 Autonomous Marine Sampling
Enhanced by Strategically Deployed Drifters in Marine Flow Fields

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Introduction
We present a transportable system for ocean observations in which an autonomous surface vehicle (ASV) adaptively collects spatially diverse in-situ samples of marine phenomena and the flow field with aid from a team of strategically deployed, inexpensive, passive floating sensors known as drifters.

Sampling Approach
- At each iteration, begin by building a model of the flow field with uncertainty. We use a Gaussian Process [6] with an exponential kernel of the form:

\[ K(a, a') = \sigma^2 \exp(-\frac{a - a'}{l}) \]

with \( \sigma = 1 \) and \( l = 4 \).

Survey Example
Figure 1: These panels show decision points in a survey in which the ASV is attempting to estimate the flow field shown below in Fig 2d. Here the ASV repeats every \( P = 15 \) steps and considers deploying one of its \( n \) drifters. The current estimate of the flow field at the numbered decision point is depicted in the background of the figures in the Proposal Points column. At each Decision State, we compare a hypothetical Adaptive Path of \( m = 50 \) steps to a drifter Deployment Path in which a drifter is deployed to the best Proposal Point. We choose the higher scoring trajectory as the next plan, with drifter path estimated using

\[ \hat{y}_{t+1} = \text{Proposal Points} \times \text{Flow Field Estimate} \]

and considers deploying one of its \( n \) drifters. The current estimate of the flow field at the numbered decision point is depicted in the background of the figures in the Proposal Points column. At each Decision State, we compare a hypothetical Adaptive Path of \( m = 50 \) steps to a drifter Deployment Path in which a drifter is deployed to the best Proposal Point. We choose the higher scoring trajectory as the next plan, with drifter path estimated using [1].

Conclusions
- We investigate survey time, energy, and modeling error and present a tunable algorithm for adaptive sampling with strategic drifter deployment.

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Selected References