Profiling River Surface Velocities and Volume Flow Estmation with Bistatic UHF RiverSonde Radar

Don Barrick
Cal Teague
Pete Lilleboe
CODAR Ocean Sensors, Ltd.
1000 Fremont Avenue, Suite 145
Los Altos, CA 94024

Ralph Cheng
Jeff Gartner
U.S. Geological Survey
Water Resources Division
345 Middlefield Road
Menlo Park, CA 94025

ABSTRACT

During the summer of 2000, a bistatic UHF radar -- the RiverSonde -- was designed, built, and tested on rivers and canals in the Central Valley of California. The transmitter and receiver were on opposite banks. They simultaneously transmit to and receive from elliptical time-delay cells that span the river, with the transmit and receive antennas as their focal points. With 30 MHz bandwidth, the cell span up / down-river is ~10 m. A three-element receive array employs the direction finding MUSIC algorithm to determine echo bearing. Velocity along the river channel is measured vs position across the river from the first-order Bragg-echo Doppler shifts. Radiating less than 1 w power, received surface-echo signal-to-noise ratios of 40 dB were received, both across narrow canals and across the American River that was 80 meters wide.

Our tests and analyses were sponsored by and conducted along with the U.S. Geological Survey in Menlo Park, CA. "Surface truth" velocity profiles were established by current meters suspended from a boat, from a bridge, and from timing the drifts of tennis balls between two transverse cuts. RMS velocity differences between 6% - 13% of the typical average flow velocity were observed. The rms differences between the three "surface truth" measurements themselves also fell within the same span.

From the velocity profiles across the river, estimates of total volume flow for the four methods were calculated based on a knowledge of the bottom depth vs position across the river. The flow comparisons for the American River were much closer, within 2% of each other among all of the methods. Sources of positional biases and anomlies in the RiverSonde measurement patterns along the river are identified and discussed.