**, Real Estate Practice Seminar, Virginia State Bar, Charlottesville, VA, May, 1985.

Steven Sader

Dr. Steven Sader is Associate Professor of Forest Resources at the University of Maine. He received his B. S. from Northern Arizona University, his M. S. from Mississippi State University, and his Ph.D. at the University of Idaho, all in Forest Resource Management. From 1983 to 1987, Dr. Sader was involved in a tropical forest research project conducted at the National Space Technology Laboratories-Earth Resources Laboratory in Mississippi. His research involved the analysis of multisensor data (including radar, laser profiler, thermal infrared multispectral scanner, and Landsat) directed to investigations of forest canopy structure, biomass, and species composition. His research emphasis was on forest change detection and relationships to landscape attributes.

Dr. Sader has also been involved in research for the U.S. Government to design and implement remote sensing monitoring programs in Costa Rica, Peru, the Sudan (USAID) as well as 11 western U.S. states. His current research interests include satellite image digital analysis for monitoring forest change, forest composition, and wildlife habitat; GIS; land use planning; and remote sensing.

Dr. Sader also teaches courses involving the application of remote sensing to natural resource management. He is a member of the American Society of Photogrammetry and Remote Sensing, the Society of American Foresters, the current Chair of the Maine Remote Sensing Interest Group and University of Maine representative to the Northeast Area Remote Sensing System (NEARSS).

Selected Publications:

Forest Biomass, Canopy Structure and Species Composition Relationships with Multipolarization L-band Synthetic Aperture Radar Data, *Photogrammetric Engineering and Remote Sensing*, vol. 53 (2), 1987, pp. 193-202.

Multipolarization SAR Data for Surface Feature Delineation and Forest Vegetation Characterization, with S. T. Wu, *IEEE Transactions on Geoscience and Remote Sensing*, vol. GE-25 (1), 1987, pp. 67-76.

Airborne Remote Sensing of Forest Biomes, *Geocarto International Journal of Remote Sensing*, vol. 1, 1987, pp. 9-17.

Analysis of Effective Radiant Temperatures in a Pacific Northwest Forest Using Thermal Infrared Multispectral Scanner Data, *Remote Sensing of Environment*, vol. 19, pp. 105-115.

A View of the Forest by NASA Forester, *Virginia Forest*, vol. 41 (4),1986, pp. 17-18.

Deforestation Rates and Trends in Costa, Rica - 1940 to 1983, with A. T. Joyce, *Biotropica*, accepted, October 1986.

Appendix C

Summary of Current and Pending research support

1. Department of Geography, UCSB, Faculty Research Support as of January 2, 1988

Faculty Name*	Managing Dept/Org Research Unit	Current Support	Pending Support
Julia Allen Jones	Academic Senate	1890	
	Geography	45871	
Luc Anselin	Comm & Organiz Research Instit	17800	97972
	Geography	49905	
	Academic Senate	650	
Richard L. Church	Geography	51300	
	Academic Senate	650	
Helen M. Couclelis			
Frank W. Davis	Geography	109763	52461
Jeffery C. Dozier	CTR Remote Sens & Env Optics	763662	1106954
	Geography	87001	
John E. Estes	Geography	1532556	74148
Reginald G. Golledge	Comm & Organiz Research Instit	233502	88179
	Academic Senate	19109	
Joel C. Michaelson	Geography	72765	
	Academic Senate	216	
David S. Simonett	Geography	229975	599401
	Marine Science Institute	64000	
	CTR Remote Sens & Env Optics		509034
	Academic Senate	650	
Raymond C. Smith	CTR Remote Sens & Env Optics	89370	198904
	Marine Science Institute	233180	377057
Waldo R. Tobler	Geography	20000	
	Academic Senate	420	
	Total Academic Senate	24399	
	Total Geography	2199136	726010
	Total Comm & Org Res Institute	306302	186151
	Total CTR Rem Sens & Env Optics	853032	1814892
	Total Marine Science Institute	297180	377057
	Total	3680049	3104110

*Note that Michael Goodchild and Hugo Loaiciga do not appear in this summary because they will not take up their UCSB appointments until July 1, 1988.

Julia Allen Jones
A. Current Support

CalSpace Institute	Potential Use of Landsat Imagery for Monitoring the Klamath National Forest Land Management Plan,	$10,000	Jul 1, 1987 Apr 30, 1988
Nature Conservancy (Island Research Fund)	Map of Soils of Santa Cruz Island: Application of a Geographic Information System,	$15,871	Jan 1, 1986 Apr 30, 1988
Water Resources Center/UC Davis	A Geographically Distributed Hydrologic Model for Mapping Flows of Soluble Toxic Substances,	$20,400	Jul 1, 1987 Jun 30,1989
CalSpace Institute	The Utility of Landsat MSS & TM Digital Data for Estimating Percent Cover Biomass and Change in Evergreen *Juniperus excelsa* forest in the northern Ethiopian highlands,	$9,800	Jul 1,1987 Jun 30,1988
Academic Senate	UCSB Soils Lab Development,	$1,890	Jul 1, 1987 Jun 30,1988

Luc Anselin
A. Current Support

National Science Foundation	Robust Estimation, Qualitative Analysis and Model Validation in Spatial Econometrics	$49,905	Jan 1,1987 Jun 30,1988
Water Resources Center/UC Davis	The Application of an Integral Multiregional Input* Output and Econometric Modeling Framework to California Water Resource Problem	$17,800	Jul 1, 1987 Jun 30,1989
UCSB	Academic Senate Research Travel	$650	Jul 1, 1987 Jun 30,1988

B. *Proposal Pending*

National Science Foundation	(Co-P.I. with D.A. Griffith) The Importance of Spatial Effects in Applied Regression Analysis in Regional Science and Geography Location: UCSB, Syracuse	$97,972	Jul 1, 1988 Sep 30,1989

R.L. Church
A Current Support

Naval Training Systems Center	IPA	$51,300	Sep 15, 1987 Sep 30,1989
UCSB	Academic Senate Research Travel	$650	Jul 1,1987 Jun 30,1988

Helen M. Couclelis

No current or pending support at this time.

Frank W. Davis

A. Current Support

Water Resources Center, UC Davis	(Co-P.I. with E. Keller) Recovery of the Riparian Zone Following Chaparral Wildfire	$17,900	Jul 1,1987 Jun 30,1988
California Coastal Conservancy	Enhancement and Restoration of the Devereux Slough and Storke Campus Wetlands	$49,363	Feb 1, 1987 Jan 31,1989
CalSpace Institute	Woodland Structure and Composition from Digital Satellite and Terrain Data.	$14,500	Jull,1987 Jun 30,1988
California Department of Fish and Game	(J.E. Estes, Co P.I.) California Condor Database Project	$28,000	Aug 6,1987 May 30,1988
NASA	(Co-P.I. with J. Dozier) Correspondence of Surface Climate Parameters with Satellite and Terrain Data	$54,001	Jun 1,1987 May 31, 1988

B. Proposal Pending

National Science Foundation	(Co-P.I. Dennis Odion) Origin of Pattern in Chaparral Vegetation Following Fire	$31,504	Jan 1,1988 Dec 31, 1989
California Department of Water Resources	Vegetation Survey of Lake Cachuma Watershed	$9,999	Dec 1, 1987 Feb 28,1988

Jeffrey C. Dozier

A. Current Support

UCSB	Chancellor's Research Funds Special Projects	$15,000	Jul 1, 1987 Jun 30, 1988
California Space Institute/UC San Diego	Remote Sensing of Snow Cover in the Himalayan and Anyemaqen Ranges	$18,000	Jul 1, 1987 Jun 30,1988
NASA	(Co-P.I. F. Davis) Correspondence of Surface Climate Parameters with Satellite and Terrain Data.	$54,001	Jun 1, 1987 May 31, 1988
California Air Resources Board	(Co-P.I. with J. Melack) Snow, Snow Melt, Rain, Runoff, and Chemistry in a Sierra Nevada Watershed	$365,002	Apr, 1987 Dec, 1988
U.S. Department of Agriculture	(Co-P.I. with J. Melack) Evaluation of Methods for Measurement of Snowfall and Collection of Snow for Chemical Analysis at Mammoth Moun tain, California	$71,444	Jan 1,1987 Jun, 1988
NASA	AVIRIS Measurements of Snow Reflectance in Alpine Terrain	$96,002	Aug, 1987 Nov, 1988

NASA	Thematic Mapper Measurements of the Snow Surface Radiation Balance	$231,214	Oct, 1985 Sep, 1988

B. Proposal Pending

California Air Resources Board	Measurements of Chemical Fluxes and Physical Properties of a Snow Cover	$43,753	Mar 1, 1987 Jun 30,1988
U.S. Army Research Office	Stereological Studies of Snow Metamorphism in a Seasonal Snow Cover	$224,726	Aug 1, 1987 Mar 1, 1988
NASA	(Co-P.I. with R.E. Davis) Snow Radiative Transfer and Measurements of Snow Properties	$75,153	Feb 1, 1988 Jan 31,1989
National Science Foundation	Chemical Evolution of Seasonal Snowpacks (Co-P.I. with R. E. Davis) Location: UCSB and Univ. of Arizona	$41,381	Jan 1, 1988 Dec 31, 1990
National Aeronautics and Space Administration	Sir-C Investigations of Snow Properties in Alpine Terrain	$721,941	Oct 1, 1988 Sep 30,1993

John E. Estes

A. Current Support

NASA NAGW-455 (Tuyahov)	NASA Remote Sensing Information Sciences Research Group (T. Smith & J. Star as Co-P.I.s)	$844,284	May 1, 1983 Apr 30, 1988
NASA	(J. Star as Co-P.I.) Browse in the EOS ERA	$298,772	Nov 1, 1986 Feb 28,1988
Region of the Veneto (ITALY)	(J. Star & M. Caswell as Co-P.I.s) Agriculture Regions of Veneto	$200,000	Dec 23, 1986 Nov 30,1988
CalSpace Institute	(J. Franklin as Co-P.I.) Species Conservation in the South Pacific through Habitat Mapping Using Remote Sensing	$7,500	Jul 1, 1987 Jun 30, 1988
USRA	(J. Star as Co-P.I.) Telescience Testbed	$182,000	Jul 1, 1987 Apr 28, 1988

B. Proposal Pending

NASA	(J. Star as Co-P.I.) Browse in the EOS-Era Year II	$75,148	Jan 1, 1988 Dec 31,1988

Golledge

A. Current Support

Public Health Service	Analysis of Navigation Without Sight	$104,251	Jul 1,1987 Jun 30,1988

John Simon Guggenheim Foundation	Spatial Cognition (Cities of the Mind)	$25,000	Oct 1, 1987 Jun 30,1988
UCSB	Academic Senate	$9,107.50	Jul 1, 1987 Jun 30,1988
UCSB	Academic Senate	$3,199.20	Jul 1, 1987 Jun 30,1988
UCSB	Instructional Improvement Grant	$6,803.17	Jul 1, 1987 Jun 30,1988
National Institute of Health	(Co P.I. with Loomis, Doherty, Pellegrino) Analysis of Navigation Without Sight	$104,251	Jul 1, 1987 Jun 30,1990

B. Proposal Pending

National Science Foundation	(Co) P.I. with Pellegrino, Doherty, Gale) Integrating Spatial Knowledge: The Transition from Landmark to Route to Configurational Knowledge	$88,179	Jan 1, 1988 Dec 31, 1988

Joel C. Michaelsen
A. Current Support

National Science Foundation	Spatial and Temporal Variability in Precipitation over Western North America	$45,542	Sep 1, 1987 Feb 28, 1989
CalSpace Institute	Time Series Analysis of Coastal Atmospheric Properties	$7,000	Jul 1, 1987 Jun 30,1988
Water Resources Center, UC Davis	Precipitation Variability in Coastal California: Spatial/Temporal Components and Relationships to Atmospheric Circu lation Patterns	$20,223.30	July, 1987 Jun 30,1988
UCSB	Academic Senate Research Travel	$216	Jul 1, 1987 Jun 30,1988

David S. Simonett
A. Current Support

IGCC	An Error Analysis of Urban Fuel Loading Estimates of Nuclear War	$12,500	Jul 1, 1987 Jun 30 1988
NASA	Flood Plain Dynamics in Georgia, USA. Co-P.I., with J. Melack as P. I.	$64,000	Oct 1 1986 Sep 30 1988
CALSPACE	Improvement and Extension of a Radar Forest Backscatter Model,	$10,000	Jul 1 1987 Jun 30 1988
NASA GSFC	Synthetic Aperture Radar Backscatter Modeling of Vegetation Structural Characteristics and Its Extension to Disease Vector Breeding Ecology and Transmission Studies. ($15,000 subcon tract)	$15,000	Oct 1 1987 Sep 30 1988

NSF	Mass Transformations in Tropical Forest Burning, Simonett/Fearnside/Robinson, Co-P.I.'s	$110,000	Aug 1 1986 Jan 30 1988
JPL	Invertible Forest Canopy Modeling using SIR-B Images (continuation)	$80,000	Apr 1 1987 Mar 31 1989
National Geographic Society	Conservation of Biological Resources in the South Pacific Though Habitat Mapping and Species Introduction (J. Franklin as Co-P.I.)	$2,475	Aug 1 1987 Mar 31 1988
UCSB	Academic Senate Research Travel	$650.00	Jul 1, 1987 Jun 30,1988

B. Proposal Pending

NASA JPL	Biomass Modeling of the Ponderosa Pine Forests of Western North America with SIR-C/X-SAR	$626,713	Oct 1 1988 Sep 30 1993
NASA	(Co)Investigator, J. Melack is P.I.) Determining the Extent of Inundation on Subtropical and Tropical River Flood plains Beneath Vegetation of Varying Types and Densities	$509,034	Oct 1, 1988 Oct 31,1993

Raymond C. Smith
A. Current Support

National Science Foundation	Oceanographic BioOptical Profiling System	$233,180	Sep 1,1986 Feb 28,1989
Office of Naval Research	BioOptics of the Upper Ocean	$89,370	Aug, 1987 Jul, 1988

B. Proposal Pending

National Science Foundation	The Relationship Between Quantum Yield, Particle Absorption and Primary Production in California Coastal Waters	$377,057	Sep 1, 1987 Aug 31,1989
NASA	BioOptics, Photoecology, and Remote Sensing	$163,572	Oct 1, 1987 Sep 30,1988
Office of Naval Research	The Determination of Spectral Absorption in Ocean Waters	$35,332	Feb 1, 1988 May 31, 1988

Terence R. Smith
A. Current Support

United States Geological Survey	A Spatial Data Base for Improved Query Response Together with Image Processing and Vector Input Capabilities for KBGIS)II	$55,000	Jul 1, 1987 Jul 31, 1988

UCSB	Academic Senate Research Travel	$814	Jul 1, 1987 Jun 30,1988

Waldo R. Tobler
A. Current Support

UCSB	Chancellor's Research Funds	$20,000	Jul 1,1987 Jun 30,1988
UCSB	Academic Senate Research Travel	$420	Jul 1, 1987 Jun 30,1988

2. Recently Completed, Current and Pending Support, State University of New York, Buffalo

Athol D. Abrahams
A. Recently Completed Research Projects

NSF	United States - United Kingdom Joint Symposium on Hillslope Processes	$15,043	1985
NATO Grant for International Collaboration in Research	Hydraulic Processes in the Formation of Desert Debris Slopes - Part I	$6,000	1985

B. Current Support

NSF	A Laboratory Study of the Hydraulics of Overload Flow on Desert Hillslopes (Doctoral Dissertation Improvement Research Grant to Paul J. Hirsch)	$13,556	Sept,1986 Aug, 1988
NATO Grant for International Collaboration in Research	Hydraulic Processes in the Formation of Desert Debris Slopes - Part II	$6,000	Jul 1, 1987 Jun 30, 1988

Barbara P. Buttenfield
A. Recently Completed Research Projects

Wisconsin Alumni Research Fund	Stochastic Modeling of Cartographic Lines Location: University of Wisconsin - Madison	$15,000	1985
IBM Trochos Grant ($65,000) Wisconsin Matching Fund ($27,000)	Map Animations Courseware Location: University of Wisconsin - Madison	$92,000 (total)	1985 to 1987
Brittingham Trust	University of Wisconsin Arboretum Hand Information System (co- PI with Sacks, Clapp, Vonderhoe, and Walker) Location: University of Wisconsin - Madison	$35,000	1987

B. Proposal Pending

NSF	Collaborative Research on the Psi-s Transformation and the Representation of Digital Cartographic Lines (co-Pi with David Mark and Michael O'Neill) Location: State University of New York at Buffalo and Virginia Polytechnical Institute and State University	$117,852	Apr 1987 May 1990

Hugh W. Calkins
A. Proposal Pending

National Science Foundation	Geography and Regional Science Program Integrated Space-Time Data Display (Co-PI with Matthew McGranaghan) Location: State University of New York at Buffalo University of Hawaii at Manoa	$53,592	June 1988 May 1989

James W. Harrington, Jr.
A. Current Support

State University of New York	The Role of New York's Foreign-Owned Companies in Regional Development (Collaboration with James E. McConnell)	$2,680	Jul 1, 1986 Jun 30, 1987
NSF	Local Labor Market Impact of Semiconductor Device Manufacture	$33,012	1987 1988

Barry Lentnek

Recently Completed Research Projects

Small Farmers Marketing Access Group, U. S. Agency for International Development (administered by Clark University's SARSA)	Ecuador Project on Rural-Urban Linkages: Phase II (Project Director and Co-principal Investigator) Location: Ecuador	$27,000	1985
U.S. Agency for Inter-National Development, Mission to Ecuador	The Use of Computer Methods and System Analysis in Regional Development Planning (co- Principal Investigator with H. W. Calkins) Location: Ecuador	$17,000	1985

James E. McConnell
A. Current Support

U. S. Department of Education	(Co-collaboration on grant proposal with U. B. School of Management's Intemational and Corporate Programs) Doing Business in China	$54,000	Jul 1, 1985 Dec 31, 1987

B. Proposal Pending

NSF	The Role of U. S. Producer Service Affiliates Upon the Economic Growth and Development of the Singapore Economy (Doctoral Dissertation Improvement Research Grant to John L. Lombard)	$4,825	Jul 1 1987

David M. Mark

A. Recently Completed Research Projects

NSF, Geography and Regional Science Program	Linear Quadtrees for geographic information systems	$37,336	1985 to 1987

B. Current Support

NSF, Geography and Regional Science Program	On the Ordering of 2-dimensional Space	$65,021	Apr 1, 1987 Sep 30, 1989

C. Proposal Pending

NSF	Collaborative Research on the Psi-s Transformation and the Representation of Digital Cartographic Lines (co-Pi with Barbara Buttenfield and Michael O'Neill) Location: State University of New York at Buffalo and Virginia Polytechnical Institute and State University	$117,852	Apr 1987 May 1990
NASA	Characterization and Synthesis of Topographic Structure: L-Band (PI, David Peterson, NASA-Ames; sub-contract co-Pi is Lawrence E. Band) Location: SUNY at Buffalo, NASA-Ames, Montana field site	$175,649	1988 1992

Peter A. Rogerson

A. Recently Completed Research Projects.

NSF	Labor Market Competition Processes and Their Effects on Migration and Unemployment Location: Northwestern University	$32,352	Apr, 1985 Mar, 1986
Office of Governor, Springfield, Illinois	Forecast of Housing Needs for the State of Illinois (with Alex Anas) Location: Northwestern University	$12,000	May, 1985 Oct, 1985
New York State Great Lakes Program	Demographic and Economic Trends and Prospects in Erie and Niagara Countries	$2,700	Oct, 1986 Apr, 1987

B. Current Support

NSF	Presidential Young Investigator Award, National Science Foundation	$125,000	Jun 1986 May, 1990

NSF	Presidential Young Investigator Award, NSF, Matching Grant	$50,000	Jun 1986 May 1989

Michael J. Woldenberg

A. Recently Completed Research Project

NATO Collaborative Research Program	Optimal Branching Systems Location: Cardio-Thoracic Institute, W. Sussex, England	$4,000	1985 to 1986

3. Current and pending support, Surveying Engineering Program Sponsored Research Projects, University of Maine

Harlan J. Onsrud
A. Current Support

NSF	Development and Implementation of Prototypes for an Experimental Infrastructure Management Systems	$59,950	Jul 1, 1986 Jun 30, 1988

Andrew Frank
A. Current Support

Bureau of the Census, University of Maine	Poset-based and Lattice-based Automated Systems for Geographic Statistical Products	$69,564	Jun, 1987 Jul 1988
NSF	A Formal Model for Representation and Manipulation of Spatial Subdivisions in Information Systems	$93,156	Jul 1, 1986 Jun 30, 1988
Digital Equipment Corporation	Locational SQL	$39,000	May 1, 1987 Jul 31, 1988
National Geodetic Survey	Measurement - Based Multipurpose Cadastre	$19,663	Sep 1, 1987 Aug 31, 1988

Appendix D
List of Ph. D Dissertations, Master's Thesis Topics, and
Master's Degrees by Examinations: in Progress and Awarded.

Department of Geography
University of California, Santa Barbara

Ph.D. Dissertations in Progress

Geographic Information and Analysis and Related Topics:

Du, Tong, Crop Yield Modeling of the Regione Veneto, Italy, in a GIS Context.

Fogel, David, Urban and Regional Modeling in a GIS Context.

Gao, Peng, Data Structures for GIS.

Gaydos, Leonard, GIS and Remote Sensing Application.

Menon, Sudhakar, Spatial Search in a GIS Using Multi-Component Object Models and Hierarchical Data Structures.

Painho, Marco, GIS Design for Forest and Water Management

Thomas, Kathryn, Vegetation Monitoring and Management Using GIS as an Analytical Tool.

Spatial Analysis and Related Topics:

Harvey, Ed, Spatial Dynamics of a Blue Oak Woodland.

Haston, Laura, Precipitation Variability in Coastal California: Spatial and Temporal Components and Relationships to Atmospheric Circulation Patterns.

Kennedy, Susan, Demographic Rate Instability and Error on Chloropleth Maps.

Lawson, David, Automation of Selected Cartographic Processes.

McGwire, Kenneth, Distributed Data Access and Processing for Emergency Response Mapping.

Odion, Dennis, Establishment and Dynamics of Vegetation Patterns Following Fire in Chaparral.

Veregin, Howard, The Effects of Spatial Errors in Grid-Based Modeling.

Remote Sensing:

Crippen, Robert, Development of Remote Sensing Techniques in the Study of Neotectonic Features, Eastern Transverse Ranges and Vicinity, Southern California.

Dubayah, Ralph, Correspondence of Surface Climate Parameters with Satellite and Digital Elevation Data.

Franklin, Janet, Invertible Canopy Reflectance Modeling in Semiarid Woodland,

Frew, James, The Image Processing Workbench: Portable Software for Remote Sensing Research.

Marks, Danny, Climate, Energy Exchange, and Snow Melt in the Emerald Lake Watershed, Sierra Nevada.

Nolin, Anne, Measurement of Physical Characteristics of Snow Using Remote Sensing Techniques in the Visible and Near Infrared Portions of the Spectrun.

Sailer, Charlene, Development of an Expert System for Crop Identification.

Shi, JianCheng, A Physical Model of Snow Hydrology Based on Remotely Sensed Data.

Stoms, David, An Intelligent User Interface for BROWSE Using a Knowledge Base of Remote Sensing of Vegetation.

Sun, Guoqing, Simulation of Microwave Backscattering of Coniferous Forests.

Woo, David, Feasibility Study of Using Landsat MSS Data to Map Tropical Rice Fields in the Philippines.

Other Topics:

Kattelmann, Rick, Runoff Generation in Mountain Areas.

Milliff, Ralph F., Modeling Circulation in the Santa Barbara Channel.

Parikh, Anuja, Factors Affecting the Distribution of Riparian Tree Species in Chaparral Watersheds of Southern California.

Schopfle, Benjamin, Modeling of Schools Under Declining and Fluctuating Enrollments.

Master's Theses In Progress

Geographic Information and Analysis and Related Topics:

Burrows, David, REFIRES (Regional Fire Regime Simulator): A C Program for Regional Fire History Simulation.

Erlich, Danielle, Processing the Image and Ancillary Data for Crop Type and Area Determination For the Veneto in a GIS Context.

Fang HsingChung, Vector-Raster Conversions for GIS.

Grice, Douglas, Ecological Modeling of Quercus Hanglasin Using Landsat Thematic Mapper and GIS.

Landsfeld, Marty, The Effects of Aggregating Data in a GIS on Distributed Hydrological Models.

Lefebvre, Paul, GIS Development for Black Oak Habitat.

Parent, Phillip, GIS: Development, Issues, and Applications.

Scepan, Joe, GIS Techniques for Managing California Condor Habitat.

Shanks, Robert, Removal of Vegetation in the Jamaican Cockpit Country: Developing a GIS for Monitoring Microclimatic Change in the Tropics.

Graduate Students with Interests in GIS Topics, but without a formal thesis title as yet:

Chmill, Vicki (GIS and Remote Sensing Interfaces Involving Vegetation)

Deichmann, Uwe (GIS Applications in Spatial Decision Making and Planning)

Leipner, Joddi, (Applications of Remote Sensing and GIS to Hazardous Waste management)

Lomband, Kristi, (GIS in Relation to System and Environmental Modeling)

Morris, Teresa (GIS and Remote Sensing Applications)

Ray, Chiu-wen (GIS in Forest Management)

Ruggles, Amy (Archaeological Applications of GIS)

Sandberg, Jeff (Remote Sensing Applications of GIS in Water Management)

Theobald, M. David (GIS and TIGER (Census Bureau) Fire Applications)

Spatial Analysis and Related Topics:

Ellison, Kris, Improved Solution Techniques for MEXCLP and MOFLEET.

Gerrard, Ross, Hierarchical Location Modeling.

Marshall, Sheila, An Investigation of the Spatial Statistical Characteristics of Atmospheric Correction Algorithm Components for Coastal Zone Color Scanner Imagery.

Rey, Sergio, Spatial Models of Housing Markets and Growth Control Regulations: An Application of Alternative Econometric Approaches in Santa Barbara County, California.

Remote Sensing:

Friedl, Mark, Remote Sensing and Artificial Intelligence Background for Resource Managers.

Marshall, Bruce, Attenuation and Scattering of Light in Sea Water.

Paddon, Judy, Image Processing Workbench: Adaptation for Educational Image Processing Software.

Peterson, Pete, Distribution and Variability of Global Ozone and its Potential Consequences on Marine Biota.

Steve Peterson Remote Sensing Applications for Snow Hydrology.

Van Den Bosch, Jeannette, Remote Sensing Application for Hydrology.

Vernon, Gregory, Multispectrum Imaging in Forest Resource Application.

Wang, Yong, Radar Modeling of Forest Biomass.

Waters, Kirk, Coupling the Physical and Biological Processes in the Mid-Atlantic Ocean.

Other Topics:

Bloxham, Craig, Incorporating Temporal Considerations in Public Facility Locations: The P-Median Problem.

Damkowitch, Jim, Load Balancing Coverage Problem: a Two-Sided Equity Objective.

Elder, Kelly, Snow Accumulation in an Alpine Watershed: Emerald Lake Basin, Sequoyah National Park, California.

Garver, Sara, El nino, Longterm Climate Fluctions and Forecasting.

Phillips, Richard, Exploring the Image of a Nation with Reference to Central and South America.

Ph.D. Degrees Awarded

Dissertation Topics

Geographic Information and Analysis and Related Topics:

Gorenflo, Larry James, Fall, 1985, On the Structure of Rule-Based Decision Making in Spatial Search.

Woodcock, Curtis Edward, Winter, 1986, Understanding Spatial Variation in Remotely Sensed Imagery.

Panzer, Micha Itzhak, Winter, 1986, Geographic Knowledge Base Design and Implementation.

Chen Zitan, Spring, 1987, Quadtrees and Quadtree Spectra in Large Geographic Information Systems - the hierachical handling of spatial data.

Foresman, Timothy Wallace, Fall 1987, Geographic Tools for Hazardous Waste Sites: Mapping, Monitoring, and Modeling.

Spatial Analysis and Related Topics:

Richardson, G. Donald, Summer, 1982, Spatial Cognition.

Halperin, William Chase Spring, 1985, Spatial Cognition and Consumer Behavior: A Panel Data Approach.

Costanzo, Carmen Michael, Fall 1985, Spatial Association and Visual Comparison in Choropleth Maps.

Gopal, Suchi, Fall 1987, Computational Process Model of Human Spatial Navigation: Using Common LISP.

Remote Sensing:

Logan, Thomas Leslie, Fall, 1983, Regional Biomass Estimation of a Coniferous Forest Environment from NOAA-AVHRR Satellite Imagery.

Stow, Douglas Alan, Winter, 1985, Numerical Derivation of a Hydrodynamic Surface Flow Field from Time Sequential Remotely Sensed Data.

Li Xiaowen, Winter, 1985, Geometric-Optical Modeling of a Coniferous Forest Canopy.

Yool, Stephen Robert, Spring, 1985, Performance Analysis of Image Processing Algorithms in Spatially Complex Areas.

Wan Zheng-Ming, Spring, 1985, Land Surface Measurement from Space.

Li Shu-Sun, Summer, 1985, A Component Decomposition Model for Evaluating Atmospheric Effects in Remote Sensing.

Davis, Robert Earl, Winter, 1986, Snow Property Measurements Correlative to Microwave Emissions at 35 GHz.

Zhan, Ci-Xiang, Winter, 1986, Grey Level Dependence Texture Measures: Sensitivity and Stability Problems and Applications in Remote Sensing.

Graham, Nicholas Earl, Spring 1986, Statistical Models of Pacific Ocean Sea Surface Temperatures.

Zhang, Xueyun, Fall 1987, A Satellite Investigation of Spatial and Temporal Characteristics of Phytoplankton Pigment Variations in the California Current System.

Other Topics:

Gale, Nathan Daniel, Spring, 1985, Route Learning by Children in Real and Simulated Environments.

Robinson, Jennifer Mary, Fall 1987, The Role of Fire on Earth: A Review of the State of Knowledge and a System Framework for Satellite and Ground-Based Observations.

Master's Degrees Awarded

Thesis Topics

Geographic Information and Analysis and Related Topics:

Stow, Douglas A., Spring 1978, Analysis of Landsat and Digital Terrain Tape Data in a Geobase Information Systems Context: Ventura County Case Study.

Milliff, Ralph F., Spring 1980, Boundary Condition Specification for a Model of Geographic Movement.

Spanner, Michael A., Winter, 1982, Soil Loss Prediction in a Geographic Information System Format.

Chen Zitan, Spring 1982, Spatial Filtering of Polygon Data.

Moran, M. Susan, Fall, 1982, Modeling Timber Suitability Class and Site Index Through the Use of Digital Terrain Tapes and Soil Maps.

Graham, Nicholas E., Fall, 1982, A Combined Algorithm for Sample Design and Interpolation.

Foschi, Patricia G., Winter, 1983, Considerations and Problems in Designing a Geocoded Database System for a Microcomputer.

Kurilla, Laurie J., Spring, 1984, A Tectonic Study of the Datil-Mongollon Sub-province Based on a Coregistered Remotely Sensed Imagery and Geophysical Data.

Hoke, Nancy, Fall 1984, Development of Sampling Techniques Applied to Location Problems.

Schwab, Matthew G, Winter, 1985, Functional Invariance Under Spatial Aggregation from Continuous Spatial Interaction Models.

Dubayah, Ralph O., Winter, 1985, Orthographic Terrain Views Using Data Derived from Digital Elevation Models.

Streich, Tod A., Spring, 1986, A Contemporary Overview of Geographic Data Processing.

Barrett, Thomas N., Summer, 1986, Quantity and Spatial Distribution of Fuel Loading in an Urban Area.

Stoms, David M., Fall, 1986, Preliminary Design of a Farm Monitoring Geographic Information System.

Holsmuller, Frank J., Spring, 1987, A Comparison of the Magnitude and Spatial Distribution of Flammable Materials in San Jose and Rotterdam.

Fletcher, Gloria, Fall, 1987, GIS Use for Hazardous Waste Site Characterization of NAEC Lakehurst, New Jersey.

McGwire, Ken, Fall, 1987, Coordinating Hazardous Waste Monitoring Activities Using GIS.

Remote Sensing:

Logan, Thomas L., Spring 1978, Western Forest Species Classification from Multidate Landsat and Terrain Data.

Marks, Daniel G., Summer 1978, A Longwave Radiation Model for Application in a Remote Alpine Area.

Frew, James E., Winter, 1980, Remote Sensing of Snow Surface Albedo.

O'Neill, Peggy E., Winter, 1980, Ground-based Microwave Radiometric Measurement of Soil Moisture Under Bare Field Conditions in the Southern San Joaquin Valley, California.

Torburn, Tara L., Winter, 1980, Identification of Cotton Fields from Landsat Imagery in the Southern San Joaquin Valley, California.

Davis, Robert E., Spring, 1980, Simulation of the Thermal Regime of an Alpine Soil Beneath a Snow Pack.

Hajic, Earl J., Spring, 1980, Digital Processing of Side Scan Sonar Imagery for Mapping the Anacapa Passage Seafloor in the Santa Barbara Channel.

Hallada, Wayne A., Summer, 1980, Crop Identification Using Principal Component Analysis of Multitemporal Landsat Data.

Wilson, Michael J., Winter, 1981, An Analysis of Marine Oil Slick Detection Capabilities for the Seasat-A Synthetic Aperture Radar.

Maynard, Paul F., Winter, 1981, The Logit Classifier: A General Maximum Liklihood Discriminant for Remote Sensing Applications.

Zhan Ci-Xiang, Spring, 1981, A Spatial-Spectral Classification Approach for Cropland.

Li Xiao-Wen, Summer, 1981, An Invertible Coniferous Forest Canopy Reflectance Model.

Kanani, Simeon S., Summer, 1981, Land Cover Mapping and Change Detection in Kitui, Kenya: A Remote Sensing Approach.

Atwater, Susan G., Summer, 1981, Monitoring Seasonal Change in Chapparal Moisture Content Using Landsat Digital Data.

Wan Zheng-Ming, Fall, 1981, A Method for Digital Snow Mapping at Subpixel Resolution from NOAA Thermal Satellite Data.

Marks, Barbara J., Fall, 1981, A Method for Estimating Canopy Density Over Large Areas.

Ikhuoria, Isidahomen A., Fall, 1981, Remote Sensing and Environmental Analysis of Urban Land Use Patterns in Benin City, Nigeria.

Irvin, Edward R., Winter, 1982, A Regional Comparison of the Probibility of Obtaining Multidate Coverage by Radar and Landsat for the USA.

Li, Shu-Sun, Winter, 1982, A Model for Anistropic Reflectance of Pure Snow.

Frampton, Michael J., Winter, 1982, Measurement of Snow Surface Temperatures from Thermal Satellite Data in the Southern Sierra Nevada.

Lees, Robert D., Spring, 1982, The Use of Soil Texture and Field Capacity to Normalize Microwave Soil Moisture Measurements: Some Problems.

Yego, Joel K., Spring, 1982, The Suitability of Landsat Data to Map and Monitor Soil Erosion Hazards in Semi-Arid Lands: A Case Study of Central Kitui, Kenya.

Zhang, Xue-Yun, Spring, 1982, A Model for Microwave Emission of a Snowpack.

Johnson, Lee J., Spring, 1982, Atmospheric Effects on Satellite Augmentation of the USDA June Enumerative Survey: A Radar/Landsat Comparison.

Woodcock, Curtis E., Fall, 1982, Reducing the Influence of Topography on the Classification of Remotely Sensed Data.

Minor, Timothy B., Fall, 1982, Seasonal Comparison of HCMM Data for the Detection of Soil Moisture Variability.

Bertke, Susan E., Fall, 1982, Fundamental Concepts of Remote Sensing.

Stewart, Bradford J., Fall, 1982, Sensitivity and Significance of Turbulent Energy Exchange over an Alpine Snow Surface.

Ezra, Carol Elaine, Fall, 1982, The Feasibility of Thermal Inertia Mapping for Detection of Perched Water Tables in Semi-Arid Irrigated Agricultural Lands.

Sailer, Charlene, Fall, 1982, The Development and Implementation of Remote Sensing.

Tinney, Larry R., Winter, 1983, Towards and Improved Understanding of the Image Interpretation Process.

Almanza, Edward P., Winter, 1983, Landsat Analysis of Phytoplankton Patchiness and Seasonality in Mono Lake, CA.

Franklin, Janet, Spring, 1983, An Empirical Study of the Spatial Pattern of Coniferous Trees.

Eckhardt, David W., Fall, 1983, Modeling the Effect on Incoming Solar Radiation on Vegetative Fuel Loading in Chamise Chaparral.

Mertz, Fred, Winter, 1984, A Primer to Spatial Data Processing Using the VICAR/MIS Software Package.

Ritter, Elizabeth R., Winter, 1985, A Comparison of Classification Methodologies for Identifying High Priority Target Objects Around Nuclear Power Facilities.

Ackerson, Vivian J., Winter, 1985, Multistage Variability Probability Sampling of Tropical Dry Woodlands for Fuelwood Resource Assessment.

Rousseau, Denise D., Spring, 1985, Texture Analysis of the Spatial Contiguity of Snow Cover.

Negri, Deborah D., Summer, 1985, Vegetation Mapping Using Landsat in a Semi-Arid Region of Africa.

Carlson, Rowena M., Fall, 1985, An Evaluation of AIREYE for the Detection of Marine Oil Slicks.

Mann, Liza, Fall, 1985, Large Area Mapping Design for Multiple-Use Management in the Superior National Forest.

Haston, Laura, Winter, 1986, Mapping Zones of Similar Terrain for Improved Estimation of Snow Volume in an Alpine Watershed.

Cosentino, Michael J., Spring, 1986, Mapping Natural Vegetation from Multidate Landsat Imagery: A Case Study of Minimum Mapping Unit and Map Accuracy Tradeoffs.

Schmullius, Christiane, Summer, 1986, A Masking Procedure for Improvement of Crop Classification with Thematic Mapper Data in the Veneto Region, Italy.

Wade, Timothy G., Summer, 1986, The Utility of an Airborne Laser Scanner and the Technical Requirements of a Related Base Station Processor.

Goldschmidt, Aaron P., Winter, 1987, Resource Mapping and Land Evaluation Around Three Ujamaa Villages in Semi-Arid Dodoma Region, Tanzania.

Shi, Jiancheng, Spring 1987, A Study of Snow Hydrology and Snow Cover Measurement from Satellite MSS Data in Pengqu.

Hickson, Diana., Spring, 1987, The Role of Fire and Soil in the Dynamics of Burton Mesa Chaparral, Santa Barbara County, California.

Other Topics:

Baggett, Jay D., Fall, 1979, Assessing Groundwater Contamination at Rocky Mountain Arsenal Through Quantitative Studies of Plant Succession.

Richardson, G. Donald, Fall, 1979, The Appropriateness of Using Various Minkowskian Metrics for Representing Cognitive Maps Produced by Nonmetric Multidimensional Scaling.

Gale, Nathan, Fall, 1980, An Analysis of the Distortion and Fuzziness of Cognitive Maps by Location.

Blakely, James R., Summer, 1981, A Quantitative Analysis of the Associations Between Plant Species in the Shortgrass Prairie of Central Colorado.

Costanzo, C. M., Fall, 1981, An Investigation of the Spatial Component in the Effectiveness of Gun Control Laws.

Halperin, William C., Winter, 1982, Market Potential and Consumer Allocation: A Methodology for Comparing Aggregate and Disaggregate Models.

Witebsky, Ellen, Spring, 1982, Online Bibliographic Information Retrieval for Geographic Research: Search Planning, Problems and Satisfaction.

Lehman, Paul E., Fall, 1982, The Status and Distribution of the Birds of Santa Barbara County, California.

Reeves, Richard C., Fall, 1982, Development of an Integrated Hazardous Transport Management Model (HTMM).

Migereko, Daudi, Summer, 1983, An Analysis of the Coffee Cooperative Marketing System in Busoga, Uganda: Transportation and Facilities Location.

Somogyi, Christine, Fall, 1983, The Capacitated Maximal Covering Location Model and the Puesto/Promotora Siting Problem.

Hedden, Saville, Winter, 1984, Spatial Dimensions to Perceived Noxious Externality Fields.

Kennedy, Susan, Spring, 1984, A Spatial Regression Model for Medical Statistics.

Reimer, Kristie K., Fall, 1984, An Applied Spatial Interaction Model: Theory Versus Practice.

Daily, Julie, Fall, 1984, A Characterization of Frequency and Intensity of El Nino Southern Oscillation Activity Reconstructed from Tree-Ring Records.

Dunlap, Elizabeth A., Fall, 1985, Abundance and Distribution of Cetaceans in the California Current System as Observed from Ship and Satellite Data.

Chima, Rangeat, Fall, 1985, Teleconnections in the Equatorial Pacific and the Americas: A Study of the Seasonal Precipitation Anomalies.

Rowton, Cyndi M., Spring, 1986, A Gypsy Moth Spatial Interaction Model.

Bianchi, Geoffrey V., Spring, 1986, A Hybrid FLEET Model for EMS System Design. Mirandola, Mauro J. L., Spring, 1986, Calculating and Plotting Great Circles and Rhumb Lines.

Master of Arts Degree by Examination:

Prendergast, Peter J. Fall 1978.

Lawler, Michael J. Summer 1980.

Taube, Donald W. Spring 1981.

Van, Cleve, David H. Spring 1981.

Cullis, Brian J. Summer 1981.

Ortega, Raul, Fall 1981.

Burley, Peter C. Fall 1981.

Davis, Scott M. Spring 1982.

LaFontaine, Donald L. Summer 1982.

Carlson, John R. Fall 1982.

Irle, Patricia S. Winter 1983.

Sundbeck, Carl W. Spring 1984.

Vallera, Robert V. Spring 1984.

Kiss, Kenneth W. Fall 1984.

Darling, Neil A. Winter 1985.

Marschak, C. Fredric, Fall 1986.

Rockwell, Kenneth W. Spring 1987.

Goetz, Scott J. Fall 1987.

Department of Geography
State University of New York at Buffalo

Ph. D. Dissertations in Progress:

Geographic Information Systems and Related Topics:

Chou, Hsueh-Cheng, GIS.

Dickinson, H. GIS Functional Requirements for Resource Management Applications.

Howard, D. An Information Model for Urban and Regional Analysis.

Tsai, Shiow-Ju, GIS.

Automated Cartography and Cartography:

Freundschuh, S. Theory on Adult and Child Navigation Skills.

Mower, J. The Selection and Evaluation of Heuristic for Automated Name Placement.

Spatial Analysis and Related Topics:

Andrle, R. An Alternative Technique to Spectral Analysis

Leifer, L. The Implementation of a Micro-level Behavioral Model to Explain the Utility of Aggregate Consumer Spatial Behavioral Models.

Wang, Jianguo, Urban Analysis.

Wong, D. An Empirical Model for Gentrification: An Operationalization of a Modified Rent Gap Theory.

Other:

Ashrafiuon, Sylvia, International Business.

Cheung, M. Shifting Regional Patterns of International Trade Flows: Implications for Economic Integration on the Pacific Rim.

Ghosheh, B. Comparative Study of East Asian and Middle Eastern Economic Development.

Hirsch, P. The Resistance of Large-Scale Roughness Elements to Overland Flow: A Laboratory Investigation.

Joe, S. Product/Package Strategies in International Transportation Business.

Lombard, J. Structural Transformation and the Singapore Economy: A Case Study of Multinational Adjustment.

Steinitz, J. The Evolving Regional Economy of Western New York and Southern Ontario.

Wieczorek, W. A Pedogeomorphic Analysis of First Order Drainage Basins in the Allegany High Plateau.

Master's Theses in Progress

Graduate Students with Interests in GIS Topics, but without a Formal Thesis Title as yet:

Allocca, Paul, GIS Applications.

Chen, Shou-Wen, GIS Algorithms.

Kuitunen, Sandra, GIS and Urban and Regional Analysis.

Voyadgis, Demetra, GIS.

Wu, Chyan, GIS.

Topics in Automated Cartography and Cartography:

Christen, Linda, Road Map Design.

Delotto, Joseph, DEM Data Structure.

McAvoy, John, Algorithm Design for Converting Digital Line Graph (DLG) Contour Lines into a Triangulate Irregular Network (TIN) Structure.

Yusuf, Matharuddin, Cartographic Generalization.

Topics in Spatial Analysis:

Brundage, Paul, Urban Analysis.

Schmidt, Jacob, Urban and Regional.

Vasiliev, Irina, Diffusion of Old World Placenames in the USA, 1800-1987.

Vega, Nestor, Regional Analysis.

In addition, 19 students are pursuing Master's degrees in international business, and several other students are working on research topics in soil and fluvial geomorphology. Titles of these ongoing projects are excluded for brevity.

Ph. D. Degrees Awarded

Dissertation Topics

Geographic Information Systems and Related Topics:

Peuquet, Donna. 1977 Rastic Processing of Spatial Data in Geographic Information Systems. (Marble; Calkins; Brassel)

Reed, Carl N. 1980. Design and Implementation of a Crime Geographic Information System. (P. Hanson; Calkins)

Guevara, Jose A. 1983. A Framework for the Analysis of Geographic Information System Procedures: The Polygon Overlay Problem, Computational Complexity and Polyline Intersection. (Calkins; Mark; Griffith)

Automated Cartography and Cartography:

Peterson, Michael P. 1981. Map, Image and Mind: A Pattern Quality Test of some Graduated Symbol Maps. (Brassel; Brophy; Jarvis)

McGranaghan, Matthew, 1986. The Creation of Effective Choropleth Maps for Color CRT Display. (Marble; Calkins; Child; Mark)

Spatial Analysis and Related Topics:

Osleeb, Jeffrey P. 1973. A Location Theory for the Uniform-Price Manufacturer. (Lentnek)

Burke, John D. 1975. A Spatial Analysis of the Export Trade of the Buffalo Customs District. (Conkling)

Foster, Stephen N. 1980 Improvements in the Efficiency of Raw Milk Transportation and their Effects on the Spatial Structure of the Dairy Industry. (Conkling; MacKinnon; Thomas)

Glick, Barry J. 1981. The Spatial Organization of Cancer Occurrence: Theoretical and Empirical Perspectives. (MacKinnon; Marble; Griffith)

Rogerson, Peter A. 1981. Behavioral and Aggregate Approaches to Migration Modeling. (Mack'innon)

Roy, Andre G. 1981. Optimality and its Relationship to the Hydraulic and Angular Geometry of Rivers and Lungs. (Woldenberg; Jarvis; Abrahams)

Lundberg, Carl G. 1983. A Language for the Investigation of the Role of Spatial Structure and Con

straints on Spatial Choice and Activity Scheduling Behavior. (MacKinnon; McConnell; Griffith)

Amrhein, Carl G. 1984. Models of Interregional Labor Migration with Information Flows: A Simulation Approach. (MacKinnon; Griffith; Mark; Harrington)

Sham, Chi H. 1984. Space-time analysis of Rainfall-Runoff Relationships in Hong Kong. (Jarvis; Ebert; Griffith; Woldenberg)

Wokoma, Wokoma D. C., 1986. Factors Affecting Variation in School Enrollment in the Settlements of Rivers State, Nigaria. (McConnell; Jarvis; Mitchell)

O'Neill, Michael P. 1987 Meandering Channel Patterns: Analysis and Interpretation. (Abrahams: Woldenberg; Mark; Griffith)

Others:

Leaman, John H. 1976. The Spatial Role of Commercial Banking in Economic Development: the Example of Ethiopia. (Conkling)

Hoyte, Donald R. 1982. Impacts of Urban Size and Structure on Industrial Productivity. (McConnell; MacKinnon; Thrall)

Erol, Cengiz, 1983. The Location of Foreign Direct Investment and the Assessment of Political Risk. (McConnell; Conkling; Thrall)

Master's Degrees Awarded

Thesis Topics

Geographic Information Systems and Related Topics:

Somers, Rebecca. 1978. Geographic Information System Tutorial. (Marble; Calkins)

Fegeas , Robin G. 1979. QUIKDIG: A Minicomputer-based Digitizing System. (Marble; Brassel)

Mcgreevy, Patrick V. 1979. Metropolitan Dominance and Employment Concentration in Mexico: 1895-1960. (Lentnek; Woldenberg)

Backman, Robert, 1981, Mobility and Deconcentration of Low-income Households: A Study of the Section 8 Housing Assistance Program in Buffalo, New York. (Woldenberg; Lentnek)

Blackman, Gillian H. M., 1981. A Comparison of Air Passenger Traffic Flows to Resort Cities in the U. S. A. Before and After the 1978 Airline Deregulation Act. (Smith; MacKinnon)

Ferrier, Bernard I. K. , 1981. Government and Urban Economics: The Mission of the Economic and Market Analysis Division, United States Department of Housing and Urban Development. (Calkins; Lentnek)

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Appendix F
Letters of Support

In the following pages are given a small number of letters of support on cooperation. Additional letters of support will be available at the time of a site visit if the UCSB/UB/LTM consortium is on the short list.

PROGRAMME DES NATIONS UNIES POUR L'ENVIRONNEMENT
UNITED NATIONS ENVIRONMENT PROGRAMME

GLOBAL RESOURCE INFORMATION DATABASE

Telephone: 43 86 60
Telex: 422227 GRID CH

GRID Processor Facility
6, rue de la Gabelle
1227 Carouge, Geneva

11 January 1987

Dear David,

Thank you for your letter of inquiry concerning cooperation/ coordination between the United Nations Global Environment Program, (UNEP) Global Resources Information Database (GRID) and the University of California, Santa Barbara; State University of New York, Buffalo and the University of Maine Consortium applying for the National Science Foundation's National Center for Geographic Information and Analysis. Based upon our long interest in geographic information systems in support of the UNEP's environmental assessment program, we recognize the need to support research towards a deeper understanding of the applications geographic information systems (GIS). At the present time we are particularly interested in research directed towards large scale "global" applications of GIS Technology. In addition, we are interested in research that will lead to a better understanding of the basic science that underpins the proper handling and manipulation of spatial data.

The GRID project is just emerging from the Pilot Phase and is entering the implementation phase during which we will expand the GRID system to a Global network. GRID will be pleased to cooperate with the National Center for Geographic Information Systems on both research and applications issues to the mutual benefit of both the Center and UNEP/GRID.

As you are aware Drs. Estes and Star of your University have already been working with us on several topics through their association with the National Aeronautics and Space Administration. This interaction has been helpful and we would like to see such contacts expanded between UNEP and scientists and researchers in the field of spatial data management.

Again, let me thank you for your interest in cooperating and coordinating your efforts with UNEP/GRID activities. We wish you well in your proposed effort.

Yours sincerely,

Wayne Mooneyhan

Wayne Mooneyhan
Director

Dr. David Simonett
Dean, Graduate Division
University of California
Santa Barbara, California 93106

National Geographic Society
WASHINGTON, D.C. 20036
GILBERT M. GROSVENOR
PRESIDENT AND CHAIRMAN

January 6, 1988

Professor David S. Simonett
Dean, Graduate Division
University of California, Santa Barbara
Santa Barbara, CA 93106

Dear Professor Simonett:

I read your letter of December 12, 1987 with a great deal of interest.

I applaud the wisdom of the National Science Foundation to support the establishment and operation of a national center devoted to research based on geographic information systems (GIS). This initiative comes at a most propitious time, a time when European, Soviet, and Japanese scholars are already deeply involved in GIS research and education. The realization of the goals of the National Center for Geographic information and Analysis is certain to provide long-term benefits to Americans, but also to people in other lands, especially to those living in the Third World.

My colleagues and I here at the National Geographic Society are delighted that you are seizing the opportunity and responding to the NSF initiative. We are also delighted that you asked us for our endorsement on behalf of all university consortia proposing for the National Center.

You will, of course, understand that we cannot give a specific endorsement at this time. Nonetheless, we are willing to discuss ways in which the National Geographic Society might contribute fruitfully to the work of a National Center for Geographic Information Analysis.

I look forward to receiving an advance copy of your proposal to the NSF toward the end of the month.

Best regards,

Gilbert M. Grosvenor

SANTA BARBARA: OFFICE OF THE DEAN
GRADUATE SCHOOL OF EDUCATION

January 13, 1988

DAVID S. SIMONETT
DEAN, GRADUATE DIVISION

RE: National Center for Geographic
Information and Analysis

The Graduate School of Education strongly supports your proposal and its recognition that not only should the Center train undergraduate and graduate students, but it also has a responsibility to address future undergraduate and graduates currently in grades K-12, especially high school. The GSE stands ready to help transfer the technology developed by the Center, especially computer tools that can energize the mathematics and science curriculum. To this end, we are prepared to seek, in partnership with the local school districts, support for K-12 educational projects that represent spin-offs from the Center.

Rich

Richard J. Shavelson, Dean
Graduate School of Education

RJS:ps

cc: William Cirone

WILLIAM J. CIRONE, Superintendent

OFFICE OF THE COUNTY SUPERINTENDENT OF SCHOOLS

4400 Cathedral Oaks Road (P. O. Box 6307), Santa Barbara, California 93160-6307 (805) 964-4711

January 11, 1988

Professor David S. Simonett
Department of Geography
University of California
Santa Barbara, California 93106

Dear Dr. Simonett:

Speaking on behalf of the 24 school districts in Santa Barbara County, I strongly support your proposal to create a National Center for Geographic Information and Analysis through an institutional consortium that will include UCSB, SUNY at Buffalo and the University of Maine. There was considerable enthusiasm at the planning meeting (which included superintendents from larger districts within the county), since the Center could spin off contributions in a variety of ways to the improvement of geography instruction in the schools.

As you have suggested, the transfer to precollege education of technology developed in the Center could be speeded up tremendously, and lead to joint UCSB/school district proposals to implement computerized teaching of geographically important materials in the high schools and training of associated spatial and statistical thinking skills. From our perspective, there are several advantages to our collaboration. We share your concern about the deplorable lack of geographic knowledge of high school students in the United States and, regrettably, in our state. We are also excited about the prospect of training spatial and statistical thinking skills of students by use of computerized learning environments to teach geography.

We find particularly attractive, the commitment to transfer the knowledge and technology developed at the Center to the schools. As we all know, technological advances and new knowledge takes on the average of 10 years to reach down into the schools. Working in partnership with our local educational institutions and UCSB Graduate School

of Education will enable us to move to the leading edge in using the newly developed information in the classroom.

Another valuable outcome of our collaboration is the prospect that we can develop more effective instructional methods to teach geography that make more effective use of teachers' time and that cultivate the independent and creative reasoning skills of our students. The projects you are suggesting seem superbly apt for this purpose.

We look forward to cooperating with you in this most exciting venture.

Sincerely,

William J. Cirone

WJC:cll

Santa Barbara Community College District
Santa Barbara City College

January 20, 1988

Professor David Simonett
Department of Geography
University of California,
Santa Barbara
Santa Barbara, CA 93106

Dear Professor Simonett:

This letter is to communicate to you my strong support for your NISF proposal to establish a National Center for Geographic Information and Analysis through an institutional consortium which will include UCSB, SUNY/Buffalo and the University of Maine.

I am aware of the enthusiastic interest expressed to you by superintendents of K-12 districts in the South Coast area. I concur with their response. Having such a high level activity in our area would provide wonderful opportunities for cooperative programs to improve geography education in our schools.

We at Santa Barbara City College would also look forward to the possibilities of cooperative educational and research involvements which would focus on improving the quality of lower division geography instruction. We offer geography courses through our departments of History/Geography and Earth and Planetary Sciences. Furthermore, geographical material is also included in a range of other disciplines. The opportunity to work with the Center or in extended activities being considered by the Graduate School of Education would enhance what we do now and bring us into contact with the latest developments in the use of computer technology to more effectively teach geography. Obviously, the product of this involvement would not only benefit Santa Barbara City College, but also, potentially, the other 105 community colleges in our state.

721 Cliff Drive ▫ Santa Barbara, California 93109-9990 ▫ (805) 965-0581

I strongly believe that the Center could serve as a catalyst to bring together the university, community college and K-12 districts into a creative and powerful consortium. We have the interest, commitment to cooperate and the quality of professionals required to fulfill this potential.

If my staff or I can be of assistance to you in any way to further develop your proposal, please do not hesitate to call me. I look forward to working together and I wish you the best in your efforts.

Sincerely,

Peter R. MacDougall
Superintendent/President

PRM:jdm

STATE OF CALIFORNIA
GEORGE DEUKMEJIAN, Governor

DEPARTMENT OF FINANCE
SACRAMENTO, CA 95814-4998

November 17, 1987

Professor Waldo Tobler
Geography Department
University of California
Santa Barbara, CA 93106

Dear Professor Tobler:

We are pleased to extend an invitation to the Geography Department of the University of California, Santa Barbara to become an affiliate in our data center program. We have attached a copy of our guidelines for the affiliate program for your review. If the guidelines meet with your approval, please respond with a letter confirming your intent to participate in the program.

Please note that the attached publication list includes many 1970 and 1980 census publications. These publications will be sent to new affiliates subject to their availability. The list of 1990 census publications is not available at this time.

We have tentatively scheduled our next meeting of the affiliate network for February in San Diego. We are hoping that you will be able to attend this meeting and meet other members of our network. We would especially like to be able to discuss your workshop program and develop some interest in this workshop among our data center affiliates.

We are looking forward to your acceptance and working with you in your annual workshop.

Sincerely,

Richard A. Lovelady
Research Manager
State Census Data Center
Department of Finance
1025 P Street
Sacramento, CA 95814
(916) 323-4141

AFFILIATE DATA CENTER GUIDELINES

The Department of Finance (DOF), Population Research Unit, is the designated State Census Data Center (SCDC) for California. The SCDC is responsible for developing a network of suitable agencies to assist in the data center program. The SCDC network is currently comprised of five regional data centers and 40 affiliate data centers. The network is officially recognized by the Census Bureau as California's 'State Data Center' for the decennial census and all other census programs.

AFFILIATE RESPONSIBILITIES

The 40 affiliates in the SCDC network represent a variety of agencies and disseminate census data in somewhat different ways. The primary purpose of 38 of the affiliates is to disseminate census data from standard publications and/or computer files and provide public access to their census libraries. Two of the affiliates (University of Southern California and University of California, Santa Barbara) are categorized as specialized affiliates and do not have the same data dissemination responsibilities as the other 38. The following responsibilities apply only to USC and UCSB.

Workshops

USC - The Population Research Laboratory will be responsible for conducting an annual workshop dealing with a relevant census topic. The census topic will be based upon current research and analysis at USC, other universities and appropriate research agencies. The workshops will be open to the general public and a fee may be charged for the purpose of recovering the expenses incurred in arranging the workshop. Members of the SCDC affiliate network (one per affiliate) will receive a 50% discount on the workshop registration fee.

UCSB - The Geography Department will be responsible for conducting an annual workshop dealing with issues related to census geography and in particular issues dealing with the development and/or use of products from the Census Bureau's TIGER system. The workshops will be open to the general public and a fee may be charged for the purpose of recovering the expenses incurred in arranging the workshop. Members of the SCDC affiliate network (one per affiliate) will receive a 50% discount on the workshop registration fee.

Workshop publicity/advertisement

The affiliates will work with the SCDC to advertise and promote the workshops. Sufficient effort will be made to create interest in the workshops and maintain them on an annual basis.

STATE C .ALIFORNIA
GEORGE DEUKMEJIAN, Governor

DEPARTMENT OF FINANCE
SACRAMENTO, CA 95814-4998

September 18, 1987

Professor Waldo R. Tobler
Geography Department
University of California
Santa Barbara, CA 93106

Dear Professor Tobler,

The State Census Data Center (SCDC), California Department of Finance, is the central unit within State government responsible for disseminating census data to State and local government. To complement this data dissemination function, the SCDC maintains geographic data in the form of computer files and maps from the U.S. Census Bureau.

We are in process of upgrading our current capabilities in preparation for the 1990 census. As part of this upgrade, the SCDC would like to make a greater commitment towards providing state-of-the-art geographic products and services.

To accomplish this the SCDC would like to make full use of the products that will be created from the Census Bureau's Topologically Integrated Geographical Encoding and Referencing (TIGER) system. Given the technology in certain State Agencies, the Census Bureau, our university system, and in regional and local governmental agencies, a collective governmental effort should be capable of taking the initative to fully utilize and maintain the TIGER products.

The SCDC is currently searching for a university to work with us in such an effort. The SCDC currently has a network of 39 regional and affiliate data centers which works to improve and disseminate census products. The addition of a geography department to our affiliate program would provide us with direct access to academic research and analysis of the TIGER products.

Our main request would be for the university to sponsor a geographic information workshop on an annual basis to discuss current GIS research. (Registration fees are normally charged for this type of workshop to cover expenses.) We would also expect the university to prepare a GIS related article for our semi-annual newsletter. Both of these requests would seem to fit into your possible need to disseminate information about your GIS research.

In return the university will receive U.S. Census Bureau computer files (data and geographic) from the SCDC. The cost of these files would be negotiable and discounted at a rate consistent with the contribution made by the university to the SCDC. The SCDC would not fund the university for its participation. The Census Bureau also provides affiliates with free publications which may be of some additional cost-savings and interest to the university.

Our interest in a geography department may be of special interest to you if you feel that this type of working relationship would fit into your NCGIA proposal. Our concern though is that your decision to participate with the SCDC is not based solely upon the NCGIA proposal. We would prefer that interest in the SCDC program be based on an independent appraisal of our program and the value it would have to your department.

We would only encourage a university to participate in the program if it were mutually advantageous. We would clearly expect the university to be supportive of the SCDC and in turn we would support the University in its census related activities.

We have enclosed a copy of our preliminary plan for geographic products and services for the 1990 census to give you an idea of our plans. Also enclosed is a listing of the current regional and affiliate data centers.

We are planning to add a total of five new affiliates this fall and we would like to officially recognize them as soon as possible. If our proposal is of interest to you, please contact us as soon as possible. We will be in the Los Angeles area September 24-25 and we would like to arrange a convenient time to meet with you to discuss this program in more detail.

Sincerely,

Linda

Linda Gage
State Demographer
Population Research Unit
1025 P Street
Sacramento, CA 95814
(916) 322-4651

Enclosures:
Affiliate/Regional data center listing
Proposed 1990 plan for GIS

SDSU

DEPARTMENT OF GEOGRAPHY
COLLEGE OF ARTS AND LETTERS
SAN DIEGO STATE UNIVERSITY
SAN DIEGO CA 92182

(619) 265-5437

December 28, 1987

Dr. David Simonett, Dean
Graduate Division
University of California, Santa Barbara
Santa Barbara, CA 93106

Dear Dave:

Here is the information that I promised to send concerning the NSF GIS Center proposal. The Geography Department here would be interested in participating in the Center, should it be established at UCSB. I have included short vitae of those people that have expressed initial interest in participating in the Center, as well as a list of GIS equipment and related resources at our newly formed Center for Earth Systems Analysis Research (CESAR). Also, included is a copy of a workshop summary report that Allen Hope and I edited. The workshop sponsored by DOE involved the use of GIS and remote sensing techniques to extrapolate site specific information concerning arctic tundra ecology over larger areas of the North Slope of Alaska. I think the report characterizes one of our major research interests - using GIS and remote sensing to extrapolate results of site specific process studies over large areas. The rest of this letter will provide you a summary of GIS related capabilities and projects at SDSU, many of which are just beginning to take form.

Inspection of the equipment list for CESAR shows that we have a fair digital GIS and image processing capability. All three of our ERDAS systems have GIS software and one is dedicated to GIS with a high resolution display, polygon digitizing table and ink-jet color printer peripherals. One of the other units has a tape drive, topographic software and Matrix digital video copy camera (QCR). The third unit has a digitizing table and a video digitizer camera. The ARC/INFO GIS is up and running on a Vax 11/750, which is the campus link to the CRAY supercomputer network. We have about 4 or 5 Tektronix terminals and a large Calcomp plotter hooked up to this VAX for usage with ARC/INFO. I have received a copy of VMS-VICAR from JPL, (which will also run on the same Vax), so that we can do larger scene and more advanced processing than ERDAS will allow. We have a Raster Technology image display system to use with VICAR. Two Exotech 4-band handheld radiometers, an Everest TIR radiometer and two polycorders support our remote sensing signature

characterization and energy balance research activities. We will be ordering a CIR videographic system to mount on light aircraft and use with the radiometers. We have the luxury of having about 5 graduate students supported by the department to learn the systems well and act as consultants/system developers.

In terms of instruction we offer a graduate level GIS course (taught by Dick Wright) and several other courses which cover or use GIS. Dick Wright also teaches a course in automated cartography. I cover the interface between remote sensing and GIS in both my introductory and intermediate R.S. courses, as well as in my graduate seminar in remote sensing. Allen Hope teaches a course on watershed hydrology and will soon be teaching a course in biophysical remote sensing, both of which integrate GIS and remote sensing methods into the curriculum. Stuart Aitken uses GIS exercises in his urban and quantitative geography courses. We will likely be hiring a Urban Geographer with a background in GIS in the next two to four years.

Quite a few GIS research and data base development projects are ongoing or just under way at SDSU. Most of these projects are using the ERDAS/GIS, but others are using ARC/INFO. The projects are summarized with the principal faculty researcher(s) in parentheses as follows:

Measurement of evapotranspitation with combined solar reflective and TIR radiance observations, utilizing GIS of Konza Prairie Site developed by J. Dozier, funded by NASA as part of the First ISLSCP Field Experiment (FIFE), (A. Hope and S Goward [U. of Maryland])

Resources data base development and prescribed burning prioritiztion for Cuyamaca State Park, funded by Cal Parks and Recreation (through D. Van Cleve), (D. Stow, R. Wright and W. Oechel [Ecology])

Extrapolation of biophysical measurements and model results for the Toolik Lake R4D Test Site to the foothills of the N. Slope of Alaska, funded by DOE and involving the North Slope Burrough GIS (ARC/INFO) and Penn State (ERDAS) GIS (A. Hope, D.Stow and J. Reynolds [Ecology])

Analysis of changes in land use and agricultural practice using a multitemporal GIS for Uruguay (E. Griffin)

Development of a resources GIS and urban development plan for Otay Mesa (San Diego County), funded by WRT Planning Associates (R. Wright)

Assessing Pacific Mackeral habitats in the Southern California Bight using a ocean GIS containing aerial fish spotter, bathymetric and satellite oceanographic data, partially funded by a SDSU Grant-in-Aid grant (D. Stow)

Hydrologic modeling studies using a watershed-based GIS for the SDSU San Margarita Research Preserve (A. Hope, J. O'Leary and W. Oechel [Ecology])

Updating San Diego County land use maps in ARC/INFO GIS using digital SPOT and air photo data for the San Diego Area Governments (SANDAG), initial support from SANDAG, $500,000 proposal submitted to NASA with ERDAS, ESRI and Fred Mertz, Consultant (D. Stow)

GIS instruction using LANDTRAK as a Beta Site for Criterion Research, Inc. (R. Wright)

Instructional data base for Geography of Soils course based on the La Mesa 7.5' quadrangle (N. Greenwood)

Other projects in the works are:

GIS for vineyard siting and viticulture studies (A. Hope)

Development of a dynamic GIS interfacing numerical ecologic models and remotely sensed data for the Jornada Desert Long Term Ecological Research (LTER) site in New Mexico, 5-year proposal submitted to NSF (A. Hope, D. Stow and J. Reynolds [Ecology])

Establishing a GIS and remote sensing data base for the proposed Mediterranean LTER in southern California, 5-year proposal submitted to NSF (A. Hope, D. Stow and P. Zedler (Ecology)

Data base specification study for the San Diego Regional Urban Information System (RUIS), proposal submitted to RUIS (R. Wright with Criterion Research, Inc.)

This should give you an idea of what we are up to at SDSU in terms of GIS instruction and research. As you can see we are building some good working relationships with other academics (SDSU-Ecology, Penn State, New Mexico State and U. of Alaska), government agencies (SANDAG, San Diego County, Cal State Parks and Recreation) and industry (ERDAS, ESRI and Criterion). Please let me know if I can provide you with other information or aid you in some other way. Seasons Greetings!

Sincerely,

Doug

Doug Stow
Associate Professor

DAVID GASKELL
EXECUTIVE DIRECTOR

STATE OF NEW YORK
EXECUTIVE DEPARTMENT
DIVISION OF EQUALIZATION AND ASSESSMENT
AGENCY BUILDING #4 EMPIRE STATE PLAZA
ALBANY, NEW YORK 12223

December 30, 1987

President Steven B. Sample
State University of
New York at Buffalo
Amherst Campus
Amherst, New York 14260

Dear Dr. Sample:

On behalf of the New York State Division of Equalization and Assessment, I would like to state our interest and support for SUNY Buffalo's exciting proposal to the National Science Foundation (NSF) for establishment of a National Center for Geographic Information and Analysis. We are pleased to have the opportunity to add our expression of support to the establishment of a Center.

New York, and indeed the entire eastern United States, is critically concerned with spatial analysis problems. Establishment of a Center and research program focusing on closing the gap between theory and practice and advancing the state of the art in spatial analysis would be worthy indeed.

I am pleased to note that the consortium organized about the proposed Buffalo Center boasts an impressive interdisciplinary array of intellectual talent, drawing on the resources of such eminent institutions as the University of California at Santa Barbara and the University of Maine. Together with the depth and breadth of its expertise, the consortium also has some of the most sophisticated computing facilities in the country in this area. Thus, it possesses the intellectual and capital resources to ably implement the proposed Center's program and address important concerns in spatial analysis.

I also commend the programmatic focus of the Center. The major research thrust, an integrated systematic approach, and its clear commitment to technology transfer and public information, make the consortium's program tremendously valuable to the science and engineering communities, and to industry and the

The Division of Equalization and Assessment is heavily involved in the use of GIS and spatial analysis technology. Over the past few years, SUNY - Buffalo's Geographic Information Systems Laboratory, and the Division of Equalization and Assessment have maintained close contact on problems of mutual interest. I would like to see this cooperative activity continue and prosper as it certainly would under the auspices of a national center.

I am pleased, therefore, to reiterate the strong commitment of the Division of Equalization and Assessment for the SUNY Buffalo proposal.

Sincerely,

David Gaskell

Erie and Niagara Counties
Regional Planning Board

David J. Evans, Director

Michael J. McKernan
Chairman
Ronald H. Moline
Vice-Chairman
Merton S. Marshall
Secretary
Philip F. Frandina
Treasurer

November 12, 1987

Dr. Steven B. Sample, President
State University of New York at Buffalo
Capen Hall
Amherst, New York 14260

Dear Dr. Sample:

The Erie and Niagara Counties Regional Planning Board at its November 5th meeting voted unanimously to support the State University of New York at Buffalo's application to the National Science Foundation for designation as the National Center for Geographic Information and Analysis. The goals of the Center coincide with the needs of the Regional Planning Board in developing its regional geographic information system (GIS) in cooperation with local, state, and federal agencies; public utilities; and SUNYAB's GIS Lab.

Dr. Hugh Calkins and other members of the faculty, along with graduate students, have been very helpful in assisting the Regional Planning Board's efforts in moving the GIS project forward. We feel we have developed an excellent cooperative effort that is of benefit to the region and SUNYAB. Through mutual efforts, the GIS project is assuming a leadership position, not only regionally, but statewide and nationally.

We have no doubt that the designation of SUNYAB as the National Center for Geographic Information and Analysis would greatly strengthen our efforts. We would look forward to developing an even closer cooperative arrangement that would assist in forwarding the goals of the center as well as the goals of the region.

We look forward to an affirmative decision by the National Science Foundation and strengthened ties with the new Center. I speak for the twenty-one members of the Regional Planning Board who represent a broad constituency in the region as well our staff in stating our support.

Sincerely,

Michael J. McKernan
Chairman

cc: Dr. Hugh Calkins

3103 Sheridan Drive • Amherst, New York 14226 • Erie County (716) 837-2035 • Niagara County (716) 625-8114

ZYCOR INC.
220 Foremost Dr. • Austin, Texas 78745-7324
Telephone: 512/282-6699 TWX: 9108742018

January 21, 1988

Dr. David S. Simonett
Dean of Graduate Division
University of California at Santa Barbara
Santa Barbara, California 93106

Dear Dr. Simonett:

I am writing to indicate ZYCOR's desire to participate in the National Center for Geographic Information and Analysis. We have several highly capable scientists who have played major roles in past research efforts concerning spatial data handling and computer cartography techniques. Mr. Steve Zoraster has completed research on terrain modeling and cartographic generalization. Mr. Steve Smyth and Mr. Robert F. Brown have many years experience in the modeling and structuring of spatial data, including the development of a generic spatial model, a spatial query language, data exchange standards, and the integration of raster and vector data. Mr. Zoraster and Mr. Brown have both managed research projects ZYCOR conducted for the U.S. Army Engineering Topographic Laboratories and the Defense Mapping Agency. Resumes for key ZYCOR staff members are available upon request.

ZYCOR can support the National Center for Geographic Information and Analysis in several ways. We can make at least one scientist available to attend the center's "kickoff meeting". This will help ensure that industry has a voice in establishing the necessary goals for geographic information and analysis research. ZYCOR can offer a summer employment position to any qualified graduate student working at the center. ZYCOR is also willing to participate in writing joint proposals with the University of California at Santa Barbara.

Sincerely,

Dale M. Davis

Dale M. Davis
Vice President

DMD/sjs

UNIVERSITY OF CALIFORNIA, SANTA BARBARA

BERKELEY • DAVIS • IRVINE • LOS ANGELES • RIVERSIDE • SAN DIEGO • SAN FRANCISCO

SANTA BARBARA • SANTA CRUZ

DEPARTMENT OF GEOGRAPHY

SANTA BARBARA, CALIFORNIA 93106

January 20, 1988

Dear_____

I write to confirm our discussions regarding possible contributions by _____ to the proposed National Center for Geographic Information and Analysis.

The three institutions which have joined as a consortium to propose to the National Science Foundation for the Center are the University of California, Santa Barbara, which will be the lead institution; the State University of New York, Buffalo; and the University of Maine.

Attached to this letter we give the National Science Foundation RFP and a summary of the central elements of our proposal which we request that you treat as confidential until the award is announced in the June 1988 time frame.

As soon as our proposal is submitted, we will provide the full submission to _____ for your consideration.

After you have read our summary, we would be interested in knowing:

a) What are your specific research interests and needs, and are they in good correspondence with those of the consortium's submission?

b) Are there areas of research interests and/or needs given in our proposal where the National Center and _____ could fruitfully cooperate?

c) Are there areas of research interest or needs which we do not at present address, but that you would wish one or more members of our consortium to examine and where we might cooperate in ways of value to you, and

d) Are there specific areas where cooperation is feasible and likely, and is there specific support which you might be prepared to consider which is related to such areas?

Support can be granted to the Center, or targeted to one of the three institutions. We envisage corporate support as taking a number of forms:

1. Corporate Research Sustaining Members: $50,000, annually, unrestricted research funds, or negotiated research topics of mutual benefit.

2. Corporate Research Sponsors: $25,000 annually, unrestricted research funds, or negotiated research topics of mutual benefit.

3. Graduate Research Fellowships: $20,000 fellowship annually to support one graduate student researcher working on a Ph.D.

4. Graduate Training Fellowship Grants/Internships: $12,000 annually (for the nine-month academic year); plus a summer internship in your facilities - with an appropriate stipend. Intended for two-year support of Master's Degree candidates.

5. Capital gifts for the purchase of hardware.

6. Gifts of company-produced hardware, or much reduced prices for such hardware.

7. Gifts of company produced software, or much reduced prices for such software.

8. The secondment of research and/or development personnel from the corporation to participate in workshops, extended research seminars, and as members of research teams at one of the Center sites.

9. Other forms of corporate support would certainly be appropriate, including special training programs and individual consultancies. Special training programs could be held for your staff either at one of the three institutions, or on-site at your facilities, for a mutually-agreed upon financial or in-kind arrangement. Consultancies might be either inside or outside the operation of the Center.

Companies and corporations which contribute one graduate training grant per annum or its equivalent ($12,000 annually) will become Corporate affiliates of the Center, and will participate in the annual research reviews through sending two persons to these reviews. They will also receive all publications of the Center automatically.

The members of our consortium look on this proposed center as a major opportunity to advance the research and operational status of Geographic Information Systems and Geographic Analysis. We are most interested in establishing strong interaction and contacts with industry and hope that we will be able to work closely with you and your colleagues.

Appendix G
GIA/GIS Courses and Related Courses

In the following pages are given, for each of the consortium institutions, the presently available course offerings in GIA/GIS, and related or supporting courses. With the added faculty resources already committed by the three institutions it will be possible to significantly strengthen the GIA/GIS offerings in all three institutions. Thereby, three already strong educational programs will be further improved. As may be seen a diverse array of courses are available, and various specializations within GIA/GIS are presently possible within or between the consortium partners. Future specializations will be further enhanced.

University of California, Santa Barbara
GIA/GIS and Related Courses

GEOGRAPHY

101. Spatial Analysis
(4) Couclelis
Prerequisite: Geography 3 or 5, or consent of instructor. Mathematics 11A recommended. Lecture, 3 hours; discussion, 1 hour.
Basic principles of modeling human and environmental systems, emphasizing major approaches and mathematical methods. Examples include applications in fields such as ecology, water resources, transportation, decision making, etc.

103. Computational Concepts in Geography
(5) Dozier
Prerequisite: Computer Science 5 (any one) or equivalent.
Software tools, programming languages and concepts, computational methods, and program packages for geography. Applications in physical and socioeconomic geography, remote sensing, and cartography.

107. Introduction to Regional Modeling and Planning
(4) Anselin
Prerequisite: junior standing or consent of instructor.
Introduction to the analysis of geographically separated regions. Topics include: definition of a region, industrial location, regional input-output analysis, migration issues, trade and interregional transportation, interregional environmental issues, spatial decision making and conflict resolution, and regional development.

109. Location and Environmental Issues in Planning
(4) Church
Prerequisite: Geography 3. Lecture, 3 hours; laboratory, 1 hour.
Location/allocation and environmental issues in planning by governments and the private sector. Conflicts over location. Location/allocation models, and environmental issues in locating pipelines, powerlines, highways, dams, retail outlets, and similar ventures.

115B. Geographic Remote Sensing Techniques
(4) Estes, Staff
Prerequisites: Geography 115A-AL, or equivalent, or consent of instructor. Must be taken concurrently with Geography 115BL. Lecture, 3 hours.
Human and computer interpretation of environmental phenomena recorded by orbital and aerial multispectral sensing systems. Emphasis is on the nature of the data recorded and the extraction of useful decision information. Contemporary LANDSAT data is used. Laboratory uses an interactive image analysis program.

115BL. Laboratory in Geographic Remote Sensing Techniques
(1) Estes, Staff
Prerequisites: Geography 115A-AL, or equivalent, or consent of instructor. Must be taken concurrently with Geography 115B. Laboratory, 4 hours.
Laboratory analysis of space photography, and multispectral scanner analog and digital products. Interactive processing of LANDSAT digital tapes.

115C. Intermediate Geographic Remote Sensing Techniques
(4) Staff
Prerequisites: Geography 115B-BL or consent of instructor. Must be taken concurrently with Geography 115CL. Lecture, 3 hours.
Intermediate instruction in the interpretation of environmental phenomena recorded by satellite imaging systems with emphasis upon digital analysis.

115CL. Laboratory in Intermediate Geographic Remote Sensing Techniques
(1) Staff
Prerequisites: Geography 115B-BL or consent of instructor. Must be taken concurrently with Geography 115C. Laboratory, 4 hours.
Laboratory exercises employing VICAR and IBIS software; interactive and batch digital processing.

125. Introductory Computer Cartography
(4) Tobler
Prerequisite: Geography 3 or 5 or Computer Science 5 FO or consent of instructor. (Computer Science 5 may be concurrent.) Lecture, 2 hours; laboratory, 4 hours.
Introduction to the digital coding, storage, manipulation, and graphical display of geographical data. Algorithms and equipment useful for digitization and interactive cartography, including vector and raster display. Rudiments of geocoding, geoprocessing, and geographic information systems.

127. Cartographic Transformations
(4) Tobler
Prerequisite: Mathematics 11A, or 34B, or 5B, or consent of instructor. Lecture, 3 hours.
Classical map projections; cartograms; empirical "rubber sheeting"; bi-dimensional regression. The geometry of geography; geodesics; geographical circles; the distortion tensor; non-symmetric distances.

129. Special Topics in Cartography
(4) Tobler
Prerequisites: Geography 118A and 125, or consent of instructor. May be repeated for credit to a maximum of eight units. Lecture, 3 hours.
Examination of selected topics in cartographic research; topic may vary from year to year, to represent current research interests of faculty.

146. Introduction to Transportation Systems Analysis
(4) Staff
Prerequisite: Economics 1 or consent of instructor. Lecture, 3 hours.
Introduction to the analysis of inter- and intra-city passenger and freight movements. Geographic and economic concepts are used to develop predictive and optimal design/maintenance models for the transportation system. Applications of the models are stressed.

174. Techniques in Geographic Data Analysis II
(3) Michaelsen, Anselin
Prerequisites: Geography 172 and 172L. Must be taken concurrently with Geography 174L. Lecture, 3 hours.
Analysis of spatial data. Spatial autocorrelation, autoregressive and moving average models, regression

174L. Laboratory in Geographic Data Analysis II
(2) Michaelsen, Anselin
Prerequisite: must be taken concurrently with Geography 174. Lecture, 2 hours; laboratory, 3 hours.
Calculation and computation methods as appropriate to Geography 174. Design and implementation of computer programs for analyzing spatial data.

176. Introduction to Geographic Information Systems
(4) Estes
Prerequisites: Geography 115B or 118A or 109, or consent of instructor. Lecture, 2 hours; laboratory, 2 hours.
Introduction to modern spatial data processing, development, implementation, and functions of geographic information systems; relations between GIS and remote sensing; and applications of geographic information systems to a variety of environmental issues are discussed.

183. Uncertainty and Spatial Decision Processes
(4) T. Smith
Prerequisite: Geography 5 or Economics 1 or 109. Lecture, 3 hours.
This course will concentrate on spatial decision making in the face of uncertainty, with references to consumer behavior, migration decisions, and geographical location decisions. Particular emphasis will be placed on information acquisition and mean-variance models.

185. Geography Planning and Policy Making
(4) Couclelis
Prerequisite: Geography 5, 106 or 109 or Environmental Studies 116.
Relevance of geographic knowledge and skills to aspects of planning and policy making. Includes review of core concepts in decision making, planning theory, systems, analysis, information systems, urban and regional modeling, forecasting, impact analysis, implementation of decisions, planning politics.

190. Location Theory in Geography
(4) Church, Anselin
Prerequisite: Geography 101 or Economics 1 or 109, or consent of instructor. Lecture, 3 hours.
An in-depth analysis of the processes underlying the spatial distribution of human economic activity through the use of models. Attention to agricultural, industrial, and settlement patterns.

191. Introduction to Optimization Models for Geographic Problems
(4) Church
Prerequisite: Mathematics 11A or consent of instructor. Lecture, 3 hours.
Survey of optimization techniques with applications to geographical problems. Methods include linear programming, dynamic programming, integer programming, networks, and queuing.

192. Urban and Environmental Systems Analysis
(4) Church
Prerequisite: Geography 101 or Economics 1 or 109, or consent of instructor. Lecture, 3 hours.
Applications of operations research techniques and decision analysis in structuring approaches to urban and environmental problems. Examples are drawn from problems in facility location, regional models, transportation and other networks, utility corridors, and similar problems.

216L Remote Sensing Instrumentation
(4) Dozier
Prerequisites: Geography 102 and 115B or consent of instructor. Seminar, 3 hours.
Radiometric and geometric characteristics of remote sensing instruments including satellite radiometers, digital and analog output devices, and instruments for ground investigations in support of remote sensing. (T)

216S. Remote Sensing Software
(4) Dozier
Prerequisite: Geography 103. Lecture, 3 hours.
Analysis and development of software systems for remote sensing data. (T)

220. Seminar in Regional Analysis
(4) Tobler, Couclelis, Anselin
Prerequisites: Geography 172 and 172L or 270 and 270L or consent of instructor. Seminar, 4 hours.
Study of current research in regional analysis. The topic will differ each year and will be announced in advance. (S)

221. Seminar in Transportation Geography
(4) Tobler
Prerequisites: Geography 172 and 172L, Geography 296 or concurrent enrollment or consent of instructor. Lecture, 2 hours; seminar, I hour.
Mathematical and statistical models of passenger and freight transportation systems. Both predictive and design models will be emphasized, as well as models used in public policy analysis. (S)

222. Spatial Decision Making
(4) T. Smith
Prerequisites: Geography 153 or 183; consent of instructor. Seminar, 3 hours.
Study of current theories and empirical evidence concerning decision making in a spatial context by individuals, firms, and government agencies. (S)

226. Consumer Spatial Behavior
(4) Golledge
Prerequisites: Geography 153 and 172 and 172L or equivalent; consent of instructor. Seminar, 3 hours.
Theories and models of the spatial aspects of both rural and urban consumer behaviors; market spatial choice models. (S)

228. Multidimensional Analysis of Spatial Problems
(4) Golledge, Tobler
Prerequisites: Geography 172 and 172L or equivalent; consent of instructor. Seminar, 3 hours.
Principles of multidimensional unfolding and scaling, applications and use of scaling algorithms to spatial problems, clustering; problems of large data sets, other multidimensional techniques. (ST)

270. Techniques for Geographic Data Analysis
(4) Staff
Prerequisites: Geography 172-172L, and Mathematics 11A or 108A or equivalent. Geography 270L required. Seminar, 3 hours.
Intermediate quantitative techniques as applied to geography. Flow networks, trend surface analysis; Markov processes, clustering algorithms; multivariate methods. (T)

270L. Laboratory in Geographic Data Analysis
(2) Staff
Prerequisite: must be taken concurrently with Geography 270. Laboratory, 2 hours.

Calculation and computation methods as appropriate to Geography 270 intermediate skills in computer programming; use of various standard computation programs. (T)

274. Classification and Clustering in Geographic Data Analysis
(4) Staff
Prerequisites: Geography 115B and 115BL, 172 and 172L. Lecture, 3 hours.
Classification and clustering in real and metric space with applications for human geography, physical geography, and remote sensing. Spatial weighting and spatial constraints in classification models. (T)

275. Seminar in Geographical Information Systems
(4) Simonett, Tobler
Prerequisites: Geography 125 or equivalent; consent of instructor. Seminar, 4 hours.
Study of current trends in geographically oriented information processing systems. (ST)

276. Distributed Computing and Computer Networks
(4) Staff
Prerequisite: Computer Science 270A
Distributed processing task partitioning, inter-process communication, synchronization, reconfiguration, file allocation, and deadlock problems; computer communication network models, analysis and synthesis. (S)

276L. Advanced Laboratory in Geographic Data Analysis
(2) Michaelsen, Anselin
Prerequisite: must be taken concurrently with Geography 276. Lecture, 2 hours; laboratory, 3 hours.
Calculation and computation methods as appropriate to Geography 276. Design and implementation of computer programs for analyzing spatial data. (T)

283. Seminar in Uncertainty and Spatial Decision Processes
(4) T. Smith
Seminar, 3 hours.
Advanced readings in this course will concentrate on spatial decision making in the face of uncertainty, with references to consumer behavior, migration decisions, and geographical location decision. Particular emphasis will be placed on information acquisition and mean variance models. (S)

294. Advanced Topics in Location and Transportation Systems
(4) Church
Prerequisite: Geography 190 or 191 or consent of instructor. May be repeated more than once with changes in content, methods, and applications areas examined.
Study of current research and application of systems models in the analysis, design, operation, and scheduling of transport and location problems. (S).

295A. Artificial Intelligence–Cognitive Modeling I
(4) T. Smith
Prerequisite: Computer Science 185 recommended. Lecture, 4 hours.
Computer programming techniques for processing information in an "intelligent" manner. LISP language, control structure (pattern-directed vs. goal-directed), knowledge structures (declarative vs. procedural), and problem solving (search and inference) will be presented. (TS)

295B. Artificial Intelligence–Cognitive Modeling II
(4) T. Smith
Prerequisite: Geography 295A. Lecture, 4 hours.
Computer programming techniques for processing information in an "intelligent" manner. LISP programming will be emphasized, as will techniques for incorporating learning and analogies. Other topics are: expert systems, imagery, pattern recognition, planning, natural languages, story understanding, and spatial knowledge representation. (TS)

296. Nonlinear Systems and Geographic Analysis
(4) Staff
Prerequisite: Geography 291 or consent of instructor. Lecture, 3 hours.
Survey of nonlinear systems analysis with applications to geographical problems. Methods include nonlinear programming and Kuhn-Tucker analysis, complementarity theory, and variational inequality theory. Extensive use of computer software packages. (ST)

COMPUTER SCIENCE

174. Data Base Management Systems
(4) Staff
Prerequisites: Computer Science 130B and 170. Open to computer science majors only or consent of department.
Data base systems architecture, network, hierarchical and relational systems; data base languages; data base operational requirements. (W,S)

180. Computer Graphics
(4) Staff
Prerequisites: Computer Science 130B. Open to computer science and electrical and computer engineering majors who are seniors or graduate students, or consent of instructor. This course is the same as ECE 180.
Basic display techniques, display devices, vector generation, display processors; homogeneous coordinates, transformations and clipping; graphic systems, interactive graphics, introduction to curve and surface representations; hidden line and surface elimination algorithms. (W)

165. Machine Intelligence
(4) Smith
Prerequisites: Computer Science 130B or consent of instructor. Open to declared computer science majors only or consent of department.
Machine intelligence is concerned with computational techniques for representing and reasoning about complex objects. Topics covered include some of the machine intelligence programming languages, data structures, control structures, and problem solving techniques used in both research and application. (W)

265. Advanced Topics in Machine Intelligence
(4) T. Smith
Prerequisites: Computer Science 165 or consent of instructor.
Topics covered include advanced programming techniques for representing and reasoning about complex objects, and various applications of such techniques including expert systems, natural language processors, image understanding systems, and machine learning. (S)

276. Distributed Computing and Computer Networks
(4) Staff
Prerequisite: Computer Science 270A.
Distributed processing task partitioning, inter-process communication, synchronization, reconfiguration, file allocation, and deadlock problems; computer communication network models, analysis and synthesis. (S)

278. Simulation
(4) Bondi
Prerequisites: Probability and Statistics 121A and Computer Science 130A.
Model formulation and programming for discrete event systems. Considerations in the design and implementation of simulation languages; statistical considerations; design of experiments, random number generation, data analysis. (F)

280. Computer Graphics
(4) Staff
Prerequisite: Computer Science 180.
Selected topics in computer graphics including: advanced display architectures; graphic representations of three-dimensional objects; techniques for achieving visual realism, shadows, antialiasing, and texture; advanced color and lighting models; ray tracing algorithms; stereoscopic projection; contour generation; mapping; metafiles; graphic standards. (S)

274. Advanced Topics in Data Base Management Systems
(4) Konheim
Prerequisite: Computer Science 174.
Data models, semantics and translation; data integrity; data base languages; design and evaluation of storage structures; associative processors; data base design tools and methodology; distributed data bases. (S)

ELECTRICAL AND COMPUTER ENGINEERING

169. Introduction to Computer and Communication Networks
(4) Staff
Prerequisite: ECE 154 or consent of instructor. Not open to students who have taken CMPSC 176. Lecture, 4 hours.
Network topology and architecture. ISO reference model. Protocols on physical link and network layers. Telecommunication subnet. Routing. Congestion. Polling. Multiplexing and concentration. Block and cyclic codes. Satellite and radio networks. Poisson distribution. Circuit, message, and packet switching. Local networks. (S)

178. Fundamentals of Computer Image Processing
(4) Wade
Prerequisites: ECE 15A and ECE 130A-B, or consent of instructor. Lecture, 3 hours; discussion, 1 hour.
Basic concepts in image processing. Techniques, capabilities, and limitations with emphasis on use of digital computer but also of optical and analog systems. Image sampling, reconstruction, enhancement, restoration, data extraction, and coding. Some hands-on laboratory experience is offered. (S)

180. Computer Graphics
(4) Scherson
Prerequisite: Computer Science 130B. Same as Computer Science 180.
Basic display techniques, display devices, vector generation, display processors; homogeneous coordinates, transformations and clipping; graphics systems; interactive graphics; introduction to curve and surface representations; hidden line and surface elimination algorithms.

205A. Theory of Information
(4) Heidbreder
Prerequisites: ECE 140 or equivalent, or Mathematics 122A-B or equivalent, or consent of instructor. Lecture, 4 hours.
The concept of information and its quantitative measure, description of information sources in terms of Markov processes, discrete noiseless channels, channel capacity, noisy channels, continuous channels, signal design for noise immunity, error detection coding, and other applications of information theory in communications. (S)

237. Advanced Network Theory
(4) Mitra
Prerequisites: ECE 139A-B or consent of instructor. Lecture, 4 hours.
Foundations of network theory. Graph theory and network equations, network functions and representations, state equations, integral solutions, scattering matrices. (W)

277B. Pattern Recognition
(4) Wood
Prerequisites: ECE 130A-B, ECE 15A, or consent of instructor. Lecture, 4 hours.
Algorithms used in the automatic recognition of patterns by machine. Machine learning and classification problems, scene analysis, speech recognition, and character recognition techniques will be covered. (W; offered every other year.)

278. Computer Image Processing
(4) Wade
Prerequisite: ECE 178 or its equivalent, or consent of instructor. Lecture, 3 hours; laboratory, 3 hours.
Processing of pictorial information by computer including digital, optical, and other analog methods. Follow-on course to ECE 178 with concepts presented at a somewhat more advanced level. Laboratory experience is offered. (F)

279. Computer System Performance Evaluation
(4) Wood
Prerequisites: ECE 140, ECE 154, Computer Science 170, or consent of instructor. Lecture, 4 hours.
Overview of the evaluation of computer system performance. Measurement, simulation, and analytic techniques for performance analysis. System work load characterization. Examples of performance evaluation for system selection, tuning, and design. Evaluation of program performance. (F)

280. Computer Graphics
(4) Scherson
Prerequisite: Computer Science 180.
Selected topics in computer graphics including: advanced display architectures; graphic representations of three dimensional objects; techniques for achieving visual realism, shadows, antialiasing, and texture; advanced color and lighting models; ray tracing algorithms; stereoscopic projection; contour generation; mapping; metafiles and graphic standards.

MECHANICAL AND ENVIRONMENTAL ENGINEERING

154. Introduction to Computer-Aided Design/Manufacturing
(3) Hickman
Prerequisites: ME 14, 15, 140A-B, 151A-B-C, 152A-B, and ME 163A.
Introduction to computer-aided design program creation. A brief introduction to UNIX and Plot 10, applied to FORTRAN-based programs. Three-dimensional transfer. Motions and general rotation. Extensive project involvement is expected on the part of the students. (F,S)

157A. Design of Optimal Systems
(3) Staff
Prerequisites: ME 140A-B
Application of operations research methods to the design of engineering components and systems. Treatment of engineering design as a nonlinear constrained optimization problem. Algorithms for linear and nonlinear programming. Computer applications using a general purpose optimization program. (W)

157B. Design of Optimal Systems
(3) Staff
Prerequisite: ME 175A. Open to ME majors only.
Continuation of probability and statistical procedures. Application of computer simulation method to the design, optimization, and use of complex systems. (S)

ENVIRONMENTAL STUDIES

135. Principles of Environmental Planning
(4) Staff
Prerequisite: Environmental Studies 116 or consent of instructor.
Lecture, 3 hours.
An introduction to the history and theory of urban, regional, national, and international planning for responsible use of the environment. Field trips to local urban areas. (F,S)

138. Economics and Land Use
(4) Caswell
Prerequisites: Economics 1 and 2, or Economics 109 or consent of instructor. Lecture, 3 hours.
Economic analysis of the use of land-based natural resources for agriculture, housing, and recreation. Public policy issues such as growth control, zoning, and coastal protection will be included in the analysis. (W)

160. Introduction to Demography
(4) Schuyler
Lecture, 3 hours.
A study of past, current and future trends of United States and global populations. Fertility, mortality and immigration are studied in detail as the major variables that describe the size and structure of population. Social, political and economic policies that affect population are examined. (S)

163B. Ecodevelopment: Models and Applications
(4) Allen
Prerequisites: Environmental Studies 164, 163A, or consent of instructor. Second of two-quarter sequence. Lecture, 3 hours; laboratory, 2 hours.
Presents models for planning the use of water, energy, non-fuel minerals, forest, and housing resources, and develops decision-making tools for resolving issues of location, allocation, and intertemporal use within the context of economic development of underdeveloped areas. (S)

164. Introduction to Environmental Analysis
(4) Jones
Prerequisites: Environmental Studies 11, 12, and 13, or consent of instructor.
Introduction to problems and practice in analysis of man's environment. Environmental management in ancient and modern cultures, major natural resources and characteristic ecosystems of the United States, concepts and methods on environmental management. Emphasis on critical analysis of environmental impacts.

177. Advanced Environmental Economics
(4) Caswell
Prerequisite: Economics 115, or consent of instructor. Lecture, 3 hours.
The course emphasis is on the economic analysis of contemporary environmental problems and the policy alternatives for their solution. Topics may include toxic substances, acid rain, endangered species, and recreation valuation. (W)

GEOLOGICAL SCIENCES

252. Geophysical Time Series Analysis
(3) Prothero
Prerequisites: Mathematics 5A-B-C, or equivalent. Seminar, 3 hours.
Basic principles of time series analysis and signal processing. Applications to geophysical data, including Fourier transforms, convolution, filtering, confidence limits, response functions, collection and processing of data, noise, power spectral density, and cross-correlation. Problems requiring the use of the computer are assigned. (F)

MATHEMATICS

131. Linear Optimization and Game Theory
(4) Staff
Prerequisite: Mathematics 108A or consent of the instructor.
Solving linear inequalities and the simplex method for finding the "best" situation. The duality theorem. Applications will include the equilibrium theorem of mathematical economics and the theory of two-person games. Opportunities will be available for students to use the computer.

132A. Introduction to Operations Research
(4) Staff
Prerequisites: Mathematics 3A-B-C or equivalent and 11A.
Deterministic methods. Linear programming: the simplex method, applications to the transportation and assignment problems, problem formulation and computation; introduction to nonlinear programming; dynamic programming; network analysis, shortest route, minimal spanning tree, and maximal flow problems, PERT including the critical path method.

132B. Introduction to Operations Research
(4) Staff
Prerequisite: Probability and Statistics 120A or 121A or Economics 141A.

Probabilistic models. Review of probability; queuing theory; waiting line models, birth and death processes, applications; inventory theory; Markov chains and applications; game theory; computer simulation.

132C. Introduction to Operations Research
(4) Staff
Prerequisites: Mathematics 132A-B.
Advanced topics. Markovian decision models; component and system reliability; decision analysis; list and area searching; linear optimization; duality, reduction of games, sensitivity analysis, special techniques and algorithms; nonlinear optimization; quadratic and convex programming; integer programming; classic case studies in operations research.

137A-B. Graph and Network Theory
(4-4) Staff
Prerequisites: Mathematics 108A or 111A or 136A or consent of instructor.
Basic elements of graph theory, including paths, circuits, trees, planarity, duality, covering, matching. Elements of network theory.

145. Introduction to Topology
(4) Staff
Prerequisites: Mathematics 11A-B-C or Mathematics 5A-B-C or appropriate portions of Mathematics 5S.
Metric spaces, continuity, compactness. Classification of surfaces, Euler characteristic, fundamental groups. Further topics at the discretion of the instructor.

226A. Foundations of Topology
(4) Staff
Prerequisites: Mathematics 118A or equivalent.
Topological spaces, continuity, homeomorphisms, connectivity, compactness, subspaces, product spaces, quotient spaces, metric spaces, paracompactness, separation axioms, Urysohn's Lemma.

226B. Manifolds
(4) Staff
Prerequisite: Mathematics 226A or consent of instructor.
Topological manifolds, differential manifolds, inverse and implicit function theorems, Brown-Sard theorem, Transversality, tangent bundles, normal bundles, bordism and cobordism, classification of low dimensional manifolds, handle body structures.

226C. Homotopy Theory
(4) Staff
Prerequisite: Mathematics 226B or consent of instructor.
Homotopy groups, exact sequences, fiber spaces, covering spaces, van Kampen theorem.

244A. Advanced Mathematical Models in Modern Economics
(4) Staff
Prerequisite: consent of instructor.
Mathematical models in modern economics selected from these topics: demand, production, input-output, competition, equilibrium stability, cycles, control, growth, welfare.

244B. Advanced Mathematical Models in Modern Engineering Science
(4) Staff
Prerequisite: consent of instructor.
Mathematical models in modern engineering sciences selected from these topics: networks, mechanical systems, optics, electromagnetics, energetics, information, entropy, statistical mechanics, quantum mechanics, solid state, plasmas.

252A-B. Theory of Formal Languages
(4-4) Staff
Prerequisite: Mathematics 251A.
Structure theory of classes of languages and their specification by means of generative devices, machines, and algebraic characterizations. Decidable and undecidable properties and the complexity of decidable properties. Much of the theory will be developed as an extension of the theory of context-free languages.

BIOLOGICAL SCIENCES

280. Ecological Theory
(3) Botkin
Prerequisites: basic course in ecology; knowledge of computer language; mathematics through calculus or matrix algebra. Lecture, 2 hours; laboratory, 1 hour.
Exposure to fundamental issues underlying the development of ecological theory and to the content of some of that theory. Laboratory provides experience in the use of computer simulation in ecological theory. (W)

ECONOMICS

141A-B-C-D. Econometrics
(4-4-4-4) Cooley, DeCanio
Prerequisites: Mathematics 3A-B-C or equivalent. Credit not given for both Economics 141A-B-C and Probability and Statistics 120A-B-C.
The application of quantitative methods in economics.
141A will cover probability and its use in decision theory, distributions and their application to the distribution of income and firms, inference and hypothesis testing and their application in econometric estimation and model construction. (F)
141B will continue with estimation covering the general linear regression model. Bayesian procedures and applications of nonparametric techniques. (W)
141C will discuss specific problems which arise in the course of estimating economic models, such as the use of dummy variables, heteroscedasticity, multicollinearity, autocorrelation, and an introduction to simultaneous equation estimation. (S)
141D will cover extensions of the general linear model, simultaneous equations estimation, identification, dynamic model structure, and limited dependent variable estimation. Emphasis is given to both theoretical development and applications of the basic theory.

147. Introduction to Econometrics
(4) Cooley, Parke, Bencivenga
Prerequisites: Economics 1, 2, and 5.
A course in the development of economic models, analysis of specific functional forms, and the application of forecasting and estimation techniques. Emphasis is placed on the student's use of the computer facility as an aid in applying these techniques for the study of social and economic problems.

148. Applied Econometrics
(4) Cooley, Parke
Prerequisite: Economics 147 or Economics 141C.
For students familiar with basic regression theory, this course examines particular econometric models and some advanced econometric techniques. Typical topics include consumption, production, and investment functions, income determination models, and simul-

taneous equations macroeconomic forecasting models.

149. Data Management and Statistical Software
(4) Staff
Prerequisite: Economics 147 or Economics 141C.
Database management and application of statistical methods stressing basic programming concepts, algorithms, data structure, database creation, management, and control. SAS (Statistical Analysis System) employed as primary language for data manipulation, programming, and econometric analysis. Direct use of campus computer facilities.

206. Operations Research
(4) Sengupta
Prerequisites: Economics 105A, Economics 205B, or consent of instructor.
Topics in applied methods of operations research selected from stochastic programming, statistical decision theory, inventory control, and queuing.

209. Introduction to Operations Management
(4) Staff
Prerequisite: Mathematics 3B or equivalent. Students who have received credit for Economics 205C will not receive credit for this course.
Linear and non-linear programming, queuing theory, inventory theory, and other topics in operations research with applications to business and economics.

220A-B. Urban and Regional Economics
(4-4) Shapiro
A: The theory of city and regional economics. Economics theory when distance is taken as an important determinant of economic activity.
B: Urban and regional policy. The application of theory to policy decisions.

248. Applied Econometrics
(4) Cooley, Parke
Prerequisites: Economics 147/247 or Economics 141C/241C.
For students familiar with basic regression theory, this course examines particular econometric models and some advanced econometric techniques. Typical topics include consumption, production, and investment functions, income determination models, and simultaneous equations macroeconomic forecasting models.

249. Data Management and Statistical Software
(4) Staff
Prerequisites: Economics 147/247 or Economics 141C/241C.
Database management and application of statistical methods stressing basic programming concepts, algorithms, data structure, database creation, management, and control. SAS (Statistical Analysis System) employed as primary language for data manipulation, programming, and econometric analysis. Direct use of campus computer facilities.

SOCIOLOGY

106. Computer Simulation of Social Processes
(4) Sonquist
Prerequisite: upper-division standing or one prior course in sociology.
Applications of computer simulation methodologies in the analysis of social and political processes.

107. Demographic Analysis
(4) Straits
Prerequisite: upper-division standing or a prior course in sociology.
Analysis of published demographic research with special reference to the accuracy of data from censuses and other sources; standardization and other methods for controlling differences in population composition; computation and use of rates and indexes, population estimates and projections.

108. Introduction to Mathematical Sociology
(4)
Prerequisites: Mathematics 30 and any two upper-division courses in sociology; or the consent of instructor.
Analysis of social systems through the use of mathematical tools; survey of structural, quantitative, and stochastic models.

109A. Introduction to Computing for Social and Behavioral Sciences
(4) Sonquist
Prerequisite: upper-division standing or one prior course in sociology.
Introductory computer science concepts, programming principles, and fundamentals of information processing as it applies to research and text processing in social science research.

109B. Computer Applications in the Social Sciences
(4) Sonquist
Prerequisites: Sociology 109A, Engineering 3, Mathematics 6A, or equivalent, or consent of instructor.
Survey of computer applications in the social sciences: statistical analysis, research data management, simulation, control of experiments, content analysis and analysis of text, information retrieval, etc.

109C. Special Topics in Computer Applications in Social Science
(4) Sonquist
Prerequisites: Sociology 109A, or equivalent, or consent of instructor. May be repeated for credit to a maximum of 12 units.
An advanced course dealing with topics selected by the lecturer. The emphasis will be on areas of computer applications within the social sciences such as research data base management, statistical computation, computer control of experiments, content analysis, information retrieval, and simulation of social systems.

110. Data Processing and Analysis
(4) Sonquist
Prerequisite: Sociology 3
Course will focus on basic principles of data organization and statistical analysis employing computer based research techniques. Students will learn how to utilize available user-oriented statistical programs as an integral part of the research process.

111. Computers in Society
(4) Sonquist
Prerequisite: upper-division standing or one prior course in sociology.
An introduction to computers, their applications, and their impact on people and social institutions. Social problems created by computer use and remedies will be discussed. Information will be presented to urge constructive and creative thinking about technology, its uses, and its social impact.

112A-B. Practicum in Social Research
(4-4) Straits
Prerequisite: upper-division standing or one prior course in sociology.
This two-quarter sequence deals with study design, conceptualization, measurement, and data collection.

Students will be working on a single research project conducted over two quarters.

113. Systems Analysis and Information System Design
(4) Sonquist
Prerequisites: Engineering 3 or Mathematics 6A or Sociology 109A or equivalent, or consent of instructor.. This course is the same as ECE 113.
Introduction to principles and techniques involved in the analysis of information-processing requirements of large-scale organizations and the design and development of computer-based information systems. Includes overview of implementation, control, and evaluation phases of system development.

204C. Topics in Advanced Data Analysis
(4) Staff
The course may be repeated twice providing the topics are different.
This seminar will deal with topics of current interest in the area of data analysis and will give participants "hands-on" experience in using the new techniques with real data. Participants will analyze data of their choosing and will write up the results in journal article form. Technical assistance and some data archives will be provided by the sociology computing facility.

205A-B-C. Data Analysis in Sociology
(4-4-4) R. Berk, W. Bielby, Wilson
Prerequisites: Sociology 44 or equivalent; Sociology 205A is prerequisite to Sociology 205B, and Sociology 205B is prerequisite to Sociology 205C.
A: Analysis of two-variable relationships with emphasis on regression models. Students are required to attend lectures in Sociology 104A.
B: Sociological applications of ordinary and generalized least-squares. Practical use stressed through exercises with actual sociological data. Students are required to attend lectures in Sociology 104B.
C: Application of multiple-equation models to sociological data and advanced topics in single-equation and interpretation models. Emphasis in exercises on analysis of actual sociological data. Students are required to attend lectures in Sociology 104C.

205AL-BL-CL. Laboratory for Data Analysis in Sociology
(2-2-2) R. Berk, W. Bielby, Wilson
Prerequisite: concurrent enrollment in Sociology 205A-B-C.
Laboratory in quantitative data analysis using computer programs to estimate and study properties of sociological applications of statistical properties.

PROBABILITY AND STATISTICS

123. Sampling Techniques
(4) Staff
Prerequisite: one quarter of upper-division mathematical statistics or consent of instructor.
An elementary development of the statistical methods used to design and analyze sample surveys. Basic ideas: estimates, bias, variance, sampling and nonsampling errors; simple random sampling with and without replacement, ratio and regression estimates; stratified sampling; systematic sampling; cluster sampling; sampling with unequal probabilities, multistage sampling. Examples from various fields will be discussed to illustrate the concepts including sampling of biological populations, opinion polls, etc.

124A-B. Ranking and Selection
(4-4) Staff
Prerequisites: PSTAT 120A-B or 121A-B. (PSTAT 120B and 121B may be taken concurrently.)
Ranking and selections from the parametric and nonparametric point of view, major emphasis on fixed sample size procedures. Both the indifference zone approach as well as the subset approach are considered. Applications to normal, binomial, and multinomial problems; complete ordering comparisons with a control, and the selection of the t test out of k populations.

130. Statistical Computing
(4) Staff
Prerequisites: PSTAT 120B or 121B or 133B or equivalent.
Survey of the various computer packages available for statistical analysis including SPSS, BMD Minitab, etc. The use of these packages in solving statistical problems will be discussed utilizing practical examples.

133A-B-C. Introduction to Statistical Methods
(4-4-4) Staff
Prerequisites: upper-division standing; an equivalent lower-division course; consent of instructor. Not open to mathematics majors. Students who have had PSTAT 33 cannot receive credit for PSTAT 133A, but may be admitted into PSTAT 133B or 133C with the consent of instructor.
Introduce basic ideas of probability and various topics in statistical methods with minimum use of calculus; will rely on use of personal computers. Topics: probability, random variables and distributions, expectation and variance, binomial, normal, and other probability models. Statistical inference, point estimation and confidence intervals, testing. Statistical tests, correlation, and regression.

134. Sequential Analysis
(4) Staff
Prerequisites: PSTAT 120A-B or 121A-B.
This course will cover sequential methods and the associated statistical inference. Topics discussed will include sequential probability ratio test and its optimal properties, application to sequential testing, t-test, sequential estimation.

140. Statistics in Industry
(4) Staff
Prerequisite: PSTAT 120A or 133A or equivalent.
Review of basic probability distributions and concepts in estimation and testing hypotheses, statistical quality control charts for the mean, standard deviation, the range, the fraction defective, and number of defects; sampling by attributes and variables; acceptance sampling, single, double, and multiple sampling plans, choice of acceptable quality level, average outgoing quality limit and lot tolerance percent defective values; Dodge-Romig and Mil-Std 105 plans; some aspects of life testing and reliability.

160A-B. Applied Stochastic Processes
(4-4) Staff
Prerequisites: Mathematics 108A and PSTAT 120A or PSTAT 121A.
Random walks, Markov chains, Poisson processes, Markov processes; second order processes, Wiener process stochastic differential equations, optimal prediction spectral distributions; queueing theory. Stochastic processes in reliability, stochastic models for time series.

207A-B-C. Statistical Theory

(4-4-4) Staff
Prerequisites: PSTAT 120A-B or consent of instructor
Univariate and multivariate distribution theory; generating functions; inequalities in statistics; order statistics, estimation theory; maximum likelihood estimation, sufficiency, Rao-Blackwell theorem; testing hypotheses; ranking and selection; sequential vs. nonsequential techniques.

213A-B-C. Probability Theory
(4-4-4) Staff
Prerequisites: PSTAT 120A-B-C and consent of instructor. Students are advised to complete Mathematics 118A-B-C in preparation for this course.
Foundations of probability, distribution functions, characteristic functions, stochastic processes, central limit problem, martingales, stationary processes.

214A-B-C. Introduction to Stochastic Processes
(4-4-4) Staff
Prerequisites: PSTAT 120A-B-C or consent of instructor. Students are advised to complete Mathematics 118A-B-C in preparation for this course.
Random walks, renewal theory, Markov processes, branching processes, information theory.

215A-B-C. Statistical Decision Theory
(4-4-4) Staff
Prerequisite: PSTAT 120A-B-C and consent of instructor.
A basic introductory mathematical statistics course in which statistical concepts and procedures are developed and examined from the point of view of game theory, optimization, and decision theory.

216A-B-C. Multivariate Analysis
(4-4-4) Staff
Prerequisites: Probability and Statistics 120A-B-C and Mathematics 108A-B.
Statistical theory associated with the multivariate normal, Wishart and related distributions, partial and multiple correlation, principal components. Hotelling's T^2-statistic, multivariate linear models, classification and discriminant analysis. Other topics may include invariance, admissibility, minimax, James-Stein estimates, multivariate probability inequalities, majorization, and Schur functions.

217A-B-C. Design of Experiments
(4-4-4) Staff
Prerequisites: PSTAT 120A-B-C and Mathematics 108A-B, or consent of instructor.
Linear models and the analysis of variance; regression and least squares theory; contingency table analysis; method of steepest ascent; ridge regression.

219. Statistics of Life Testing and Reliability
(4) Staff
Prerequisites: PSTAT 120A-B-C and 160A-B or consent of instructor.
Will discuss probability failure models and associated test procedures. Topics will include: parametric and nonparametric life-testing procedures, estimation of hazard rates, component and system reliability, maintenance policies, and renewal theory.

GRADUATE SCHOOL OF EDUCATION

290A. Artificial Intelligence–Cognitive Modeling I
(4) Cotton, Smith
Recommended: Computer Science 185. Crosslisted with Geography 295A.
Computer programming techniques for processing information in an "intelligent" manner. LISP language, control structures (pattern-directed vs. goal-directed), knowledge structures (declarative vs. procedural), and problem solving (search and inference) will be presented.

290B. Artificial Intelligence–Cognitive Modeling II
(4) Cotton
Prerequisite: Education 290A. Crosslisted with Geography 295B.
Computer programming techniques for processing information in an "intelligent" manner. LISP programming will be emphasized, as will techniques for incorporating learning and analogies. Other topics are: expert systems, imagery, pattern recognition, planning, natural languages, story understanding, and spatial knowledge representation.

State University of New York at Buffalo
GIA/GIS and Related Courses

GEOGRAPHY

101 **Introduction to Physical Geography** Contemporary aspects of geography: physical and environmental. Lithosphere, atmosphere, hydrosphere, and biosphere of the Earth.

112 **Geography of Economic Systems** Theoretical and empirical assessment of the world's natural and human resources and analysis of the spatial systems of production, exchange, and consumption.

120 **Maps and Air Photos** A non-technical introduction to maps and air photos designed for all geography majors.

121 **Maps and Air Photo Interpretation Laboratory** Weekly lab in reading and analysis of maps and air photos; map and air photo interpretation. Accompanies GEO 120.

225 **Managing Land in the United States** Land management in the United States by the federal, state, and local governments; processes of land use change and the institutions that affect this change.

300 **Spatial Organization Problems and Methods** Problems, methodological approaches, and techniques that are characteristic of current geographic research; survey research design; data systems; and survey information.

331 **Transportation Geography** Contemporary transportation problems: provision of transportation; transport networks; transport flows; transport costs, rates, and regulation.

335 **Transportation Systems** Survey of fundamental theories and computational models relating to aggregate geographical aspects of transportation system usage and planning; models of spatial interaction; network improvement; socioeconomic impact.

380/ 560 **Geographic Information Systems** Introduction to the various uses of computers in geography, including spatial modelling, and spatial data handling. Principles of geographic information systems and the basic internal operations of a GIS are covered. (Currently offered as Introduction to Computing in Geography.)

381 **Cartographic Design** Introduces concepts of data collection and abstraction for mapmaking, with special focus on principles of graphic design. Skills include drafting and positive artwork.

410/ 505 **Univariate Statistics in Geography** provides a basic introduction to statistical methods. Emphasis throughout the course is on a spatial analysis. Class lectures are devoted to conceptual issues. Labs are used to help the student with exercises, familiarize the student with the use of statistical tables and hand calculators or statistical packages, and conduct experiments that illustrate selected classroom materials.

411/ 509 **Multivariate Statistics in Geography** Surveys the application of multivariate analyses in geography, and reviews selected parametric as well as non-parametric statistical theory and applications. An introduction to SAS computing will be provided, and analyses will be made of spatial data.

482/ 554 **Cartographic Techniques** Introduction to darkroom techniques, negative artwork in a skills-oriented framework.

483/ 553 **Remote Sensing** Analog remote sensing including air photo interpretation and photogrammetric principles. Digital remote sensing including microcomputer-based image processing, classification of imagery, and elements of feature recognition algorithms

484/ 590 **GIS Applications** Explores the capabilities of existing GIS software (micro, mini, and mainframe) including such topics as data volumes, system performance, data partitioning, and data base construction and maintenance. Application exercises include urban planning, natural resource management, and anthropology. Systems available for use include ARC/INFO, SYSTEM 9, and MAP-PC. (Currently offered as Census Data and Their Uses.)

485/ 551 **Computer Cartography** Provides the conceptual understanding for creation of graphical displays on the computer. Concepts to be covered include digital encoding, geocoding, basics of geoprocessing and an overview of graphic design principles for effective communication. (Currently offered as Introduction to Computer Cartography.)

487 **Thematic Cartography** Application of formal principles of graphic design with skills of computer and manual cartographic production.

488/ 556 **GIS Planning and Development** Focuses problems, processes and methods for defining the need for a GIS and the development cycle. Topics include product identification, data source identification and evaluation, system selection, and implementation scheduling. Methods and techniques from software engineering are adopted to the GIS planning process. (Currently offered as GIS Design.)

489/ 555 **GIS Algorithms and Data Structures** Examination of the data models for geographic information systems. Algorithms common to most current geographic information systems are presented and student programming projects emphasize alternate methods of implementing the common GIS operations. (Currently offered as Geographic Information Systems.)

507 **Location Theory** Survey of the historical development of the central ideas of location theory, and an analysis of the origin and development of the major subfields of economic geography, spatial economics, and regional science.

508 **Methods of Regional Analysis** Surveys quantitative techniques essential to subsequent graduate study focusing on the theme of regional analysis. In-depth study of regional concepts, together with mathematics and computer algorithms that accompany these concepts.

518 **Regional Population Analysis** Introduces the student to the study of population change and its impacts on both the public and private sector. It provides knowledge of the essential methods of producing population estimates and forecasts. The student is also directed to the use of population analysis in planning activity for public services, marketing and manpower planning.

520 **Transportation Systems: Theory and Techniques** Survey of fundamental theories and computational models relating to aggregate geographical aspects of transportation system usage and planning. Topics include models of spatial interaction, network improvement, and socio-economic impact.

605 **Advanced Spatial Statistics** Introduces spatial statistics at an advanced level. Numerical work is carried out with the help of IMSL subroutines or other statistical packages. Topics include spatial autocorrelation, space-time

autoregression, simulation experiments in geography, shape indices, and nearest neighbor, quadrat and directional statistics.

629 **Mathematical Models in the Social and Behavioral Sciences** The course addresses the issues associated with the specification, estimation, and inference that arise in the construction and testing of models in the social sciences. Non-linear models are also covered.

687 **Urban Models and Policy** Surveys the contemporary mathematical land rent literature referred to as "the new urban economics". Emphasizes urban equilibria and optima, the public sector, externalities, and housing.

XXX **Analytical Cartography** Focuses on principles and methods of vector-based map analysis, and digital evaluation of data in map form. Students will learn and use analytical geometry to measure map patterns, and will apply statistical description and inference to predict error on cadastral and thematic maps. Topics to be covered include density traces, generalization algorithms, map classification strategies, and map complexity measures. (Proposed new course.)

XXX **Digital Elevation Models** Focuses on raster-based map analysis, and specifically on algorithms for terrain and solid modelling. (Currently offered as a special topics course.)

ECONOMICS

505-506 **Microeconomics I,II** Basic sequence in economic theory dealing with the behavior of the household, firm and market. Some applications included: emphasizes development of analytical tools for application in the subsequent field courses of the evening M.A. program.

515 **Mathematics for Economists** Designed to provide a sufficient mathematics background for M.A. candidates in Economics. Topics include basic processes in algebra, simple fractions and factors, simple equations and inequalities, graphical and variable functions, and a broad but practical introduction to the calculus. Additionally, special topics presented are devoted exclusively to the use of the various mathematical techniques in economic problems.

521 **Urban Economics** Theory of urban growth; trends in urbanization, location theory, the provision and financing of local government and the external effects of production and consumption on the urban environment. Other topics include transportation problems, housing and urban poverty.

523 **Theory and Problems in Environmental Economics** Application of economic theory to problems of environmental problems associated with economic activity. Uses extension of economic analysis to non-market problems of air pollution, water pollution, etc., and to use and evaluation of community resources such as wilderness areas, historical sites, etc. Principles of cost-benefit analysis and their application to environmental problems are covered.

580 **Economic Statistics** Survey of basic statistical concepts and methods employed in economic analysis and research. Emphasizes testing of hypotheses, analysis of variance, and correlation and regression analysis. Includes basic introduction to econometrics.

611 **Mathematics for Economists I** Application of mathematics to economic analysis. Basic techniques of mathematical analysis and linear algebra are developed and applied to economic theory. Emphasizes implications of optimization and some applications of theory of non-negative square matrices as they apply to formulation of economic theory.

612 **Mathematics for Economists II** Introduction and development of dynamics as used in economic analysis. Standard material of difference and differential equations covered includes solutions of single and multi-equation systems along with stability properties in local and global sense. Dynamic optimization is then investigated within context of dynamic programming and calculus of variations.

613 **Introduction to Econometric Theory** Classical multiple regression setup and its variants relevant in economic applications. Variants include: generalized least squares, heteroscedasticity, multi-collinearity, error-in-variables, prior information, etc. Also treated are auto-regressive and distributed lag models.

614 **Applications and Methods of Econometrics** Begins by developing asymptotic theory. Covers seemingly unrelated regressions, and puts major emphasis on simultaneous equations systems. Identification, limited and full information estimation, testing and model performance studied in detail.

665 **Microeconomic Theory I** Introduction to theories of the household, the firms, and the market. Emphasis on development of analytical tools used extensively in advanced economic theory. Topics include consumer behavior, producer behavior, advanced topics in utility and production analysis, single market equilibrium, market structures and pricing, consumers' and producers' optimization over time.

666 **Microeconomic Theory II--A General Equilibrium Approach** Introduction to general equilibrium theory and welfare economics, including the pure theory of exchange (two-good and many-good models); general equilibrium models of production and exchange; existence and uniqueness of competitive equilibrium; input-output system; stability of competitive equilibrium; theory of qualitative economics; theory of technical change; introduction to capital theory and theory of distribution; and introduction to welfare economics.

712 **Applied Econometrics** Advanced course in application of statistical analysis to testing of hypotheses and estimation of economic models. Three main areas of concentration: econometrics of production, demand, and large-scale or economy-wide models. The principal approach throughout is rigorous derivation of econometric specifications from economic theory. Literature in these three fields reviewed with a view toward identifying respective frontiers and determining which studies are sufficiently soundly-based to provide bases for further development.

713 **Advanced Econometric Methods** Topics course leading up to latest developments. Topics include non-linear estimation, disequilibrium models, switching regressions, Bayesian inference, ARMA-ARMAX (p,q) and ARIMA (p,d,q) models.

714 **Advanced Econometric Methods** Topics course leading up to the frontiers, including aggregate, pooling of time-series and cross-section data, random coefficients, time-varying parameters, error-components, qualitative choice, 'New' errors-in-variables, and rational expectations models.

765 **Activity Analysis** Advanced course in price theory, including the application of programming techniques to microeconomic problems.

721-722 **Industrial Organization** Structure of competition in industries, and effects of structure on price, output, and efficiency. Economics of firm size, adaptation of industries to technical change. Economic problems in government regulation.

LINGUISTICS

538 **Semantics** Review of approaches to the study of semantics. Structure of meaning; cognitive function of

language; measurement of meaning; problems of translation; social and psychological aspects of semantics, including early development, pathology and psychodynamics. Literary change and language change.

567 **Computational Linguistics** Linguistic problems encountered in the computer processing of natural language data (textual and otherwise). Two kinds of activities are surveyed: research oriented (such as automatic parsing, grammar testing, automatic aids to analysis) and user oriented (such as automatic speech recognition, machine translation, information retrieval). Emphasizes conceptual problems and systems design.

582 **Language and Cognition** Survey of evidence that language, perception, and memory bring to bear on the problems of the origin and nature of man's cognitive abilities. Topics include psychological performance models derived from current linguistic theories, genetic and environmental contribution to cognitive development, and cross-cultural, animal, and computer simulation studies.

PSYCHOLOGY

633 **Digital Computers in Psychological Research** Basic concepts of von Neumann type machine organization. Computer languages and communication with a computer. Overview of systems programming. Introduction to data structures, simulation, and artificial intelligence. Use of minicomputers for control of on-line experimentation.

635 **Artificial Intelligence** Theoretical course examining the relevance of formal and mathematical procedures in computing science to psychology. General topics include elementary automata theory, introduction to logical design of digital systems, elements of computer operating systems and artificial intelligence techniques. Specific topics vary, depending upon participants' interests.

639 **Cognitive Processes** Survey of dimensions of cognitive behavior. Emphasizes current theoretical and experimental analyses of information processing, memory, learning, psycholinguistics, perception, and thinking.

642 **Psycholinguistics** Relationship between linguistic theory and behavioral research. Topics include competence-performance distinction, language acquisition, and perception, processing and storage of linguistically marked materials.

719 **Speech Perception** Examines mechanisms and processes which enable humans to recognize and understand speech. Particular attention given toward describing speech signal and various models that have been proposed for perception. Topics include speech production, psychoacoustics, phonetics, and machine recognition of speech.

726 **Theories of Representation** Examines current theories of memory structures and processes that constitute knowledge of the world and comprehension of language, especially connected discourse.

727 **Human Information Processing** Thinking, decision-making scene and speech perception, language, and performance of skills will be analyzed from the standpoint of the human as a processor of information.

728 **Memory** Provides background in verbal learning research (serial and association learning, transfer and mediation) and memory research (organization, strategies, imagery, short-term, long-term and semantics memory). Used to facilitate in-depth analysis, understanding, and critical evaluation of current models, research issues and techniques, relating to verbal behavior and memory. Potential trends in theory and research development discussed.

729 **Visual Pattern Recognition** Examines current body of theory and data concerning visual system organization emphasizing evidence for recent neural-net and computer-based theories.

732 **Quantitative Methods in Cognition** Reviews selected topics relevant to mathematical theory in cognition, e.g., decision theory additive factors, information transmission, stochastic processes.

MANAGEMENT SYSTEMS

602 **Information Technology** Provides the student with a basic understanding of the underlying hardware and software that drives a computerized MIS. The student will develop a competency to evaluate the hardware/software requirements of an MIS design proposal by the end of this course.

606 **Introduction to Information Systems** Examines management information systems in the business environment. How such systems are conceived, developed and implemented is examined. The challenge of the next decade will be in the functional areas where systems will be developed by the users. End-user computing requires both a global and a micro perspective of information processing in organizations. The concepts, tools, and techniques developed in this course provide the foundation for facilitating information processing in complex organization.

613 **Management Information Systems** One of the purposes of this course is to give the student an understanding of the most common business programming language, COBOL. This will enable the student (manager) to both communicate with applications programmers and to manage application development projects. Appropriate systems analysis and design techniques (top down design, structure charts) are introduced to aid in program development and system documentation.
Data base management (DBMS) techniques and language are also examined in this course. Management of the data resources is fundamental to the use of information systems and underlies areas such as decision support systems and expert systems. The vast majority of all DBMS languages have a COBOL interface and so the combination of the two topics is fairly neutral.
Students will also be exposed to a microcomputer DBMS language such as dBase III or similar language.

614 **Management Information Systems II** Designed to cover systems analysis and design techniques as well as issues involved in implementing computer-based Management Information Systems. Readings and lectures in the course will be supplemented with case studies and field projects.

615 **Data Base Management Systems** Designed to provide the student with a basic understanding of data structure, generalized file management systems and data base management systems (DBMS). By the end of this course, the student will be able to evaluate proposed DBMS's function as a data base administrator and understand how DBMS may be used to support decision support systems. The course will consist of lectures, readings, and 'hand-on' experience. There will be a major term project to develop a DBMS application in a functional area of interest to the student.

616 **Decision Support Systems** Aimed at understanding and utilizing the concepts of Decision Support Systems (DSS) to support managerial judgement in specific decision and organizational contexts. Students study the existing literature in the area, develop selected DSS's in the context of cases, and use specialized DSS 'planning language' like IFPS. They will learn key concepts in design, evaluation and implementation of DSS's. In this task, they will integrate knowledge from the fields of management science, computer

science, information systems, and behavior science.

COMPUTER SCIENCE

250 **Data Structure and Abstract Data Types** A modular, structured approach to the design of data types. Survey of common data types (numbers, sequences, arrays, sets, lists, trees, graphs, etc.), concentrating on their abstract, formal properties. Methodology of design of special data types for particular problems. Distinction between the specification of a data type and its implementation or representation by another data type. Programming in an appropriate language, such as LISP.

351 **Software Design, Development, and Testing** This course examines in detail methods of software management for large programs. Software design and evaluation; design representation; structured techniques for program development; data-flow diagram; data dictionaries; process description; systematic program testing.

562 **Database Concepts** Basic design principles of systems for storing and retrieving large amounts of information. Topics include: hardware characteristics; file organization and evaluation; data models; database schemas; and three main database approaches-relational, hierarchical, and network. Students implement their own prototype database system.

565 **Introduction to Pattern Recognition** Foundations of pattern recognition algorithms and machines, including statistical and structural methods. Topics to be covered: data structures for pattern representation; feature discovery and selection; classification vs. description; parametric and nonparametric classification; supervised and unsupervised learning; use of contextual evidence; clustering; and small sample size problems. Programming projects will include handling of pictorial and textual patterns.

572 **Introduction to Artificial Intelligence** Survey of artificial intelligence - the study of how to program computers to behaves in ways normally attributed to 'intelligence' when observed in humans. Topics include: heuristic vs. algorithmic programming; cognitive simulation vs. machine intelligence; problem solving; inference; natural language understanding; scene analysis; learning; decision making. Topics are illustrated by programs from literature and programming projects in an appropriate language.

580 **Computer Graphics** General introduction to computer graphics; graphic devices and processors; graphic input; programming and data structures for graphics; basic transformations (translations, rotation, scaling and projection); visualization techniques and the hidden line/surface problem; shaded pictures.

591 **Fundamentals of Computer Mathematics** Basic mathematics for computer scientists with emphasis on discrete mathematics and on the design and analysis of algorithms; standard topics include combinatories, graph theory and various aspects of abstracts of abstract algebra.

642 **Techniques of Artificial Intelligence** Techniques of artificial intelligence will be studied via a small number of large programming projects using one or more artificial intelligence oriented programming languages. Projects and languages used vary from semester to semester.

665 **Advanced Computer Graphics** A small number of large programming projects are used to study several advanced topics, involving display files, interactive graphics, three-dimensional computer graphics, graphics systems.

666 **Introduction to Image Analysis** Survey of techniques for computer processing and analysis of images produced by modern scanning devices. Topics will include: representation of two- and three-dimensional images; orthogonal transforms; boundary detection; segmentation; computational geometry and topology; shape characterization; time-varying images; and description of spatial organization. Topics are illustrated by programming projects in computer vision and computed tomography.

673 **Computational Vision** Computational theories from artificial intelligence and psychology concerning interpretation of digitized images of three-dimensional scenes. Topics include early visual processing, segmented images, geometric and relational structures.

674 **Computer Learning and Human Information Processing** Discusses techniques of computer learning programs and the following areas of human information processing: perception, the visual and auditory system, neural information processing, pattern recognition and attention, using memory, representation of knowledge, language, learning and cognitive development, problem solving and decision making, the mechanisms of thought.

675 **Natural Language Understanding** In-depth introduction to computational models of understanding natural language. Background and goal of research; representation of knowledge: ad hoc, predicate calculus, relational graphs, semantic networks. Inference mechanisms: chaining, relational calculus, declarative and procedural representations. Parsing, Generating.

681-682 **Formal Languages** Languages and their representation; grammars: regular, context free, context sensitive, type 0; automata used as recognizers; complexity considerations; decision problems.

CIVIL ENGINEERING

536 **Analysis of Transportation Supply** Study of basic performance attributes of different modes of passenger transportation. These include the service attributes of travel time, cost, safety and reliability, and the cost of providing the service at different capacity levels. Modeling of the services and cost relationships as a function of planning and engineering options. Introduction to service and cost functions of freight transportation.

537 **Transportation Systems Design and Policy** Application of systems analysis techniques to the generation, analysis, and evaluation of transportation alternatives. Use of quantitative and qualitative analysis of multi-modal networks for the selection of satisfying operating policies and investment programs. Consideration of the planning process and the role of federal, state, and local governments in the implementation policies. The objectives of federal transportation policy. The role of the citizen in the planning process.

538 **Urban Transportation Planning** An analysis of current techniques of transportation planning. Federal planning requirements. Short range and long range requirements and associated planning techniques. The use of model in alternatives analysis and evaluation. Analysis of plans in the U.S. and other countries since 1980. Case studies, including Buffalo and Niagara Frontier plans.

539 **Public and Common Carrier Transportation** Planning, design, and operation of public and common carrier transportation systems in urban, rural and interurban areas. Elements to be studies include rail, bus, taxi, air, para-transit, and other forms of ridesharing. Operating efficiency in terms of cost and level-of-service. Management of public and common carrier transportation.

540 **Travel Demand Analysis for Forecasting** Examination of economic

and psychological theories of consumer behavior and choice. Analysis of data and estimation of models using statistical econometric and psychometric techniques. Development of demand for passenger travel in multimode situations. Demand for freight transportation. Design of travel surveys and consumer interviews.

551 **Water Resources Systems** Modeling and analysis for planning and operation of water resources systems. Topics include water quality management, reservoir systems, conjunctive use of surface and ground water resources, multistructure and multipurpose systems and pumped storage.

552 **Water Resources Planning and Development** Consideration of economic, financial, and environment analysis techniques and their use in planning for development of flood control, water supply, storm and land drainage, navigation, hydroelectric power, water quality control, recreation; and fish and wildlife enhancement.

ELECTRICAL AND COMPUTER ENGINEERING

522 **Advanced Image Processing** Enhancement: contrast manipulation, histogram modification, noise cleaning, edge-preserving smoothing, transform processing. Restoration: image noise models, time-domain and frequency-domain restoration techniques. Edge detection in the presence of noise, edge-point linking, application to computer vision. Image coding: PCM, DPCM, run-length coding, linear-predictive coding, transform coding

530 **Computer Communications** Network concepts and terminology. Network modeling. Review of stochastic processes. Queuing theory. Performance analysis. Optimalization methods. Multi-access techniques. Radio and satellite communication. Local area networks. Integrated services. Discussion of research topics.

535 **Parallel Processing Architectures** Need for parallel processors and processing. Interleaved memory, memory hierarchies and cache memory organizations. Pipelined architectures, vector processors, array processors and associative processors. Algorithms for searching and sorting in associative memory. Interconnection and permitting networks for parallel processors. Vectorization methods and parallel algorithms. Data flow computer architectures and systolic array processing. Discussion of specific features on VAX 11/780, IBM 360 Model 91, Cray-1, CDC Cyber 205, Illiac-IV, BSP and MPP systems.

536 **Multiprocessor and Computer Networks** Introduction to multiprocessors and their use. Loosely and tightly coupled systems. Interconnection networks. Multiprocessor operating systems. Consistency problems. Parallel algorithms for multiprocessors. Multiprocessor features of CmX, Cmmp, IBM 370 Model 168, CDC Cyber 170 and Cray X-MP. Introduction to local computer networks. Packet switching, circuit switching and bus-structure networks. Decentralized distributed computer systems.

589 **Computer Communication Networks** Focus on problems involved in large scale computer networks. Concentration multiplexing, routing, flow control, etc. Terminal and computer-oriented networks. Introduction to relevant aspects of queuing theory as analytical background for the course. Probabilistic models for analysis. Reading and reporting current literature.

SYSTEMS COURSES

521 **Image Processing** This course deals with the modern computer techniques for processing of images. Topics discussed are related to image data compression for transmission of image data, image restoration and enhancement and image analysis. The course demonstrates the application of computer techniques in the relatively new field.

INDUSTRIAL ENGINEERING

530 **Introduction to Human Factors** A first course in the design of Task/Operator/Machine/Environment systems. Four parts apply anthropometry to the layout of workspaces, physiology to the design of work/rest schedules, experimental psychology to the design of displays and controls, and social psychology to the design of work groups.

532 **Behavioral Foundations of Human Factors** Introduction to basic behavioral and psychological factors such as sensory, perceptual learning, and cognitive processes. Emphasis is placed upon the application of knowledge about these factors to the design and development of man-machine systems.

542 **Operations Research in Health Care** The health care delivery system is analyzed at three levels: intrafacility, interfacility, and epidemiological. Models of facility location and planning, manpower assignment, scheduling, and demand forecasting are discussed.

550 **Introduction to Operations Research** Introduction to the philosophy and methods of quantitative modeling. Introduction to concepts of objective function, theories of value, and optimization. Topics include linear programming and network theory and a brief introduction to integer programming, nonlinear programming, Markov decision processes, and game theory.

551 **Simulation and Stochastic Models** A second course in general operations research, with specific attention to computer simulation. Other topics include inventory, queuing, and scheduling theories.

561 **Information Systems** An introduction to the principles and practices in the design of information systems for industrial organizations. Development of relational databases and database management systems. Optimization and security requirements for database systems. CAS/CAM systems and their applications for interactive design and planning.

562 **Computer Graphics Methods of Engineering** A comprehensive development of mathematical techniques, data structures, and algorithms for the generation of effective computer graphics displays in engineering. Special attention is given to engineering applications of these techniques, including computer-aided design, computer-integrated manufacturing, real-time simulation of industrial systems, and interactive multiobjective system optimization techniques.

572 **Linear Programming** Algebraic and geometric characterization of the linear programming problem. Adjacent extreme point methods, postoptimality analysis, and decomposition methods.

573 **Mathematics for Operations Research** Presentation of specific mathematical techniques used frequently in operation research. Topics include linear algebra, Laplace, Fourier, and Z-transforms, transform methods of solving difference and differential equations, the calculus of variations, and modern algebra.

575 **Stochastic Methods** An introduction to the methods and models of applied stochastic processes. Topics covered include probability spaces, condition arguments, Bernoulli processes, Poisson processes and their generalization, and discrete and continuous time Markov chains.

576 **Applied Stochastic Processes** A continuation of 575. Topics covered include renewal theory, Markov processes, potential and optimal stopping problems, diffusions, and martingale methods. Emphasis is on applicability to operations research problems in

areas such as queuing, inventory, reliability, maintenance, and scheduling.

580 **Advanced Simulation** Model validation, design of simulation experiments, variance reduction techniques, random number generation, distribution generation. Investigation of simulation languages with actual model building in several. This course is intended for graduate students with previous simulation modeling experience who wish to explore major issues by means of extensive review of literature and by experimentation.

603 **Location Theory** A research seminar investigating the current state of facilities planning and design theory. Emphasis is on decision variables related to space, location, position, size, and placement of independent facilities and processes. While examples will be drawn from manufacturing and production, students will be encouraged to probe other environments: hospital planning, school planning, transportation planning.

535 **Human/Computer Interaction** A broad overview of issues in human/computer interaction, including user friendliness, use of input devices, dislog design, computer graphics, voice I/O, training, and cognitive models.

673 **Applied Decision Theory** A Bayesian approach to the problems of decision-making under the conditions of uncertainty is presented. Relationship of these procedures to the classical methods of statistical inference is considered.

Surveying Engineering

SVE 101. Introduction to Surveying Engineering (1)
Lec 1 hours.
A definitive overview of the profession of surveying, retracement of the institution of property and ownership; land survey and recording systems; professionalism; surveying in the United States; the present and future role of surveyors; the relationships between surveyors and users of surveying expertise.

NOTE: This course is currently team taught by all the professors in the Surveying Engineering Program. Each professor presents approximately two introductory lectures so that a large and varied number of surveying engineering topics have been addressed by the end of the semester.

SVE 111. Plane Surveying (4)
Lec 3 hours, Lab 3 hours.
Prerequisite: trigonometry in high school.
An elementary course presenting fundamental plane surveying concepts including: reference planes and surfaces, distance and angular measurement, traverse computations, horizontal and vertical curves, error propagation, area determination and stadia mapping.

SVE 112. Advanced Plane Surveying (4)
Lec 3 hours, Lab 3 hours.
Prerequisite: SVE 111, Mat 126.
A second course in plane surveying techniques which considers the subject areas of horizontal control networks, state plane coordinate systems, surveying, astronomy, earthwork computations and engineering surveys.

SVE 221. Legal Aspects of Land Surveying (3)
Lec 3 hours.
Prerequisite: SVE 111.
Property law, boundary law, conveyance of property, recording systems and procedures, interpretation and writing of land description.

SVE 281. Advanced Computer Usage for Surveyors (3)
Prerequisite: COS 220, Mat 128.
Standard solutions to typical engineering problems: simultaneous linear equations and matrix advanced operations, minimum/maximum using conjugate gradient, numerical differentiation and integration, finite elements, critical path. Graphical output of functions etc. and discussion of CAD. Introduction to CMS and FORTRAN (data types, common block, input/output, control structure).

SVE 321. Cadastral Systems
Lec 3 hours.
Prerequisite: Junior standing.
The concept of property, land tenure and land ethics; land registration systems; the function and design of multipurpose cadastre; political, economical and social constraints of land information systems.

SVE 331. Photogrammetry (3)
Lec 2 hours, Lab 3 hours.
Prerequisite: SVE 111.
Procedure and methods used to derive metric data from photographs. Use of aerial photographs to prepare topographic maps of the earth's surface.

SVE 332. Advanced Photogrammetry (3)
Lec 2 hours, Lab 3 hours.
Prerequisite: SVE 361, SVE 331, or equivalent.
Advanced topics in metric photogrammetry including optics, orientation and tilted photos, photo control, stereoscopic plotting instruments, orthophotography, oblique and panoramic photography, terrestrial and close-range photography and photogrammetric control extension.

SVE 341. Geodetic Models (3)
Lec 3 hours.
Prerequisite: MAT 228, SVE 281, SVE 111.
Three Dimensional Geodesy, computations on the ellipsoid, conformal mapping. Geometric properties of ellipsoids, normal sections, geodesic, geodetic datum definitions, direct and inverse solutions as well as adjusting networks on the ellipsoid, on the mapping plane and in space. Reduction of observations and elements of Physical Geodesy. Review of spherical trigonometry, differential geometry and complex variables as necessary.

SVE 361. Adjustment Computations (3)
Lec 3 hours.
Prerequisite: MAT 334, MAT 262 or consent, SVE 281.
Least squares adjustment as applied to surveying: Propagation of random and non-random errors, variance-covariance matrix and its propagation; observation equation model, condition equation model, mixed model; conditions between parameters, sequential solutions, observed parameters, minimal constraint solutions, statistical tests, laboratories. Some concepts from linear algebra and statistics reviewed.

SVE 393. Junior Seminar (1)
Lec 1hour.
Prerequisite: Junior standing or permission.
Selected topics of current interest within the surveying profession are discussed by outside speakers and enrolled students. Juniors in Surveying Engineering must research, prepare and present a

topic of current interest to the group. A paper is required. The seminar sessions are open to anyone who chooses to attend.

SVE 394. Field Practice (3)
Prerequisite: sophomore standing and 2.5 GPA.
Work experience in surveying engineering through the cooperative education program.

SVE 411. Hydrographic Surveying (3)
Lec. 3 hours.
Prerequisite: SVE 112, MAT 228, SVE 341.
Concepts of hydrographic instruments operating from different types of marine platforms along with the planning and operational aspects of hydrographic surveys. Specific treatment will be made of measurement instruments for position, tidal control and depth; as well as magnetic, bottom, water, and geological parameters.

SVE 425. Land Development Design (3)
Lec 2 hours, Lab 3 hours.
Prerequisite: Senior standing in SVE or CIE with at least one of the following: SVE 112, CIE 350, CIE 455.
This is a capstone design course which takes the student step-by-step through the design of a large housing development located theoretically in a major metropolitan area. The lectures cover all phases of the development process while the labs are primarily design oriented. Site evaluation includes consideration of boundary survey, topographic survey, control survey, soil analysis, hydrographic analysis, traffic evaluation, plus environmental, aesthetic, and cultural considerations. Students study applicable Maine state laws and local ordinances. Students design lot and building arrangements and design all streets, drainage channels, detention basins, culverts, and consider the layout of sanitary and storm sewers.

SVE 433. Remote Sensing (3)
Lec. 3 hours.
Prerequisite: MAT 288, PHY 122.
Definition and overview of remote sensing, sensors, signatures and information; electromagnetic radiation, interactive mechanisms; photographic systems photometry and spectroradiometry; electro-optical sensors, non-imaging sensors, radar system; space platforms; information systems; processing; interpretation; application; practical utility of remotely sensed data; term project.

SVE 451. Engineering Databases and Information Systems (3)
Lec 3 hours.
Prerequisite: COS 220 and SVE 281 or permission of instructor.
Develop a theoretical foundation for representation of knowledge in information systems. Logic based programming as a tool for fast prototyping and design of data structures. Database management systems and their suitability for DBMS. Physical data storage and basic data-structures (list, tree, hashing). Transaction concept. Design of database scheme for engineering application.

SVE 452. Geometry and Computer Graphics (3)
Lec 3 hours.
Prerequisite: SVE 451 or permission of instructor.
Analytical geometry on computer systems. Representation of topological and metric properties of two dimensional geometric structures. Overview of raster based systems. Computer graphics hardware. Design of device independent programs for graphics output. Coordinate systems and transformation. Principles of effective visual communication and their application in cartography. The use of interactive engineering workstations.

SVE 493. Senior Seminar (1)
Lec 1 hour.
Prerequisite: senior standing or permission.
Presentations by students and faculty of pertinent happenings in surveying. Discussions based upon term projects, literature reviews, current events, or thesis topics. Professional practice and ethics are explored with members of the surveying community. Each participant prepares and moderates a seminar session. A paper is required.

SVE 496. Surveying Engineering Practice (3)
Lec 2 hours, Lab 3 hours.
Prerequisite: SVE 112, SVE 341, SVE 332, SVE 361.
A course intended to apply theoretical concepts introduced in previous surveying, geodesy, photogrammetry and adjustments to the solution of comprehensive problems in surveying engineering. Emphasis will be on laboratory work including field observations.

SVE 498. Selected Studies in Surveying Engineering (1-3)
Prerequisite: permission of the instructor.
Topics in surveying, photogrammetry, remote sensing, land information systems, and geodesy not covered in other courses. The content may be varied to suit current needs. The course may, with consent of the department, be taken for credit more than once.

SVE 499. Senior Thesis (3)
Lec 1 hour.
Prerequisite: senior standing.
A required course by seniors in Surveying Engineering. Includes selecting an area of study with

advisor approval, then performing a full literature search, conducting the necessary research and reporting results in thesis format. The thesis must meet University format requirements and be submitted in duplicate to the department.

SVE 511. Signal Processing for Hydrographic Measurements (3)
Lec 3 hours.
Prerequisite: SVE 112, MAT 228, SVE 341.
Consideration of electromagnetic and accoustical signals used in marine survey measurements and the impact of environmental factors on these signals. Also an introduction to fourier transforms and power spectra followed by a treatment of signal processing techniques that can be used to recover information from these signals.

SVE 522. Environmental Law and Resource Regulation (3)
Lec 3 hours.
Prerequisite: Permission.
Selected topics in common law solutions to environmental problems, major statutes in air, water, solid waste, and coastal zone management, environmental litigation, land use controls, water rights.

SVE 531. Analytical Photogrammetry (3)
Lec 3 hours.
Prerequisite: SVE 332, SVE 361.
Methods of aerotriangulation, examination of control requirements and internal accuracy and reliability considerations in large blocks of photography, numerical methods used to solve reduced normal equations, topics of current interest in analytical photogrammetry.

SVE 541 Satellite Geodesy (3)
Lec 3 hours.
Prerequisite: SVE 341.
Stellar coordinate systems, precession, nutations, time systems, troposphere, ionosphere; satellite orbital theory, Global Positioning System (GPS), space segment, correlating receivers and code-less receivers; pseudo ranges; single, double, and triple difference phase processing; point positioning, relative positioning; dual frequency processing; code smoothing techniques; positioning of moving platforms; simultaneous orbital and baseline estimation; GPS vector adjustments and combination with terrestrial observations; astronomical azimuth, latitude and longtitude determination; proper motion, aberration, parallax; laboratories.

SVE 552. Interactive Land Information Systems (3)
Lec 3 hours.
Prerequisite: SVE 552.
Advanced course treating the interactive input and update of data in a Land Information System. Main topics will be the treatment of consistency constraints (including geometrical consistency constraints) and solution to a conceptual simple model of interaction with the user.

SVE 693. Graduate Seminar in Surveying Engineering (1)
Lec 1 hour.
Prerequisite: graduate standing.
Presentations by students and faculty of pertinent happenings in surveying engineering. Discussions are based on term projects, literature reviews, current events, or thesis topics. Each participant leads a seminar session and prepares a paper.

SVE 698. Selected Studies in Surveying Engineering
Prerequisite: graduate standing.
Topics in surveying, photogrammetry, remote sensing, land information systems, and geodesy not covered in other courses. The content may be varied to suit current needs. The course may, with consent of the student's advisory committee, be taken for credit more than once.

Forestry

FMT 206A. Aerial Photo Interpretation (3)
Prerequisite: FMT 201A, FMT202A, FMT203A.
Rec. 2 hours, Lab 3 hours.
Use of aerial photography in connection with forest inventory techniques, and improvements.

FMT 209A. Forest Land Management (3)
Prerequisite: FMT 201A, FMT203A, FMT203A.
Rec. 2 hours, Lab 3 hours.
Land titles, surveys, owner's rights and liability, trespass and relations with the public. Organization and management of properties for timber production and other uses. Methods of predicting returns from investment.

FTY 357. Forest Watershed Management (3)
Prerequisite: FTY 204, FTY 307 (or other equivalents), PSS 150, or permission of the instructor.
Rec. 2 hours, Lab 2 hours.
Role of forests in water cycle. Effect of logging, recreation, mining, and other forest land uses on water resources.

FTY 455. Remote Sensing of Land Use (3)
Procedures and methods used to evaluate and utilize remote sensor data as well as the design of remote sensing systems are considered. Emphasis will be given the use of aerial photography in determining land use. Image interpretation procedures and mapping methods for imagery collected from aircraft and earth orbiting satellites will be studied in the laboratory.

FOE 472. Planning and Control of Forestry Operations (2)
Prerequisite: Seniors, graduate students, or consent of instructor.
Rec. 2 hours.
Applications of scientific methods to management decision problems of forestry operations. Mathematical programming, markov processes, waiting-line analysis, sequencing, simulation, and competitive strategies.

RPM 554. Forest Recreation Planning (3)
Prerequisite: RPM 352, or consent of instructor.
Measuring, analyzing, and forecasting recreational use of forest lands. Concepts of planning, and their application to forest recreation.

Computer Science

COS 440. Computer Networks (3)
Prerequisite: COS 331.
This course covers data and computer communications using the ISO model as a basis of presentation. Discussion of physical media, communication protocols, and network architectures including wide area and local area networks. Examples of networks currently in use are include.

COS 460. Interactive Computer Graphics (3)
Prerequisite: COS 220, MAT 126, junior standing.
Topics include I/O devices: plotter, CRT, light pen, etc; vector generation; transformation of two and three-dimensional objects; clipping and windowing; hidden line removal; interrupt handling; interactive techniques; data structures for graphics; and various display algorithms.

COS 461. Advanced Computer Graphics (3)
Prerequisite: COS 460, MAT 126.
This course builds on COS 460 Interactive Computer Graphics, and continues with advanced topics. Topics include three-dimensional transformations, hidden line and surface algorithms, color and raster graphics.

COS 480. Database Management Systems (3)
Prerequisite: COS 350.
Provides the knowledge necessary to understand and use existing DBMS technology. The data model approach is followed, with heavy emphasis on the relational model. Topics include DBMS architecture and underlying file organization, integrity, relational algebra and calculus, query optimization, and normalization. Students will design and manipulate a system using an existing DBMS.

COS 492. Computer Related Law (3)
Prerequisite: COS 230.
This course will acquaint the student with the basic legal concepts that a computer professional might reasonably expect to encounter. Practice in the analysis of judicial opinions dealing with computer-related issues will be included along with an introduction to legal research. Students will be required to analyze fact situations to identify legal problems and the means of addressing these problems.

COS 520. Software Engineering I (3)
Prerequisite: COS 350, COS 331.
Provides the knowledge and tools necessary for the specification, design, implementation, and maintenance of reliable non-trivial software. Various specification and design methodologies are explored with Ada as the implementation tool Students are assigned problems in both an individual and group setting.

COS 520. Software Engineering II (3)
Prerequisite: COS 520.
A continuation of COS 520, concentration on the specification, design, implementation, and maintenance of highly concurrent systems. Topics include: architectures of concurrent subsystems, control flow vs. data flow design strategies, and layered systems. Students will develop small, highly concurrent systems in both an individual and group setting.

COS 554. Algorithms (3)
Prerequisite: COS 350.
This course surveys the classes of important algorithms and how they may be adapted to solving specific problems. Students will be expected to program some of the algorithms discussed in class.

COS 560. Advanced Graphics - LIght and Color (3)
Prerequisite: COS 461 or consent of the instructor.
Theories of light and color and their application in computer graphics. Topics covered will include diffuse reflection, specular reflection, refraction, shading models and algorithms, halftoning, color perception, physical theories of color, and color models. Emphasis will be on three dimensional images.

COS 570. Advanced Artificial Intelligence (3)
Prerequisite: COS 470.
PROLOG programming techniques, natural language parsing and

comprehension, and expert systems including detailed study of some successful expert systems.

COS 580. Advanced Database Management Systems (3)
Prerequisite: COS 480 or equivalent.
The study of DBMS issues paralleling, but largely independent of, the choice of data model. Topics include recovery, integrity, concurrency control, security, distributed DBMSs, and database machines. The relationship between first order logic and the relational model is explored. An existing distributed DBMS will be explored in depth as a case study.

Mathematics

MAT 355. Introduction to Operations Research I (3)
Prerequisite: COS 210 or equivalent.
Introduction to linear programming, including various algorithms, transportation and assignment problems, duality. Network and game theory. Emphasis on modelling problems arising in business and industry.

MAT 355. Introduction to Operations Research II (3)
Prerequisite: MAT 355.
A continuation of the material in MAT 355.

MAT 357. Introduction to Mathematical Modelling (3)
Prerequisite: MAT 215 or MAT 127 or MAT 124.
A hands on approach. Students will be expected to formulate, analyze and criticize mathematical models. The models will be chosen from biological and managerial sciences as well as the physical sciences. Students will be encouraged to report on particular models of their choosing.

MAT 388. Graph Theory (3)
Prerequisite: MAT 228 or MAT 225.
General survey of a number of topics in graph theory. Topics include: Eulerian and Hamiltonian lines, factors, of graphs, embedding of graphs in surfaces, room squares and various decomposition problems.

MAT 471. Differential Geometry (3)
Prerequisite: MAT 228 or MAT 225.
Applications of calculus to the study of space curves and surfaces.

MAT 533. Stochastic Systems (3)
Prerequisite: MAT 234.
The study of mathematical models which involve random processes. Topics include Poisson process, waiting-line models, Markov chains, decision analysis and reliability theory. Some emphasis on modelling problems arising in business and industry.

MAT 554. Topics in Operations Research (3)
Prerequisite: MAT 355.
Course designed to cover recent developments in O.R. Topics vary according to interests of the class.

MAT 577. Topology I (3)
Prerequisite: MAT 426 or consent of the instructor.
Fundamental concepts of topology, including cardinal and ordinal numbers, topological spaces, cartesian products, connectedness, compactness, continuity, separation axioms and metric spaces.

MAT 578. Topology II (3)
Prerequisite: MAT 577.
A continuation of the material in MAT 577.

Physics

PHY 472. Optics (3)
Rec. 3 hours.
Prerequisite: PHY 112 or PHY 122; Corequisite: MAT 259.
Geometrical optics, refraction and reflection at plane and spherical surfaces, optical instruments. Fourier optics, interference of waves and diffraction by a single and double aperture. Lasers: theory of their operation, mode locking and pulse formation.

PHY 475. Methods of Mathematical Physics (3)
Rec. 3 hours.
Prerequisite: MAT 353 or permission of the instructor.
Methods and special functions of mathematical physics. Examples from continuum mechanics, electricity and magnetism, heat flow and diffusion. Suitable for seniors and graduate students.

Oceanography

OCE 560. (OCE, GES) Marine Geology (3)
Rec. 3 hours.
Prerequisite: GES 101, GES 102 and permission of the instructor.
Current theories dealing with the origin of the earth as a planet and the development of continents and ocean basins. Morphology and structure of the sea floor. Interpretation of geological and geophysical evidence relevant to the origin and evolution of major tectonic features of ocean regions.

Electrical Engineering

ELE 383. Communications

Engineering (3)
Lec. 3 hours.
Prerequisite: MAT 259, ELE 314.
Basic principles of modern communication engineering; methods of analysis; modulation techniques; effects of noise; information transmittal.

ELE 512. Linear Systems Analysis (3)
Lec. 3 hours.
Prerequisite: ELE 314, MAT 262 or equivalent.
Basic concept of linear system. Methods for analyzing linear systems using transforms, convolution, and state variables.

ELE 533. Advanced Robotics (3)
Lec. 2 hours, Lab 2 hours.
Prerequisite: ELE 417.
The intelligent robot control system and programming will be introduce. Robot dynamical equations, path planning and trajectory generation, control system, off-line simulations, robot languages, and vision integration in robot applications will be discussed.

ELE 535. Computer Vision (3)
Lec. 2 hours, Lab 3 hours.
Prerequisite: COS 215 or COS 220, ELE 314 or equivalent.
An introduction to computer vision and perception. Image generation, the physics of images and sensors, binary images, image processing and understanding, computational methods for recovery and representation of visual information, a general review of available vision systems and their applications in automation.

Civil Engineering

CIE 557. Water Resources Engineering (3)
Lec. 3 hours.
Prerequisite: CIE 455 or permission. Development, control, and engineering of water resources systems. Emphasis on Basin-wide and regional analyses. Introduction to systems engineering techniques applied to water resources problems.

CIE 558. Advanced Coastal Engineering (3)
Lec. 3 hours.
Prerequisite: MAT 259.
Hydraulics principles will be applied to civil engineering problems in lakes and coastal areas. Topics include: wave forecasting, shoaling, refraction, sediment transport, stability of rubble mound structures and design of coastal structures.

CIE 559. Numerical Modeling of Lake and Estuarine Processes (3)
Lec. 3 hours.
Prerequisite: MAT 259.
Using various numerical models as case studies, strategies for environmental modeling are discussed. Emphasis placed on calculation of flows and on transport of water-borne material and pollutants. Topics include the relative validity of different numerical formulations as well as considerations of stability, economy, and accuracy. An important consideration, model verification using field data is discussed along with measurement techniques.

Botany

BOT 567. Plant Disease Epidemiology (3)
Lec. 3 hours.
This course provides an analysis of plant-pathogen interactions at the population level, and thus offers the scientific and conceptual bases for plant disease management. The study of epidemiology serves two purposes. The scientific aspects yields understanding of the behavior of plant pathogens in time and space, and the practical aspect uses that understanding to regulate disease.

Geology

GES 325. Ore Deposits-Origin and Exploration (4)
Lec. 4 hours.
Prerequisite: GES 312, GES 416, or consent of the instructor.
The chemical and physical factors controlling the formation of metallic mineral deposits. Information derived from experimental work is considered and related to field observations. Techniques employed in ore deposit exploration explained as the apply to specific geologic situations.

GES 538. Geology of Continental Margins (4)
Lec. 3 hours, Lab 2 hours.
Prerequisite: GES 315 or OCE 560 or consent of the instructor.
Structural framework, stratigraphy, and sedimentation. An integrated analysis based on modern marine geological discoveries of structural controls and sedimentation along continental margins, with emphasis on the best known example, the U.S. east coast.

GES 541. Glacial Geology (3)
Lec. hours, Lab 2 hours.
Prerequisite: GES 101, GES 102, MAT 126.
Study of glaciers and their deposits, flow dynamics of glaciers, mechanics of erosion, transportation and deposition, development of soils, isotopic and sedimentologic techniques in stratigraphy, chronology, and reconstruction of paleoglacial events from glacial deposits. Required field trips.

GES 542. Quaternary Environments and Climatic Change(3)
Lec. 2 hours, Lab 2 hours.
Prerequisite: GES 541 or consent of the instructor.
Study of the Physical environments of the Quaternary Period with special emphasis on ice-age theories work-wide terrestrial and marine glacial stratigraphy, paleoclimatology, and effects of environment on man. One weekend field trip.

GES 545. Glaciology (4)
Lec. 3 hours, Lab 3 hours.
Prerequisite: MAT 127, COS 210 or 220 or consent of the instructor.
The dynamics of ice sheets. Creep deformation of ice and the interaction between a glacier and its bed, numerical methods for modeling ice sheet dynamics, interpretation of glacial erosion and deposition.

GES 553. Coastal Geomorphology (3)
Prerequisite: OCE 370, GES 101, GES 102 and consent of the instructor.
Classification methods, mapping procedures and techniques to study coastal landforms and interpretation of their origin and development. Dynamic processes that affect coastal environments including regional geology, climate, weather, tides, sea level, waves, storms, coastal currents, ice and crustal movements. Emphasis on field studies of beach forms, processes and sedimentation on Maine beaches as an example. Field emphasis requires several field trips.

GES 565. Micropaleontology (4)
Rec. 3 hours, Lab 2 hours.
Prerequisite: GES 314 or ZOL 453 plus GES 101, GES 102.
Study of major groups of microfossils, their biology, morphology, taxonomy; their use in ecologic and stratigraphic interpretation.

GES 581. Introduction to Geophysics (4)
Lec. 3 hours.
Prerequisite: GES 101, GES 102, PHY 112 or PHY 122, MAT 228, MAT 259, PHY 238, MAT 353, COS 210 (FORTRAN) desirable, and consent of the instructor.
Introduction to geophysical studies of the Earth's crust, mantle and core. Gravity, magnetism, seismology and geothermal studies are emphasized. The methods of mathematical physics are extensively used in problem solving approach to indirect studies of the Earth's interior.

Sociology

SOC 442. Population and Society (3)
Prerequisite: SOC 101 or consent of the instructor.
Population processes and their effects on society. Includes fertility, migration, mortality; population, resources and technology; population, social change and economic development; family planning and population policy.

SOC 463. The Sociology of Knowledge (3)
Prerequisite: SOC 101 or consent of the instructor.
The relationship between knowledge and social interaction. The general characteristics of knowlede as a social phenomenon. The problem of knowledge as being both influenced by and an influence upon the social structure.

Anthropology

ANT 380. Sociolinguistics (3)
Prerequisite: ANT 102 or SOC 101 and INT 310 or consent of the instructor.
Relationships between language and society, emphasizing societal rules or norms that explain or constrain language behavior and functions played by language in hman societies. Speech styles and dialects, languages in contact, bilingualism, and the language problems of developing nations.

ANT 381. Language and Culture (3)
Prerequisite: ANT 102 and INT 310 or consent of the instructor.
Introduction to the writings of key figures in the field, exploring their broader implications in such areas as non-linguistic communication, semantics, linguistic relativity, structural anthropology, and general problems in Cognitive Anthropology.

ANT 573. Advanced Methods in Historic Archaeology (3)
Prerequisite: ANT 374 and ANT 377.
A seminar devoted to researching American life-ways of historic periods using archaeological and historical data. Emphasis given to interpreting current UM excavations.

ANT 576. Models in Archaeology (3)
Prerequisite: ANT 372 or equivalent and consent of the instructor.
A seminar designed to consider current theoretical approaches to prehistoric archaeology.

Philosophy

PHI 450. Logic I (3)
An introductory course in modern symbolic logic. Techniques of

deductive inference, including decision procedures and aciomatization, are studied in developing the propositional and predicative logics. Some attention is given to metalogic and the philosophy of logic.

PHI 451. Logic II (3)
Prerequisite: PHI 450 or consent of the instructor.
Advanced topics in symbolic logic.

History

HTY 485. World Maritime History I (3)
Prerequisite: Not open to freshman.
The growth of human understanding, use and interaction with the seas from prehistory to 1800. Demographic and social effects of the seas on human populations, marine technology, economics of the seas, national and international ramifications, contemporary problems.

HTY 486. World Maritime History II (3)
Prerequisite: Not open to freshman.
The growth of human understanding, use and interaction with the seas from 1800 to the present. Demographic and social effects of the seas on human populations, marine technology, economics of the seas, national and international ramifications, contemporary problems.

HTY 491. Technology and Society Until 1800 (3)
Prerequisite: Not open to freshman.
Development of technology from earliest times through the English Industrial Revolution. Examination of the history of technology both 'internally' - as tools and machines - and 'externally' - as related to the societies which have produced them and upon which they in turn have had impact.

HTY 491. Technology and Society Since 1800 (3)
Prerequisite: Not open to freshman.
Development of technology since the English Industrial Revolution, with emphasis on America. Examination of the history of technology both 'internally' - as tools and machines - and 'externally' - as related to the societies which have produced them and upon which they in turn have had impact.

Zoology

ZOL 434. Avian Biology and Ecology (3)
Lec. 3 hours, Lab 3 hours.
Prerequisite: ZOL 330 and an ecology course, or consent of the instructor.
Advanced discussion of the characteristics, functional morphology, behavior, evolution, biogeography, and ecology of birds. Lectures, laboratory study and an independent project.

ZOL 468. Limnology (3)
Prerequisite: ZOL 204 and BOT 203, CHY 112; INT 419 is recommended.
The ecology of inland waters, with emphasis on the physical, chemical and biological characteristics of lakes.

ZOL 470. Fishery Biology (3)
Prerequisite: ZOL 329, INT 419 or WLM 200. Recommended: FOR 204 or MAT 232.
Introduction to theory and practice of contemporary fishery biology emphasizing ecology, life history, fish population sampling and manipulation, human factors and multiple use concepts.

ZOL 521. Polar Ecology (3)
Lec. 3 hours, Lab 3 hours.
Prerequisite: ZOL 453 or equivalent or permission..
Interrelationships between organisms and their physical and biotic environment in high latitudes. Marine ecosystems emphasized.

ZOL 525. Community Ecology (3)
Lec. 3 hours.
Prerequisite: INT 419 or equivalent.
An advanced discussion of the organization of biological communities: community structure, stratification, and patterns, niche division and species diversity; competition; predation; community classification and description; biogeography of communities; succession and climax.

ZOL 585. Physiological Ecology (3)
Lec. 3 hours.
Prerequisite: ZOL 377.
The functions and adaptive responses of animals to environmental variables, with emphasis on marine and estuarine invertebrates. Extensive reading in original literature required.

Agricultural Resource Economics

ARE 471. Resource Economics (3)
Rec. 3 hours.
Prerequisite: ECO 110.
Principal economic and institutional factors affecting man and his use of land and resources; supply, demand and future requirements; economics of

resource allocation, functioning of the market, benefit cost analysis; planning for more efficient use of resources.

ARE 473. Land Economics (3)
Rec. 3 hours.
Prerequisite: ARE 148 or ECO 110 or permission.
Principal economic and institutional factors affecting land use. Emphasis on land rent, economics of land conservation, public measure for directing land use and taxation of landed property.

ARE 474. Land Use Planning (3)
Prerequisite: ARE 471 or consent of the instructor.
Principals of planning for coordinated use and development of the land resource base. Survey of emerging concepts and problems that relate to land use policies and control measures. Emphasis on economics, legal, institutional, and social issues.

ARE 527. Community Development-Principles (3)
Analysis of the principals of community economic development in rural settings, with emphasis on social analysis, strategy planning and policy forming.

ARE 571. Advanced Resource Economics (3)
Prerequisite: ARE 511.
Analysis of economic theory as it relates to the development and management of exhaustible and renewable natural resources. Examines the unique characteristics of resource markets, the determination of optimal pricing and use, resource policy, and management issues.

ARE 572. Resource Use and Economic Growth (3)
Prerequisite: ARE 471, ARE 473.
Resource utilization and economic growth in retrospect. Importance of resources. Theories and measurements of regional economic development. Planning for resource development.

ARE 577. Economics of Public Choice (3)
Prerequisite: ECO 373.
Analysis of economic systems as mechanisms for collective action. Emphasis on the role of property rights in natural resource utilization. Focus on the market system; reasons for market failure in resource allocation and income distribution: and analysis of extra-market and non-market alternative for collective action.

Economics

ECO 560. Seminar in Common Property Economics (3)
Prerequisite: Consent of the instructor.
A market economy of the sort found in the United States depends upon scarce resources being the object of private ownership. When resources are not owned, or are common property, a market economic system also automatically leads to the degradation and depletion of those resources. Consequently, common property gives rise to many difficult and important questions of public policy. This course will address these problems as they occur in the management of fisheries and other common property renewable resources, pollution and environmental concerns and the exploitation of non-renewable resources.

INTERDISCIPLINARY COURSE:
INT 358. (ANT, ECO) Cultural and Economic Change (3)
Prerequisite: ECO 120, 2 121 and ANT 102 or ANT 215 or consent of the instructor.
The interface between cultural anthropology and economics, especially as these disciplines shed light on problems of economic change in the societies of the Third World.

Public Administration

PAA 370. Urban Policy and Management (3)
Prerequisite: POS 233 or PAA 200.
An analysis of the formation and implementation of urban public policy. Municipal management concerns with human and financial resources, city planning, programs and urban services are considered. In-depth cases are utilized throughout.

PAA 405. Administrative Law (3)
Prerequisite: PAA 200.
Primarily case studies of the legal adjustment of administrative authority and individual liberty, including: judicial control over administration, personal liability of officers, scope and limits of administrative powers and the due process measurement of administrative procedure.

PAA 410. Local Government Law (3)
Prerequisite: PAA 200.
Fundamentals of law relating to local government, viewed from the perspective of the public administrator.

PAA 515. Computer Applications in Public Administration and Policy (3)
Prerequisite: Graduate students or consent of the instructor.
Practical applications of microcomputers in federal, state, and local governmental units including word processing, financial management, personnel administration, decision-making and policy analysis.

PAA 520. Policy Studies (3)
Prerequisite: PAA 200 or consent of the instructor.
Examines approaches to the study of public policy such as public choice theory, implementation analysis, systems analysis, and impact analysis as they are applied to policy areas such as health, welfare, education, and criminal justice. Students participate in seminar discussions and complete a research project.

PAA 580. City and Regional Planning (3)
Prerequisite: Graduate students or consent of the instructor.
Principles of city and regional planning; legislative aspects and court decisions; administrative organization and application; zoning and land use; financing; formulation of master plans, and their administration; political problems and public relations.

PAA 600. The Environment of Public Administration (3)
Presents an integrating perspective for approaching American public administration as an academic and professional discipline. The course acquaints students with theoretical, legal, economic and ethical aspects of administrative accountability by reviewing the cultural, ethical, socio-economic and legal environment of public administration.

PAA 605. Community Political Power Structures (3)
Examination of the location of political power in the American community; operational concepts and general methodological approaches defined; empirical findings based on various methodological approaches; conclusions on community political systems and power.

PAA 610. Methods of Analysis in Public Administration and Public Policy (3)
Applied methodological issues and procedures in public administration and public policy, including research design, empirical analysis, and the research process. Computer usage is an integral part of the class.

PAA 615. Advanced Methods of Analysis in PUblic Administration and Public Policy (3)
Prerequisite: PAA 610.
A continuation of PAA 610. Advanced methodological issues in public administration and public policy, including multivariate analysis, time series analysis, decision modeling, and the research process. Computer usage is an integral part of the class.

PAA 620. Program Analysis and Evaluation (3)
Prerequisite: PAA 610 or consent of the instructor.
Design, implementation, and usefulness of evaluation as a tool in public administration and public policy, including RFP development, proposal formulation, causal diagraming, evaluation design, measurement of program objectives, statistical procedures, staffing needs and time-lines, budgeting, evaluation critiques, and political issues and constraints.

PAA 680. Planning and Organization for Economic and social Development (3)
Analysis of institutions, procedures and problems associeated with achieving economic and social development in developing countries and the United States. Focus on political and administrative implications.

Business Administration

BUA 440. Decision Support Systems for Management (3)
Prerequisite: permission of the Director of the MBA Program.
This course provides an intensive and accelerated introduction to computerized decision support systems. It is designed to provide pre-MBA students with a foundation for understanding and analyzing information systems for business planning and control.

BUA 636. Quantitative Methods and Information Systems for Business Decisions (3)
Prerequisite: MAT 113, 114, 215, and COS 210 or equivalent.
Introduction to various methods of quantitative analysis and information systems including classification techniques, decision theory, a brief overview of operations research, and computerized data processing for managerial decisions.

BUA 638. Operations Research (3)
Prerequisite: BUA 636 or consent of the instructor.
Course deals with formulation and solution of optimization models for business decision making and economic resource allocations through mathematical programming models. Emphasis on applications in accounting, finance, economics, marketing, and production management.

Psychology

PSY 350. Cognition (3)
Prerequisite: PSY 100.
An introduction to the psychological study of human information processing and thinking. Representative topics include: attention, pattern recognition, short and long-term memory, semantic memory, visual memory, mental imagery, problem solving and creativity.

PSY 361. Sensation and Perception (3)
Prerequisite: PSY 345 or consent of the instructor.
A systematic examination of selected sensory and perceptual processes. Emphasis on experimental method, research findings and theoretical interpretations.

PSY 462. Perception and the Perceptual System (3)
Prerequisite: PSY 361.
A survey of research on issues about, and theories of perception. Topics include perception of space, form, events, and representations.

PSY 556. Advanced Perception (3)
Prerequisite: PSY 361 or consent of the instructor.
Current theories and research in perception. Topics include theories of seeing, signal detection theory, depth perception, and perception in its ecological context.

PSY 567. Advanced Cognitive Psychology (3)
Prerequisite: Consent of the instructor.
An advanced survey of cognitive psychology. Representative topics include a comparison of the cognitive or information processing paradigm as contrasted with behavioristic and psychodymanic paradigms, feature analysis and pattern recognition, memory storage and retrieval, attention, psycholinguistics, problem solving and neuropsychological bases of cognitive processes.

PSY 667. Topics in Cognition (3)
Prerequisite: PSY 567 or consent of the instructor.
A critical, in-depth analysis of recent research and theory on certain topics in human information processing and cognition. The topic will change from year-to-year, depending on the interests of the students and faculty. This course may be taken more than once for credit, provided that the topics are different.

PSY 675. Topics in Sensation and Perception (3)
Prerequisite: PSY 361 or consent of the instructor.
Current experimental literature in areas of sensation and/or perception; examination of newer theoretical issues; discussion and evaluation of theoretical interpretations of sensory and perceptual phenomena.