At the Water's Edge

Installation and Optimization of Robotic Sensing Systems

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Motivation

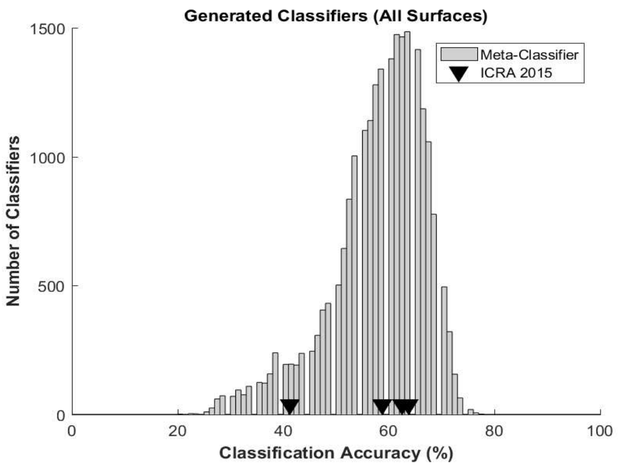
Wetlands are critical to the water cycle, yet they are a difficult environment to safely and effectively monitor. Robot systems have the potential to transform our understanding of complex wetlands systems by not only allowing faster and higher density sensing, but also by enabling new types of measurements and sample collections that cannot currently be performed without significantly disrupting these sensitive systems. This project proposes expanding current unmanned aerial vehicle (UAV) systems, developing novel water monitoring systems, and designing algorithms in order to enable: (1) accurate measurement of the dynamic wetlands channels, including topography and flow, without prior knowledge, (2) adaptive and autonomous installation of static and limited-mobility sensors, and (3) optimization of the overall robot and sensor system to improve information gain while constrained by limited energy and communications.

San Luis National Wildlife Refuge and the City of Stockton Wetlands .

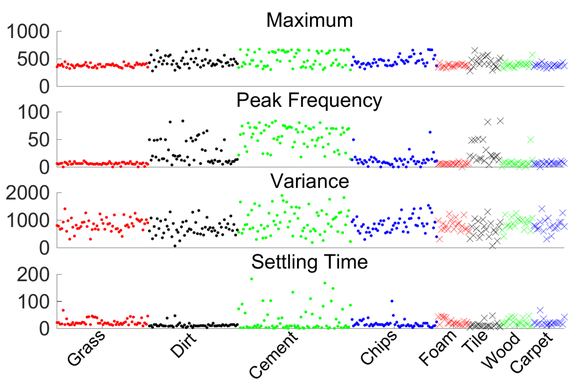
Goals and Objectives

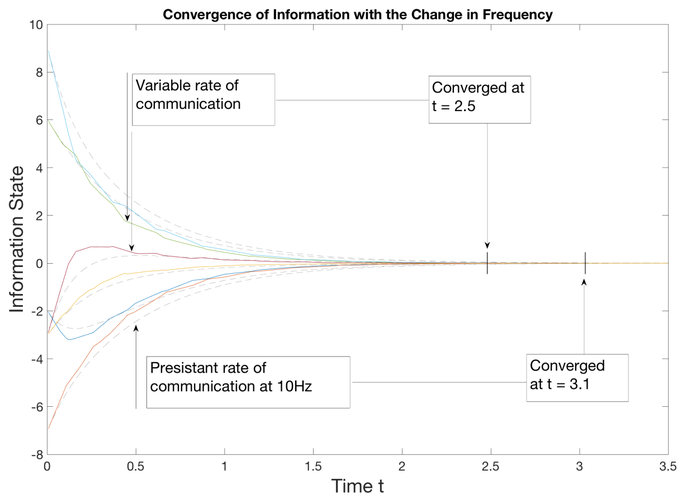
- Design and implement UAV-based systems that measure wetlands channels including channel depth, topography, bathymetry, and water chemistry. Systems will focus on three challenges: sensor fusion for improved topography, land and water differentiation, and bathymetric models of identified water regions.
- Develop algorithms and approaches to ensure sensing repeatability independent of environmental conditions.
- Design and implement algorithms to verify sensor node installation via UAV onboard sensors as UAV installs sensor node.
- Develop co-optimization planning schemes for single-vehicle multi-flight missions.
- Verify the systems and algorithms with our environmental engineers, incrementally incorporating the technical advances and assessing the capabilities of the systems through field studies conducted in wetlands in Nebraska and California.
- Educate students, scientists, and the public on the use, challenges, and need for robotics in wetlands systems through courses, workshops, and presentations.

Progress

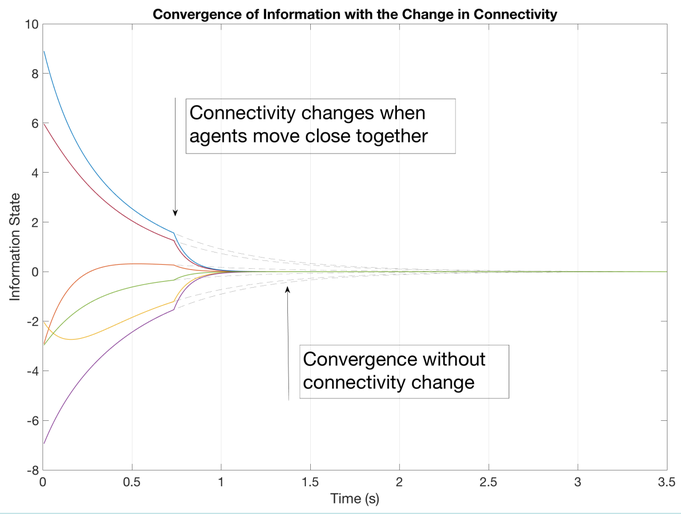


Multi-Sensor Surface Classification

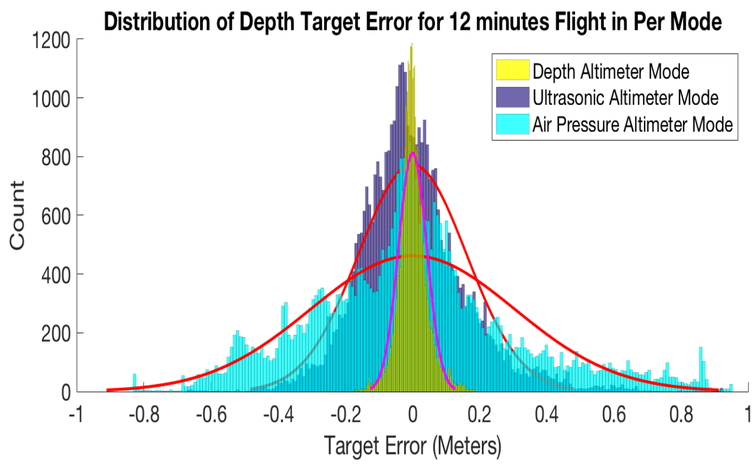


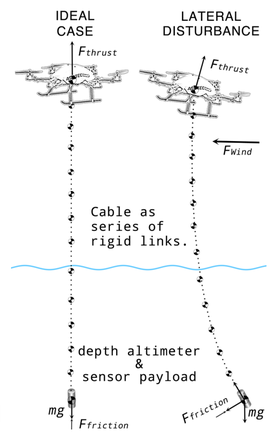


Co-Optimization of Comms

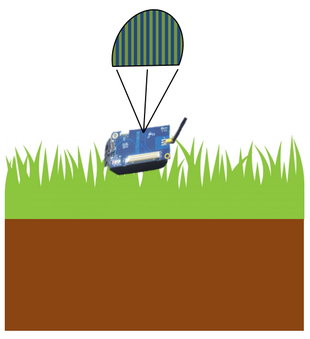


Platform, Design, and Analysis



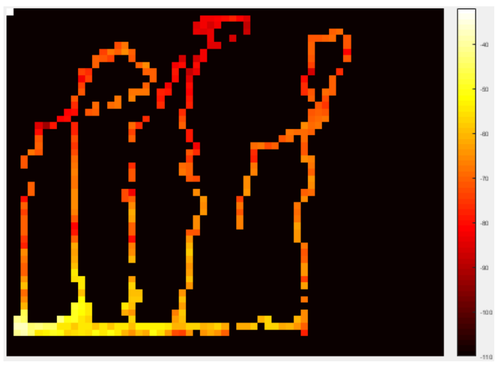


Future Work

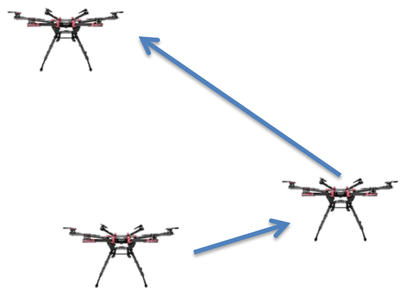


Sensor Installation

Integration with Static Sensors



Development of Communication, Power, and Other Metrics



Single Vehicle Multi-flight Optimization

Verification with Field Deployments

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