Modelling uncertainties for the design of ships and offshore structures has been a topic of discussion by the International Ship Structures Congress (ISSC) and the International Towing Tank Conference (ITTC) for a long time. As part of the mandate of these internationally recognised organisations to encourage cooperation in areas of mutual interest, the 1st Joint ISSC/ITTC International Workshop on Uncertainty Modelling for Ships and Offshore Structures (UMSOS) was held as pre-amble to the 18th International Ship Structures Congress, on 8 September 2012 at Rostock (Germany). The workshop, organised by ISSC I.1 Committee on Environment, ISSC I.2 Committee on Loads as well as the ITTC Seakeeping and Ocean Engineering Committees facilitated the exchange of ideas on understanding the influence of improved uncertainty modelling in the design of Ships and Offshore Structures. The topics discussed included:

- model testing,
- full scale measurements,
- load prediction techniques,
- experimental validation techniques,
- utilisation of satellite measurements,
- extreme environmental phenomena,
- risk assessment and mitigation, and
- goal based standardisation.

As a Special Issue was considered appropriate to underline the importance of the subject I feel honoured that I was given the opportunity to write this Editorial note. The papers presented in this issue of Ocean Engineering outline aspects of uncertainty from the viewpoint of both industry and academia, hence representing the importance of the subject at theoretical and application level.

The benchmark study on hull girder bending induced slamming and whipping loads presented by Drummen and Holtmann (2014) successfully discusses the degree of variation in estimates produced by different numerical methods when compared against experimental results. The authors conclude that vertical- and horizontal-bending steady state flexible fluid structure interaction responses derived by different computational tools generally agree well with experimental results. However, computations considering the influence of impulse induced responses even in regular head waves may demonstrate significant differences because of uncertainties related to the implementation of hydroelastic modelling assumptions, model testing methods and user experience.

The first paper by Bitner Gregersen et al. (2014a) demonstrates the importance of uncertainties related to wind and wave description for engineering applications. The inherent variability and epistemic uncertainties associated with wind and wave data, including model tests and their consequences on specification of design criteria are illustrated by practical examples. Particular attention is given to stationarity or non-stationarity of sea states and wind fields, sampling variability, directionality of wind and waves and squalls. Considering waves generated in test tanks, a review of uncertainty analysis recommended in the current ITTC guidelines is also given and an error analysis method that may be used in model tests is suggested.

The second paper by Bitner Gregersen et al. (2014b) reviews recent research progress in developing accurate models and methods for the estimation of uncertainties related with wind, waves, current, seawater level and ice. Particular attention is given to the importance of developing robust models describing rogue waves as well as the significance of validating ice and wind data models that may be used for the design and operation of ships and offshore structures. The authors conclude that the accuracy of wind and waves hindcast databases as well as satellite data has significantly improved. However, the issue of met-ocean data ownership remains a general problem bringing some limitation to work on comparison of different data sources.

The paper by Papanikolaou et al. (2014) highlights the importance of understanding and integrating uncertainties in the context of useful prediction tools for the assessment of ship wave-induced design loads and operations. This is elaborated by presenting some recent advances in (a) modelling the combined hydrodynamic responses of ship structures using cross-spectral combination methods and (b) in implementing uncertainty...
models used for the development of modern decision support systems as guidance to ship's master. It is hoped that with the emergence of performance based regulations the concepts discussed in this publication will become increasingly important.

The paper by Qiu et al. (2014) discusses uncertainties related to the prediction of loads and responses for offshore structures in accordance with the findings by the Ocean Engineering Committee of the International Towing Tank Conference (ITTC). In this work the parameters that may cause uncertainties in ocean engineering model tests, full-scale tests and numerical simulations are categorised in terms of physical properties of the fluid, initial conditions, model definition, environment, scaling, instrumentation and human factors. Emphasis is given to the uncertainty sources in model tests involving deep water mooring lines, risers and dynamic positioning systems and the need for quantifying them. The authors conclude that it is particularly challenging to extrapolate model test results to full scale and utilise successfully complex numerical models, especially if the effects of hydrodynamic nonlinearities are significant.

Finally, the paper by Kim and Hermansky (2014) discusses uncertainties in seakeeping analysis and the related ITTC procedures for loads and responses in waves. Technical uncertainty analysis issues are outlined within the context of the ISO-GUM method and the corresponding ITTC procedures. The authors conclude that following a well-established verification and validation process is important in order to understand the error sources and the degrees of uncertainty and accuracy of both computational predictions and model tests. For this reason further research and development that may establish the engineering robustness of such process is considered necessary.

In concluding, as signatory of this Special Issue I wish to express my gratitude to the UMSOS workshop Chair and Editor in Charge of this Journal, Professor Atilla Incecik of the University of Strathclyde. I am also pleased to acknowledge that both the workshop and the proceedings of this Special Issue have been supported by Lloyd’s Register Group Ltd. and DNVGL. To this end I would like to especially acknowledge the support received by Dr. Fai Cheng (Head of Lloyd’s Register Strategic Research) and Dr. Elzbieta Bitner Gregersen of DNVGL Strategic Research. It is hoped that this Special Issue of Ocean Engineering will stimulate interest in uncertainty analysis, contribute to our understanding on the subject and its strategic scope for the design of safe ships and offshore structures.

References


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