Statistics of Surf Parameter and Wave Power for individual waves

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Objective and Scope

Objective: Explore the statistical properties of derived Longuet-Higgins probability model for surf parameter and wave power

Scope

The investigation is limited to the suitability of theoretical model derived from [1] for the short term distribution of surf parameter and wave power

Introduction

1. Characteristics of theoretical model for surf parameter and wave power are presented by giving conditional, marginal probabilistic quantities of wave parameter as well as application examples
2. Comparative study of theoretical model and parametric model for surf parameter and wave power is carried out

Methods

1. Convergence study is performed for not only the integration step but also the truncation of infinity
2. Results from different numerical integration methods are verified with each other
3. Numerical investigation is conducted to validate against theoretical results

Statistics of surf parameter

Fig. 1 shows evident difference exists between parametric model [2] and theoretical model in predicting occuring frequency of surf parameter.

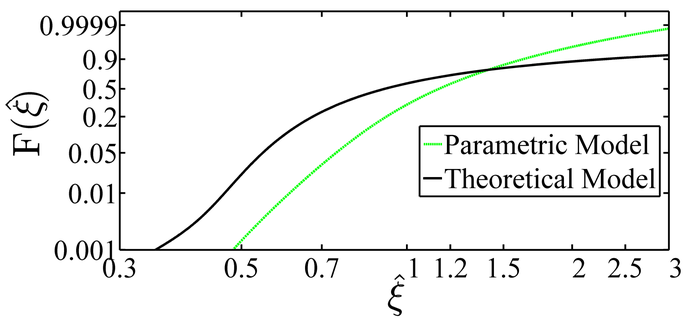

Figure 1: Marginal cumulative distribution function of normalized surf parameter $\hat{\xi}$

Figs. 2 and 3 give application examples of the derived Longuet - Higgins model for joint distribution of surf parameter and wave height. Plunging breaker of breaking waves is defined by surf parameter ξ being in the range of (0.5, 3]. Wave run-up is connected with surf parameter by $R = \xi h$.

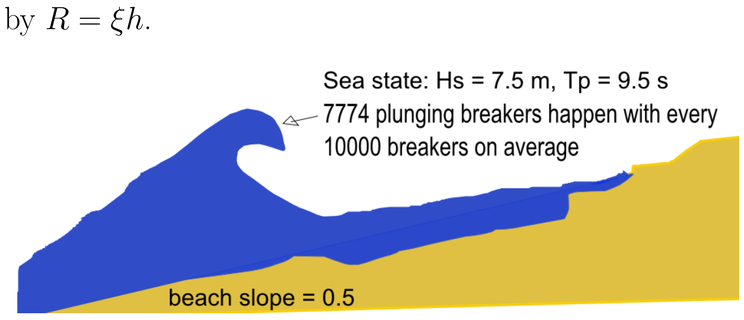

Figure 2: Occuring frequency of plunging breaker

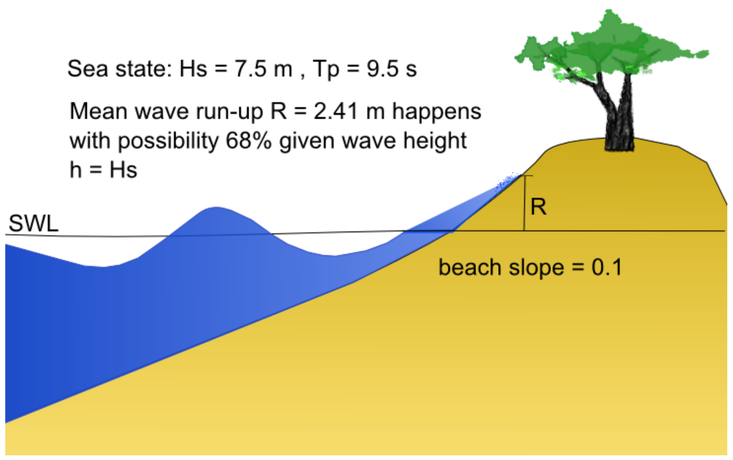

Figure 3: Occuring frequency of mean wave run-up

Statistics of Wave Power

From Fig. 4, it is observed that parametric model [3] and theoretical model [4] agree well.

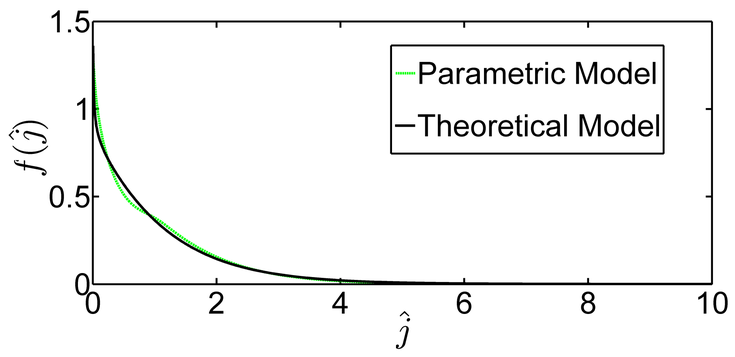

Figure 4: Marginal probability density function of wave power

It is seen from Figs. 5 and 6, conditional expected normalized wave power $\hat{j}$ given normalized wave height $\hat{h}$ and normalized wave period $\hat{t}$ from two models both agree with each other in low wave primary parameters but difference rises significantly in their large values.

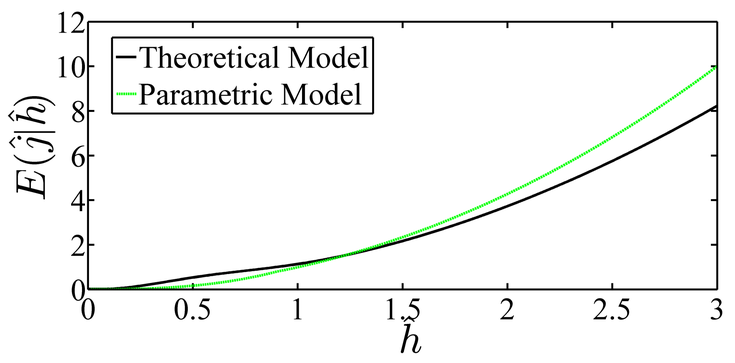

Figure 5: Conditional expected value of normalized wave power $\hat{j}$ given normalized wave height $\hat{h}$

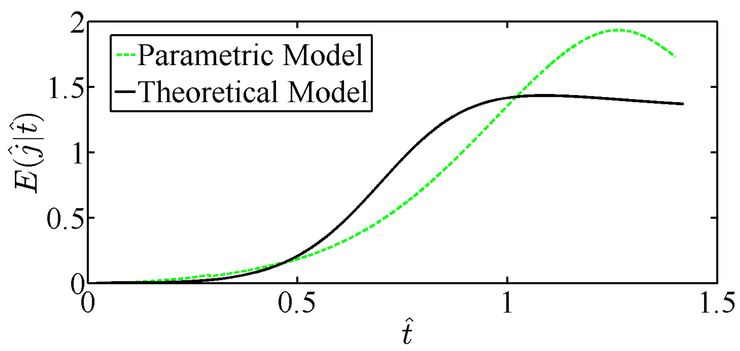

Figure 6: Conditional expected value of normalized wave power $\hat{j}$ given normalized wave period $\hat{t}$

Conclusions

1. Statistical quantities of interest for surf parameter from the derived Longuet - Higgins model differ from those from the parametric model
2. Statistical quantities of interest for wave power from the derived Longuet - Higgins model are comparable well with those from the parametric model

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[3] Myrhaug, D., Leira, B. J., and Holm, H.(2009). Applied Ocean Res., 31(4):246–250.

[4] Izadparast, A. H. and Niedzwecki, J. M. (2011). Ocean Eng., 38(1):177–185.