

# **UCLA**

## **Posters**

### **Title**

MAS 2: Multiscale Actuated Sensing Theory

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# Multiscale Actuated Sensing Theory

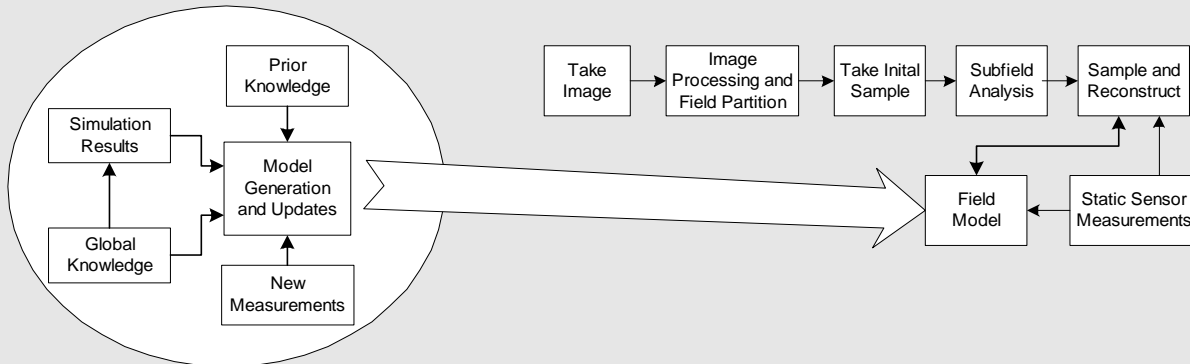
Xiangming Kong, William J. Kaiser and Gregory J. Pottie

## Model-Based Multiscale Sensing

- **Multiscale Sensing:** Combining hierarchy of sensor data sources with varying deployment density and sensing mode
- **Problem:** Achieve the high fidelity of exhaustive sensing by engaging multiple levels of sparse sensing
- **Application:** Determine spatiotemporal characteristics of sunlight field under forest canopy
- **Motivation for Model Based Approach:**
  - Direct fusing of measurements at multiple levels enhances performance, but improvement benefit is limited
  - Models directly extract phenomena behavior
  - Communication and computation rate requirements constrained to most important data
  - New information can be directly incorporated by updating models

## Interactive Information Processing

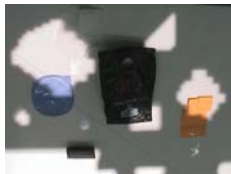
- Extract field distribution models and correlation models from measurements and simulated field
- Apply image processing technique to captured field image to obtain high level information
- Assign uncertainty to measurements based on field distribution models and the image
- Reconstruct field from samples with the help of correlation model
- Update models with new measurements and reconstructed field



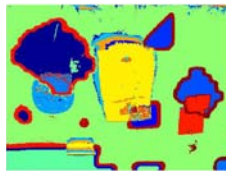
## Current Progress

### Image Processing

- Segment the field image into feature clusters
- Partition the field based on pixel features and connectivity



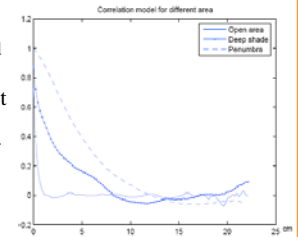
Original Image



Partitioned Patches in Pseudocolor

### Field Model

- Decompose sunlight into 3 components
  - Direct beam, sky diffused light and leaf diffused light
- Obtain correlation model of sky diffused light and leaf diffused light from measured data
- Obtain distribution and correlation models of direct beam from simulated field
- Prior knowledge and reconstructed field can be applied to make correction to the simulation models and update models



### Field Simulation

- **Motivation**
  - Impossible to acquire sufficient data to establish models under all conditions
  - Geometry determines direct solar radiation distribution
- **Simulate solar radiation direct beam distribution**
  - Generate leaf spatial distribution - simulating canopy
  - Compute shade for each leaf, taking into account the penumbra effect
  - Combine shade of each leaf to form a snapshot of the light field
  - Perturb leaves according to wind strength
  - Average snapshots of the light field to get short time average field
- **Simulation validation**
  - Compare with theoretical results and field data

