Adaptation of STAR-CCM+ Numerical Wave Tank to an Offshore Floater Design Tool

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Advanced features of STAR-CCM+, such as Volume Of Fluid, DFBI and overset grid techniques have made it possible to simulate extreme waves and their interaction with floating structure to provide essential design information such as wave run up, air gap, green water and wave impact load. However, the application of the Numerical Wave Tank (NWT) for floater design remains challenging due to its computational cost, especially for the simulation of the floater response in irregular waves.

Simulation of irregular waves by a NWT requires a computational domain large enough to simulate the nonlinear evolution of the incoming waves with sufficient fetch length. Fine mesh or cell size is needed along the fetch length to prevent excessive numerical attenuation of the incoming wave. On the downstream, sufficient domain length with damping zone is necessary to prevent wave reflection. All of these requirements make the computation cost of the NWT extremely expensive for practical applications.

Recently, Technip introduced the Euler Overlay Method (EOM) to reduce the computational cost of the NWT and make it practical for hull structural design. The hybrid numerical method, EOM, matches a pre-defined wave solution at far field with a CFD solution near the structure. The far-field wave solution is either regular or irregular transient waves obtained by a Euler equation solver without the presence of the structure. The EOM-based NWT has been utilized in a number of offshore projects to provide extreme design load on structures, which were available only from physical model tests in the past.

Introduction of the NWT based on EOM and STAR-CCM+ and its successful application on recent offshore projects will be presented.

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