Exploration and Exploitation in Actuated Communication Networks

Team and the PIs
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Objectives
Our goal is to design networking tools for mobile underwater networks, develop innovative navigation mechanisms for communication-constrained autonomous underwater vehicles, and ultimately integrate sensing and classification to provide solutions for the exploration-exploitation tradeoff.

Research thrusts

1. Mobile Underwater Network Design

Actuated nodes such as AUVs introduce significant time-variation into underwater acoustic networks. Resource allocation, channel access and sharing, and topology control for underwater acoustic communication networks have not actively considered the challenge of time-variation.

2. AUV routing with Communication Constraints

While path planning for robotic sensors has been active research area, very few works have explicitly considered the joint optimization and integration with communication. Given the severe restrictions of underwater acoustic channels (delay, data rate, transmission range), joint communication and navigation designs are needed.

3. Tying in Sensing: Addressing the Exploration-Exploitation Challenge

In order to achieve the optimal exploration-exploitation trade-off, sensing must be introduced into our framework. Central to achieving this goal is the development of cost functions which jointly treat communications and sensing as well as novel classification algorithms that are naturally descriptive of location as well as performance. As such, we will design methods for AUVs which jointly examine communication, sensing and routing.

Broader impacts of the proposed research activity include: (i) training of new information technology professionals and scientists with expertise in interdisciplinary research; (ii) training of technology professionals and scientists in both theory and experiment; (iii) the development of methods with application to science, security, and industry in the areas of environmental monitoring, aquatic ecosystem analysis, ocean accident remediation, surveillance for defense applications, homeland security, oil and gas, aquaculture, geological and oceanographic science, marine biology, etc.; and finally (v) active engagement of the PIs to work with under-represented women and minorities in their research program, leveraging existing efforts and prior success.
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