Enabling new techniques in environmental assessment through multi-sensor hydrography

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Abstract

A suite of complementary survey tools aimed at producing 1-cm resolution bathymetric models co-registered with 2-mm pixel color photography has been assembled. The design goal is to produce quantitative documentation of both geological and biological features that will allow change over time to be assessed at vertical and lateral scales approaching one centimeter. The current suite of tools combines multibeam sonar, stereo cameras with dual xenon strobes, lidar, and an inertial navigation system (INS) aided by Doppler velocity log (DVL). This sensor package is mounted beneath remotely operated vehicles (ROV) and used to map the seafloor from low altitudes. A 100-m by 100-m survey can be accomplished in a single ROV dive. All surveys are conducted with scripted station-keeping control loops operating on the ROV, resulting in more efficient area coverage through tended automation. Fine scale surveys of a chemosynthetic biological community at 2850-m depth show that individual clams can be observed in both lidar bathymetry and photographic imagery. Repeat surveys over multiple years have been conducted in the morphologically active floor of Monterey Canyon. Comparison of these data resolve subtle transitions from depositional to erosional textures, and reveal the changes associated with frequent sediment transport events down the active canyon. The rocky, high relief environment of Sur Ridge offshore California hosts sponge and deep water coral habitats. Here the combination of acoustic and optic sensing proves particularly useful for quantitatively characterizing the benthic community. The multibeam sonar measures bathymetry without sensing soft animals, while the lidar measures a surface that includes these animals. Subtracting the multibeam bathymetry from the lidar bathymetry maps the locations and sizes of soft animals.

Keywords

Laser radar, Sonar, Cameras, Software, Animals, Vehicles.