Priors and Persistence in Aquatic Monitoring with Autonomous Robots

Abstract

Ocean processes are dynamic and complex events that occur on multiple different spatial and temporal scales. To obtain a synoptic view of such events, ocean scientists focus on the collection of long-term time series data sets. Measurements are continually provided by fixed sensors, e.g., moorings, or gathered from ships. Recently, an increase in the utilization of Autonomous Underwater Vehicles (AUVs) has enabled dynamic data acquisition.

With existing AUVs having endurances ranging from a few days to months, a core challenge is predicting or deciding where and/or when to deploy these assets to maximize the information gain with respect to the process of interest over the duration of the deployment. This challenge has motivated investigation into the utility of a priori measurements and/or predictions (priors) to solve path planning and asset allocation problems. The need for such prior information is motivated by: 1) robots have limited resources, 2) we need to plan robot motion, 3) we need to plan efficient robot motion when operating in an environment as complex as the ocean, and 4) effective ocean observation requires accurate spatiotemporal sampling - gathering data within or following a specific mass of water at/for a certain time.

Here, we examine the use of priors for planning science-driven mission objectives for AUVs to study coral reef ecology, algal blooms and nutrient flux. Simulation and experimental results are presented to demonstrate the ability of the proposed techniques to resolve large-scale events, while simultaneously collecting high-resolution data for smaller-scale processes.

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