Dataset for Regular Waves Measured using a Single Photon Avalanche Diode Array

Test Overview

This document describes the experimental data obtained from experiments assessing the performance of a Single Photon Avalanche Diode (SPAD) array used to measure surface gravity waves. A range of waves with different amplitudes and frequencies were generated at the FloWave Ocean Energy Research Facility (FloWave) based at the University of Edinburgh. Twelve regular wave case were used, spanning a range of steepness, as defined in . Measurements were obtained using a SPAD array and a conventional resistance type wave gauge for comparison.

Table 1: test cases

Ref.	Target f [Hz]	Actual f [Hz]	Amp a [m]	steepness ka	test type
1	0.7	0.688	0.02	0.0395	amplitude sweep
2	0.7	0.688	0.04	0.079	amplitude sweep
3	0.7	0.688	0.06	0.118	amplitude sweep
4	0.7	0.688	0.08	0.158	amplitude sweep
5	0.7	0.688	0.1	0.197	amplitude sweep
6	0.3	0.313	0.06	0.0291	frequency sweep
7	0.4	0.406	0.06	0.0432	frequency sweep
8	0.5	0.5	0.06	0.0623	frequency sweep
9	0.6	0.594	0.06	0.0875	frequency sweep
10	0.8	0.813	0.06	0.155	frequency sweep
11	0.9	0.906	0.06	0.196	frequency sweep
12	1	1	0.06	0.242	frequency sweep

The surface gravity waves were measured by a 256x256 array SPAD sensor. The sensor enables on-chip histogramming functionality, and in this mode pixels are combined in 4 x 4 groups to form 64 x 64 "macropixels", each of which generates a 16-bin histogram of the time of arrival of detected photons. The histograms were processed by a simple centre of mass (CMM) algorithm to provide depth data for each macropixel. A hardware issues in the prototype sensor currently restrict readout to approximately half the array, resulting in a usable 64 x27 macropixel array and 15 out of the 16 histogram bins. The exposure time was set to 10ms and processed, and readout time was near 0.33ms for each frame, 300 frames were captured for every case. Processed depth data is provided with the accompanying dataset.

In addition to the SPAD array, a calibrated resistance type wave gauge in the same x-position (relative to wave propagation) was used. This was set to sample at 32 hz. It is to be noted that the wave gauge data is not time-synchronized to the SPAD data.

File Details and Structure

In the data folder, there are three sub-folders names WaveGaugeData, SPADDepthData and Video. The details of the different datatypes are described below:

WaveGaugeData

In this folder there is one file per test case defined in , named TestX.csv for Ref. X. The first column is time (at 32 hz) and the second column is the surface elevation in meters.

SPADDepthData

In this folder there is one folder per test. In these folders there are 300 files corresponding to the 300 frames (at approx. 10 hz) captured by the SPAD for each test case. Each file, named TestX_frameY.csv is the processed depth data for the SPAD array for test X () and for frame Y. The data is in metres.

Video

In this folder there is one video per test. Each video shows the processed surface elevation data obtained for the SPAD array, along with the histograms for a single pixel captured for each frame. This pixel is highlighted by a red dot in the surface elevation surface.