openDynamics Validation Cases

https://github.com/TimB-QNA/openDynamics

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Chapter 1

Introduction

This document details the tests undertaken to validate openDynamics. This document is very much a work in progress, so it is not guaranteed that it is in any way complete. The aspiration is that this document will cover both unit testing of all the components used in the simulation, as well as broader verification of the results against manouvring and seakeeping tests on published hullforms.

Chapter 2

Seastates

2.1 Pierson-Moscowitz Wave Spectrum

Several different versions of the Pierson-Moscowitz spectrum exist. In this code we only consider the simplest spectrum, which has only a single parameter. More detailed spectra can be added later, but for initial test work this provides a reasonable deep-water seastate.

2.1.1 Spectrum calculation

The spectrum is taken from [1], wherein it is given in the general form as

$$S(\omega) = A\omega^{-5}\exp(-B\omega^{-4}) \tag{2.1}$$

With the single-parameter equations for A and B given as

$$A = 8.1 * 10^{-3} g^2 \tag{2.2}$$

$$B = 0.0323\left(\frac{g}{H_{1/3}}\right)^2 \tag{2.3}$$

Additionally, we define phase angles for each wave component in software. These angles are generated randomly in the range 0 to $2 * \pi$. At present there is no capability for the user to seed these values.

2.1.2 Spectrum validation

The spectrum has been validated for a waveheight of 5 meters against the data given in [1]. The source data was reverse-engineered from the given graph (pg 63, fig 3.3), and thus may have some associated inaccuracy, however, this is minimal. The two data sets are compared and shown to be accurate in figure 2.1.

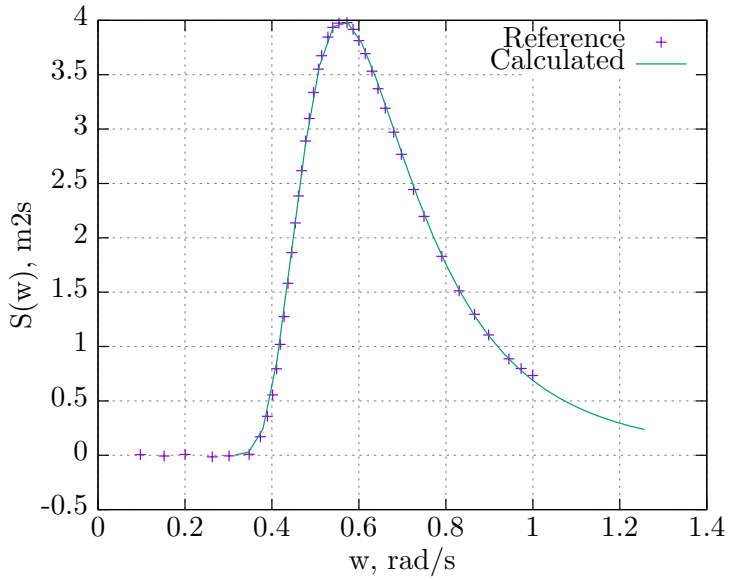

Figure 2.1: Pierson Moscowitz Spectrum

Chapter 3

Bibliography

[1] Thor I. Fossen. Guidance and Control of Ocean Vehicles. 7