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Networked InfoMechanical Systems (NIMS): New Architectures and Systems for Actuated Observation

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Problem Definition: High-fidelity Environmental Sensing

- Environmental phenomena are often dynamic
- The environment may not tolerate a dense traditional static sensing infrastructure.

Approach: NIMS-RD & NIMS-3D – Novel Systems for High-fidelity Environmental Sensing

**NIMS-RD: Rapidly Deployable (Pictured Left)**
- Scalability (in a 2D plane): from 2 meters to 100s of meters
- Ability to support a heavy load: ideal for monitoring in environments that may place a large load on the node platform (e.g. river currents)

**NIMS-3D: Three Dimensional (Pictured Right)**
- Scalability (in 3D Volumes): from 10s to 1000s of cubic meters
- Minimal infrastructure: requires only three or four aerial anchor points and one ground mounting point
- Self anchoring coordinate system: any arbitrary 3D coordinate system can be mapped to the NIMS-3D coordinate system

**Application Examples: NIMS Systems in the Field**

**Merced & San Joaquin River Confluence Study**

Monitoring results:
"The San Joaquin River case demonstrated that the NIMS RD velocity distributions are in quantitative agreement with conventional flow-stage observations. Although analogous data were not available for validating the salt loads associated with [Spatial Conductivity] distributions, the close agreement between the two scans suggests that NIMS RD can be used as a quantitative tool in evaluating distributed water quality properties and chemical fluxes in river systems."


**White Mountains Alpine Plant Study**

Monitoring results:
Over the course of a 24hr period the system was allowed to collect thermal data in the alpine plant transect. The images on the left and right show the relative temperature variation over this time period. (system is using a linear resolution of 1cm)

Portability and Ease of Transport:
The NIMS-3D system can go from transport (bottom left) to set-up (bottom right) in under an hour. Calibration of the system only requires a relative positioning of the aerial pulleys and a single point measurement on the ground. It should be noted that the poles are optional as the aerial pulleys can be mounted to any surface that will support them (e.g. tree, utility pole, etc.)

Next Steps: More flexible platform:
Pictured (right) is the new design for the NIMS-RD system. The next generation will reside entirely on the static cable. In doing so, a deployment can occur anywhere a static cable can be strung. This will allow even greater flexibility in the environments that can be monitored.