Performance Characteristics of the Spotter: A New Developed Wave Measurement Buoy

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1. Abstract

There is considerable demand for high fidelity, low-cost wave measurements in coastal and oceanic environments for academic, government, commercial, and recreational purposes. Present-day commercial off-the-shelf (COTS) wave measurement devices are typically cost-prohibitive (order of tens of thousands of dollars) and their operations can be considered labor intensive and/or require scientific or engineering expertise, limiting its wide adoption by many public and private entities, including economically disadvantaged nations.

The Spotter is a low-cost, real-time, solar powered wave measurement buoy that was recently developed by Sofar Technologies, Inc. (formerly Spoondrift). To evaluate the data quality of the Spotter device, we performed a series of validation experiments that included comparisons between Spotter-derived motions and prescribed wave motions (monochromatic and random waves) on a custom-built, motion-controlled validation stand, and simultaneous in-water measurements using a conventional wave measurement buoy, the Datawell DWR-G4 (Datawell). Spotter evaluations included time domain validation (i.e. wave-by-wave) and comparisons of wave spectra (Figure 1), directional moments, and bulk statistical parameters such as significant wave height, peak period, mean wave direction and, directional spread. Spotter wave measurements show excellent fidelity and lend a high degree of confidence in data quality. Overall, Spotter-derived bulk statistical parameters were within 10% of respective Datawell-derived quantities (Figure 2). The Spotter's low-cost and compact form factor enabled unique field deployments of multiple wave measurement buoys for direct measurements of wave characteristics such as ocean wave decorrelation length scales, wave speed, and directional spread. Wave decorrelation lengths were found to be inversely proportional to the width of the spectrum, and wave speeds compared well against linear wave theory.

The low-cost and compact Spotter makes it easy to deploy arrays of wave buoys which was previously not feasible (or cost prohibitive) with traditional wave buoys. A well-designed array can provide a direct measurement of the directional wave spectrum, which is not available from a single buoy measurement. To explore this possibility, field trials were conducted using two Spotters and Datawell deployed as a three-element linear array. The array allowed for the application of plane-wave beamforming techniques to compute wave directional spectra, which are shown to compare reasonably against traditional maximum likelihood techniques (Figure 3).

2. Acknowledgment

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![Figure 1. Comparison of Spotter vertical displacement power spectra to that measured by a Datawell DWR-G4 in Half Moon Bay (CA) in March 2018.](image1)

![Figure 2. Comparison of Spotter bulk statistics to that measured by a Datawell DWR-G4 in Waimanalo, HI in March 2016.](image2)

![Figure 3. Comparison of directional spectra obtained using conventional maximum likelihood techniques (left) and plane-wave beamforming (right).](image3)