

# STREAMFLOW MEASUREMENT USING A RIVERSONDE UHF RADAR SYSTEM

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Initial field tests have been performed to evaluate the performance of a RiverSonde streamflow measurement system. The tests were conducted at a concrete-lined canal and a natural river in central California during June, 2000. The RiverSonde is a UHF radar operating near 350 MHz and is based on a modified SeaSonde system normally used to measure ocean surface currents in salt water using lower frequencies (5–25 MHz). The RiverSonde uses energy scattered by Bragg-resonant 0.5 m water waves and does not require any sensors in the water. Water velocity is calculated by observing the Doppler shift of the scattered radar energy and comparing that with the Doppler shift expected from resonant waves in still water. The radar has sufficient resolution to allow the estimation of a velocity profile across the width of the river.

The antennas consisted of a 2-element transmitting antenna and a 3-element receiving antenna. The transmitting antenna provided broad illumination of the water surface, and MUSIC direction finding was used to determine the arrival direction of the reflected radar energy. The transmitting and receiving antennas were placed on opposite banks to reduce the signal intensity variation across the channel. A chirp frequency sweep was used to determine range. Transmitted power was under 1 W, and the maximum range was a few hundred meters. Range resolution was on the order of 10 m, and velocity resolution was about 2.5 cm/s.

Extensive *in-situ* surface truth measurements were performed by personnel from the United States Geological Survey. The instruments included current meters suspended at various depths from a small boat positioned at several locations across the channel, video tracking of many floaters (tennis balls) on the water surface, an optical flow meter, and anemometer wind measurements. Typical water velocities were about 40 cm/s, and RMS velocity differences between the radar and *in-situ* measurements were 6–18% of the mean flow, with similar differences among the various *in-situ* velocity measurements. Total volume flow was estimated using *in-situ* bottom sounders for water depth, and volume flow differences between radar and *in-situ* measurements were less than 10%.