

Detection and Identification of Sardine Eggs at Sea Using a Machine Vision System

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Abstract: The Real-time Flow Imaging and Classification System (REFLICS, Iwamoto et al. 1998 SPIE 3251:214-220) was designed to identify and count fish eggs in the Continuous Underway Fish Egg Sampler (CUFES, Checkley et al. 1997 Fish. Oceanogr. 6:58-73). Such data are used to assess the distribution and abundance of fish eggs for both basic (e.g. spawning stock size estimation) and applied (e.g. spawning habitat assessment) research. Here, we present the further development of REFLICS and its use during an oceanographic cruise to study eggs of Pacific sardine (*Sardinops sagax*) off Southern California. REFLICS is an image acquisition and processing system that now consists of a digital line-scan camera, illuminator, flow cell, pump, and computer with image acquisition hardware and custom software for acquisition, segmentation, and classification of imaged objects. Object characterizing features, such as size, shape, and shading, are computed for sardine eggs, copepods, and bubbles detected in the segmented images. These features

comprise a training set for input into the Classification and Regression Tree (CART) algorithm. CART uses these features to create a decision tree that can accurately classify the desired objects. Simultaneous to REFLICS operation, fish eggs and other plankton are collected and ancillary data logged, including time, position, temperature, salinity, and chlorophyll a fluorescence. REFLICS and CUFES were used April 4-19, 2003, on the R/V Roger Revelle (<http://swfsc.nmfs.noaa.gov/frd/CalCOFI/CurrentCruise/currentcruise.htm>). 583423 REFLICS images were segmented during 92 CUFES sample intervals of 30 min each, in which 9987 sardine eggs were microscopically enumerated by experts. We present results of REFLICS classification of segmented images and their comparison with shipboard microscopic counts. We also discuss the implications of the routine, real-time sensing of fish eggs and other variables continuously from a moving ship, including high resolution and adaptive sampling and relational databases.