Putting Water Online — Wednesday, May 9, 2012

A Floating Sensor Network enabling better management of water resources

Objectives at a glance:

A Field Experiment Using 100 Smart-Phone Enabled Floating Robots to Track Delta Water Flow

A proof of concept for water flow reconstruction from floating probe measurements.

The experiment will test a novel water flow monitoring system designed to collect velocity data from 100 floating sensor platforms equipped with cellular phones and short-range mesh networking radios.

Fleets of Mobile Robots for Collecting Water Flow Data

Two-thirds of the water in California passes through the Sacramento-San Joaquin Delta, providing drinking water for 22 million Californians and supporting agriculture valued at tens of billions of dollars. For decades, scientists and policy makers have studied the Delta with the goal of protecting this vital resource while also meeting the demands for water. Currently, government agencies collect data about the Delta using fixed water sensor stations, but these sensor networks are expensive and do not always generate sufficient data for modeling and prediction. As a result, oceanographic and hydrological research communities have been investigating the potential of mobile sensors to operate as water flow collection devices has been considered by the oceanographic and hydrodynamics research communities for many years. Unsupervised operation of floating sensors in inland environments such as rivers and deltas is challenging because floating objects tend to get entangled at the shore or on other obstacles. Practitioners currently employ fixed water sensor stations in estuarial environments like the Sacramento / San Joaquin Delta. These sensor networks are expensive and do not always generate sufficient data for modeling and prediction. New advances in autonomous robotics and the availability of commercial cellular networks allows a drastic expansion of water flow monitoring and extend coverage to the thousands of miles of natural and manmade channels in the Delta which are currently under-monitored. As a swarm of mobile sensors float through the Delta, the GPS data that they gather gives a snapshot of the water flow conditions as they evolve. Gathering the fleet's GPS traces and combining them in a process called data assimilation allows researchers to build a complete picture of the water flow conditions in the environment. The prospect of large numbers of floating robotic sensors reporting flow and velocity data represents a significant leap forward in water monitoring.

An Innovative Approache for Sensor Fleets

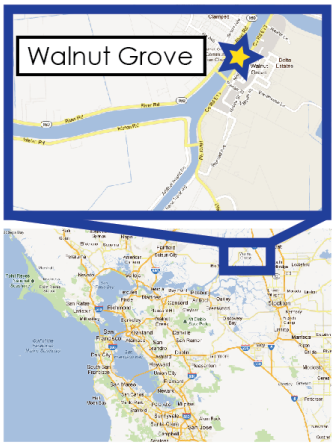
Making floating sensor technology efficient and scalable requires addressing the challenges of autonomy and obstacles in the Delta environment. The Floating Sensor Network laboratory at UC Berkeley is pioneering a new approach to this challenge: an actuated, autonomous, self-propelled robotic sensor platform, which can avoid obstacles in the environment and stay mobile; complemented by a radically low-cost approach to floating sensors, using off-the-shelf smartphone technology to build a device so inexpensive that it can be deployed in large enough numbers.

The Experiment

Under the umbrella of the Center for Information Technology Research in the Interest of Society (CITRIS), Lawrence Berkeley National Laboratory (LBNL), and the UC Berkeley's Department of Civil and Environmental Engineering (CEE) and Department of Electrical Engineering and Computer Science (EECS) are collaborating to conduct an unprecedented experiment in the

http://float.berkeley.edu/

A Floating Sensor Network enabling better management of water resources



100 floating sensors equipped with smart-phone hardware will navigate along a stretch of the Sacramento River and Georgiana Slough located in Walnut Grove, California.

Floating sensors displayed on Google Maps visualizer.

Schedule of VIP and Media Events:

Walnut Grove, California

Experiment
10:00 a.m. — 4:00 p.m.

Inaugural launch
10:30 a.m.

UC Berkeley, California

CITRIS round-table
2:00 p.m. — 4:00 p.m.

Public seminar
4:00 p.m. — 5:00 p.m.

area of hydrodynamic monitoring. For the large part of a day, 100 mobile sensors will be placed into the Sacramento river near Walnut Grove, CA. The robotic sensors will use their propulsion to perform safety and channel selection operations, while the low-cost passive sensors will demonstrate the ease-of-use and efficiency of the large fleet approach. The large number of sensors will provide a comprehensive observation of the river's velocity in the region and adequately represents the potential of low cost floating sensors. The data obtained in the experiment will be processed using the National Energy Research Scientific Computing Center (NERSC) cloud computing testbed at LBNL to create a flow map of the water in the experimental region. Analyzing the results of this experiment will allow a team of UC researchers to determine the trade-offs between data volumes, information quality, logistical requirements, and cost. The experiment will thus underline the value-added available from low-cost mobile sensors which could rapidly complement existing fixed water sensing infrastructure. This work will ultimately guide the design and sharing modalities of future hydrological studies and information collection systems that can offer substantial benefit to government agencies and the water-using public.

Logistics

The experiment will take place from 8:00 a.m. until 5:00 p.m, Wednesday, May 9, 2012. A group of graduate students will deploy a fleet of 100 floating sensors. Each floating sensor is equipped with the hardware of a smart-phone, which will transmit position information every 5 seconds. The measurements from the floating sensors will be sent wirelessly to a LBNL server for real-time display of their locations and for later processing of the flow field. The floating sensors will navigate the Sacramento River and Georgiana Slough junction located near Walnut Grove, California.

Capturing the Event

A public relations event will be organized at 10:00 a.m. at the experiment command center for representatives from governmental agencies, industry, and academia. A launch ceremony at 10:30 a.m. will mark the inaugural launch of this pioneering water-sensing technology. From 2:00 p.m. to 4:00 p.m., a round-table discussion and panel of UC faculty and experts will explore the ramifications of this new sensing technology for the future of California's water systems. This will be followed by a seminar at 4:00 p.m. at UC Berkeley. Come share the excitement of a Berkeley-scale event with major potential for transformation of California water management!

Contact Information

Alexandre M. Bayen
Associate Professor
EECS & CEE
UC Berkeley
bayen@berkley.edu

Andrew Tinka
Research Leader
EECS
UC Berkeley
tinka@berkley.edu

Paul Wright
Director
CITRIS
UC Berkeley
pwright@citris-uc.org

Center for Information Technology Research in the Interest of Society
UC Berkeley • 330 Sutardja Dai Hall, MC 1764 • Berkeley, CA 94720-1764
Phone: (510) 643-9034 • Fax: (510) 642-1800 • http://citris-uc.org/
More information available at http://float.berkeley.edu/