NIMS: 3-Dimensional, Aquatic & Autonomous-IDEA

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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)

NIMS-AQ: Mobile Aquatic Sensing Platform

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