Stochastic models for non-linear ocean waves

Nicolas Raillard

Coastal marine systems, such as Wave Energy Converters, are subject to loadings due to waves. In shallow water and with a variable bathymetry, these waves are highly nonlinear. To study the statistical properties of the dynamic behavior of the systems, as for example probability of extreme situations for reliability assessment, a great number of long wave time series are needed. Hydrodynamic numerical software for simulating wave time series in such context exist, but they are too much CPU time consuming for that purpose. The aim of this work is to compare different models of stochastic processes suited to this context: physical second-order wave model, Laplace Moving Average process (LMA, see e.g. Podgòrski and Wegener (2010) and Raillard (2015)), and time modulated process (see e.g. Ailliot et al (2016)). These processes can reproduce the asymmetries observed in the records of coastal waves, such as peaked crest and flat thought for example. The models will be validated on synthetic sea waves and on a time series of sea wave measured in a wave flume with a varying bottom. References: - Ailliot P., Delyon B., Monbet V., Prevosto M. (2016). Dependent time changed processes with applications to nonlinear ocean waves. arXiv:1510.02302; - Podgórski, K., & Wegener, J. (2011). Estimation for Stochastic Models Driven by Laplace Motion. Communications in Statistics - Theory and Methods, 40(18), 3281–3302. https://doi.org/10.1080/03610926.2010.499051; - Raillard Nicolas, Prevosto Marc, Ailliot Pierre (2015). Modeling process asymmetries with Laplace moving average. Computational Statistics & Data Analysis , 81, 24-37;