Title
NIMS: 3-dimensional, aquatic & autonomous-IDEA

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NIMS: 3-Dimensional, Aquatic & Autonomous-IDEA

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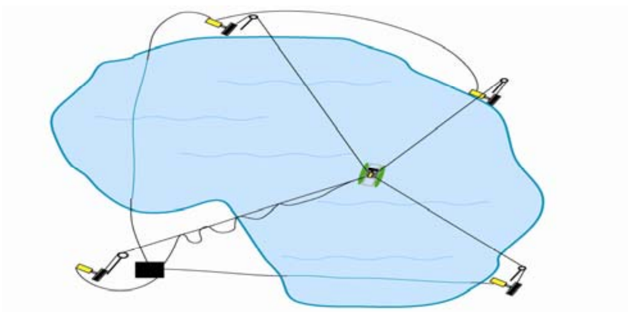
NIMS-3D: Three-Dimensional Extension to Aquatic Applications

NIMS-3D: Four Cabled NIMS-AQ Concept

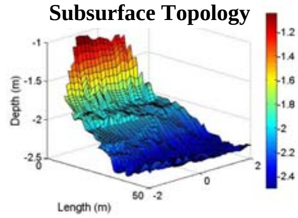
- Active *tension control* using tension gauges and PID control
- Kinematically redundant four cable configuration.
- Optimal tension distribution generates the desired force vector on the end-effector while minimizing the sum of tensions.



Underwater Sonar

- High fidelity monitoring of the underwater environment
- Enables precise, *autonomous calibration*
- Expedited experimental design and system setup
- Environmental characterization (*spatial* and *semantic mapping*)

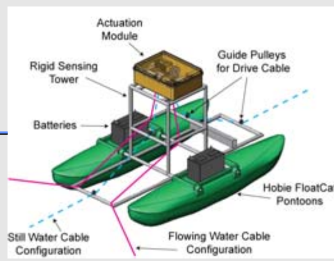
Subsurface Topology



Sonar Sensor

NIMS-AQ: Mobile Aquatic Sensing Platform

Still Water Configuration



Flowing Water Configuration

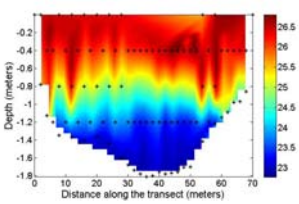
NIMS-AQ prototype at Merced, August 2007

- Developed specifically for *aquatic applications*
- Provide *autonomous calibration* and *depth profiling*
- Self contained mobile tethered platform

  Actuators, sensors, processor, radio and power requirements all on board (no shore festooning required)
- Pontoons capable of supporting up to 350 lbs
- Extendable for use with NIMS-3D configuration
- Designed for use with *Autonomous-IDEA* methodology

A-IDEA: Autonomous Iterative experimental Design for Environmental Applications

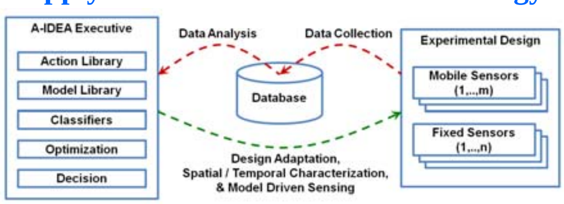
Initial Raster Scan



- Temperature distribution (°C)

  Points represent 89 observation locations using a raster scan
- Time to complete: 34 minutes

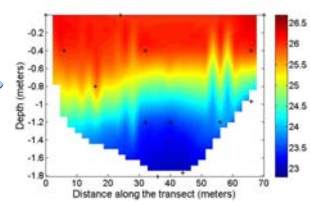
Apply Autonomous-IDEA Methodology



- Iterative experimental Design for Environmental Applications

  IDEA provides a methodology for in-field adaptation of experimental design to perform detailed characterization of the spatiotemporal distribution of the observed environment. This involves an in-field adaptation in the experiment design to capture phenomena dynamics exploiting observations from prior models, iteratively executed experiments and the behavior of the underlying control processes (if known).
- Bilinear interpolation used for surface distribution of 89 observations
- Iterative path planning model yields 13 location output set

Model Based Adaptation



- Temperature distribution (°C)

  Points represent 13 observation locations using path planning algorithm and learned GP model
- 6.85 × reduction in points sampled
- 0.59 (°C) RMS error between predicted and observed values
- Time to complete: 17 minutes

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