Robotic Methods for Surveying the Impacts of Oil Spills

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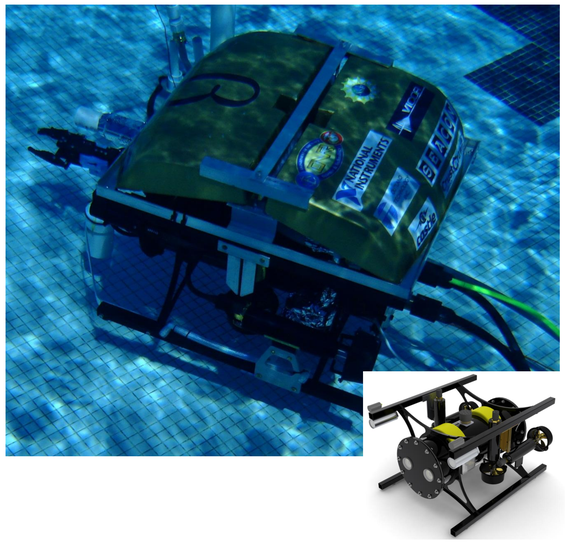
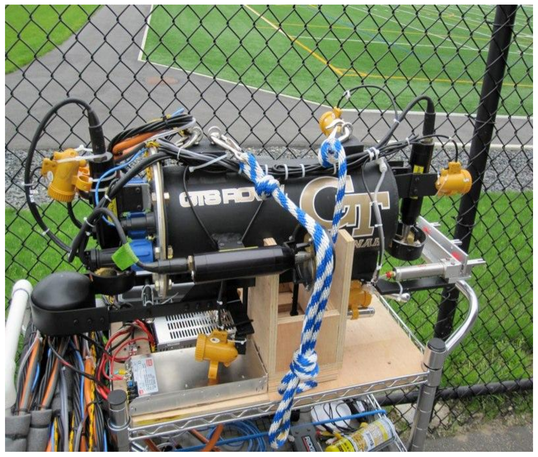
Remotely Operated Vehicle-β



Remotely Operated Vehicle-α



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Project Overview

This NSF/RAPID project establishes a collaborative research program involving Louisiana State University (LSU) and the Georgia Institute of Technology (GT) to jointly develop theoretical and experimental methods that are implemented on marine robots. The methods are being designed to survey Louisiana estuaries, coastal wetlands, and lagoons that have been impacted by oil spills or other environmental stresses. The project goals are:

- Demonstrate the capabilities for student developed marine robots to survey estuaries that are inaccessible, dangerous, or tedious when using conventional surveying methods.
- Develop novel autonomous control and sensing algorithms that are specialized to surveying the impacts of oil spills on coastal environments, under the guidance of biologists, geologists, and oceanographers.
- After verifying the algorithms using mathematical control methods, implement the algorithms on marine robots, and perform surveys in estuaries that have been impacted by oil spills.
- The research is urgent because of the scale and scope of the recent Deepwater Horizon oil spill in the Gulf of Mexico, the need for survey methods for Gulf Coast estuaries, and the hazards and high costs associated with conventional human-based surveys, so the RAPID program is the most appropriate source of support for the project.

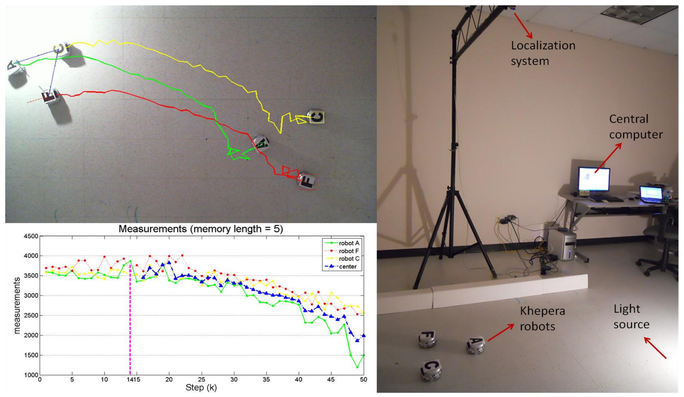
Ongoing Research:

- Autonomous navigation capabilities
- 3 DOF underwater manipulation
- Autonomous chemical field-tracking
- Vehicle, thruster & battery modeling (for simulation and improved controller design)
- Simulation environment for algorithm testing

Education Benefits:

- A diverse team of 20 LSU and GT math and engineering students led by graduate students has been formed.
- With 2 ROVs, an ASV and other platforms planned, undergraduate students are working with graduate students to help apply research to competition vehicles.

Autonomy and Control

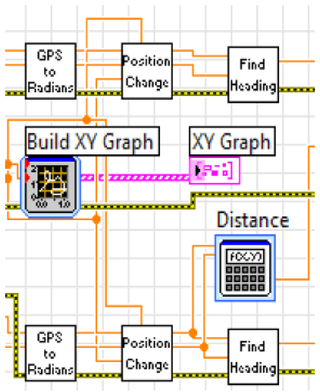


A testbed with overhead camera systems and Khepera mobile robots are employed to verify the autonomy and control algorithms.

A switching exploration strategy inspired by fish behavior is being tested. Robots switch from individual exploration to cooperative exploration based on the environment.

Robot Ship -Victoria

Software Systems



LabVIEW 2009 is used for all programming. The LabVIEW FPGA module and Vision module are used for FPGA control and vision tasks, respectively.

References:

[1] Malisoff, M., and F. Mazenc (2009). **Constructions of Strict Lyapunov Functions**, Communications and Control Engineering Series, Springer-Verlag London, London, UK.

[2] Malisoff, M., F. Mazenc, and F. Zhang (2010). "**Stability and Robustness Analysis for Curve Tracking Control using Input-to-State Stability**," *IEEE Transactions on Automatic Control*, submitted.

[3] Zhang, F., and N. E. Leonard (2010). "**Cooperative Control and Filtering for Cooperative Exploration**," *IEEE Transactions on Automatic Control*, 55(3):650-663.