

2010 Ocean Sciences Meeting

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CoTrack: A Framework for Tracking Dynamic Features with Static and Mobile Underwater Sensors

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Current feature tracking frameworks in sensor networks exploit advantages of either mobility, where mobile sensors can provide micro scale information of a small sensing area or numerical models that can provide macro scale information about the environment but not both. With the continual development of underwater sensor networks, mobility becomes an important feature to integrate next generation sensing systems. In addition, recent advances in environmental modeling also allow us to better understand basic behavior of the environment. In order to further improve existing sensing systems, we need a new framework that can take advantages of existing fixed sensor networks, mobile sensors and numerical models. We develop CoTrack, a Collaborative Tracking framework, that allows mobile sensors to cooperate with fixed sensors and numerical models to accurately track dynamic features in an environment. The key innovation in CoTrack is the incorporation of numerical models at different scales and sensor measurements to guide mobile sensors for tracking. The framework includes three components: a macro model for large-scale estimation, a micro model for locale estimation of specific features based on sensor measurements, and an adaptive sampling scheme that guides mobile sensors to accurately track dynamic features. We apply our framework to track salinity intrusion in the Columbia River estuary in Oregon, United States. Our framework is fast and can reduce tracking error by more than 50% compared to existing data assimilation and state-of-the-art numerical models.

<http://web.cecs.pdx.edu/~dangtx/pub/oceanscience10/CoTrack.pdf>

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TRACKING PERFORMANCE COMPARISON.

Metric	SELFE Model	Data Assimilation surrogate model	CoTrack

RMSE (m)	6362	550	200
MAE (m)	4553	450	155
Processing Time (s)	0.02	25	0.2

TRACKING PERFORMANCE COMPARISON. THE SALINITY THRESHOLD IS 15 PSU. COTRACK CAN REDUCE THE RMSE FROM 550M TO 200M OR EQUIVALENTLY 63% AND REDUCE THE MAE FROM 450M TO 155M OR EQUIVALENTLY 67% COMPARED TO THE STATE-OF-THE-ART DATA ASSIMILATION. COTRACK PROCESSING TIME IS NEGLIGIBLE.

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