The ComMotion project: Computational Methods for Moving and Deforming Objects in Extreme Waves

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ABSTRACT

Extreme waves and their impact on (fixed and floating) offshore structures have long been subjects that could only be studied with experimental methods; the complex, highly non-linear wave kinematics could not be predicted sufficiently accurate with existing numerical methods (CFD). Phenomena like green water loading and slamming are highly dependent on the relative motion of a ship versus the oncoming wave crests, i.e. as influenced by the preceding wave groups. At the same time, the hydrodynamic forces due to the surrounding flow are jeopardizing the structural integrity of a body; its hydro-elastic response often has a significant influence and then also needs to be part of the modelling.

Thus, accurate prediction of the occurring hydrodynamic forces requires methods that can reliably predict the interaction between extreme waves and body dynamics (including deformation). In close cooperation with the offshore industry, over the years the ComFLOW simulation method has been developed which covers this CFD niche. Several novel ingredients have been developed, like the use of local height functions and energy-preserving discretization schemes. A recent ingredient in the approach is a (generally applicable) unsteady coupling algorithm that is numerically stable under all circumstances (such as ratio of body mass versus added mass) [1]. Also, a new class of absorbing boundary conditions [2] has been extended to include the effects of current.

Applications that are covered in the ComMotion project comprise green water loading and slamming, wave impact against TLP platforms, free fall life boats, dock ships and hydro-elastic response of offshore wind turbines. Because of the complex physics, experimental validation of the selected flow models is essential. Such model tests have been carried out at MARIN.

REFERENCES

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