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Remote sensing of coastal waves using stereo imaging

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Wave measurements in the nearshore region play a valuable role in coastal management and forecasting. The most commonly measured parameters are wave period and wave height and these data are of use to the shipping industry, to coastal developers, and to public safety officials, among others. In recent decades, remote sensing methods have been applied to coastal and offshore measurements with increasing frequency. Three of the key advantages of remote sensing are that (i) capital and maintenance expenses are relatively low, (ii) the exposure of instrumentation and personnel to potentially hazardous field conditions is minimized, and (iii) measurements over a large area are easily obtained.

An experimental study of the remote sensing of water wave elevations, through the application of stereo photogrammetry, is presented. This method uses two spatially offset cameras, with overlapping fields of view, to determine water surface elevation. This remote sensing approach provides data with excellent spatial coverage and spatial and temporal resolution. Additionally, the hardware needs are minimal and the system is quickly deployed, calibrated, and operational. Finally, in contrast with other remote sensing methods in the surf zone (radar, single-camera optical methods), stereo imaging has the ability to determine wave height.

In the present study, a phased approach was taken, with medium scale laboratory experiments being followed by a large-scale field test of the method. In the laboratory, reconstructed surface elevations were validated using a pressure sensor and demonstrated excellent agreement. In the field, measured wave heights and periods were found to agree well with available buoy data. Additionally, derived energy spectra in the vicinity of the breaker line demonstrated a decrease in energy at the peak frequency and an increase in energy in the sub- and super-harmonics as the waves passed through the breaker line. Additional uses of the data include estimating bathymetric depth from nonlinear wave theories.