Smoothed Particles Hydrodynamics Simulation of U-Tank in Forced Motion

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Abstract

Anti-Roll Tanks (ARTs) represent a reliable device to reduce ship rolling motion in waves. Even tough they have some known problems in specific operating conditions, e.g. at low frequencies, there is a renewed interest for applications other than ships such as on some Wave Energy Converter (WEC) devices. In the recent years CFD have started to be used in Simulation Based Design (SBD) frameworks to reach reliable predictions of the hydrodynamic behaviors of such a devices. Considering ARTs from a hydrodynamic perspective there are some relevant phenomena that can be categorized in the classes of *sloshing* and, eventually, of *slamming* that should be properly addressed to achieve high fidelity solutions.
The hydrodynamic forces generated by the water moving inside a U-shaped anti-roll tank are predicted by using a Smoothed Particle Hydrodynamic (SPH) solver. In particular the study focuses on the roll moment prediction when the U-tank is forced to roll at different frequencies and amplitudes. Results of the CFD simulations are validated by comparison against available experimental data on a selected U-tank. Sensitivity of the hydrodynamic solution with respect to variations of some of the most relevant SPH solver parameters is investigated by a systematic set of numerical simulations. Finally the effect of geometric parameter variations on the hydrodynamic performance of the U-tank are analyzed and discussed.

Keywords: Smoothed Particle Hydrodynamics, Anti-roll tank, Sloshing, Forced roll motion, Ship Hydrodynamics