Efficient time domain simulation of waves

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ABSTRACT

Most often metocean data are presented either in the frequency domain or as scatter matrices with frequency of occurrence versus wave period and significant wave height. As a result, seastates for time domain simulations are most often obtained from frequency domain data. Normally the transformation from frequency domain to time domain is carried out by inverse Fourier transformation or similar procedure. Currently, methods are available with good quality of much of the statistical properties, presented in e.g. ref. [1] and widely spread in standards and recommended practices such as [3]. However commonly used methods, require a large number of frequency components to obtain waves that does not repeat in relatively short periods. For many applications this result in computationally intensive simulations.

The current paper proposes and investigate quality measures to ensure that the right amount of frequency components is used for different applications. The current paper also studies a novel approach to select discrete frequencies that minimise the number of frequencies required.

The paper also discuss possible applications, benefits and future developments that can be anticipated thanks to improved efficiency in time domain simulation of waves, starting with a brief background of the current paper: A continuously growing demand have been noted, for increased fidelity in representation of forces acting on a ship when performing simulations for training, engineering studies and research.

Concurrently there is an increased interest in simulating marine operations, tug boat operations et.c with several ships involved. The current method development plays a central role in providing such simulations of missions and operations without demand for excessive computational resources. Efficient wave simulations are also an enabler for providing simulations in the form of software as a service, which require centralised core computations and distributed graphics. Currently this approach of providing simulations is demonstrated by SSPA Swedens WebSEAMAN service [2], which can be run in the end users own web browser.

The current paper compares statistical properties of the novel approach of selecting discrete frequencies with the most commonly used for ocean engineering, naval architecture, et.c. there is also a presentation of the computational power and a discussion of the relationship between demand for computational power and quality of statistical properties for different methods of time domain simulation of waves. These properties of different numerical methods are also compared to measurement data, e.g. presented in [4].

REFERENCES

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