Investigation of Green Water in FPSO by a Particle-based Numerical Offshore Tank

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ABSTRACT

The oil exploitation in deepwater and ultra-deepwater is performed by using floating structures such as Floating Production, Storage and Offloading (FPSO) and Semi-submersible (SS) platforms. In rough seas, severe hydrodynamic impact loads due to wave slamming, wave-in-deck-impact and green water may occur and compromise the operation of the floating structure. In order to investigate the fluid-structure iteration problem with complex moving body and large free-surface deformation is adopted the Moving Particle Semi-implicit (MPS) method [1].

In previous works [2] and [3], simulations of the green water on models of the floating platforms were carried by the authors. The validation of the particle-based numerical approach were carried out by comparison between the computed results and the experimental results available on the literature regarding 3D dam-breaking problem and fixed FPSO models. Due to hardware restrictions associated to the shared memory parallel processing, numerical models with less than 2 million particles were used. Despite the relatively rough resolution, the effects of the bow shape could be determined in [2]. In the present paper, a parallelization technique based on dynamic domain partitioning and distributed memory architecture is adopted to overcome the hardware limitation. This improved the scalability of the computation and allowed the numerical modeling of 10^8 particles in a PC cluster.

The green water analysis carried out in the present work is divided into two parts. The first part consists in the convergence analysis, based on the simulation of a simple free floating reduced scale FPSO model. The results obtained using the maximum resolution allowed by the shared memory parallel processing are compared to the results of finer resolution model with distributed memory parallel processing. In the second part, full scale simulations of a FLNG are carried out, including topside structures and using a high resolution model with approximate one hundred million particles.

REFERENCES

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