ABSTRACT

Towing-tank experiments are performed for a surface combatant as it undergoes static and dynamic planar motion mechanism maneuvers in calm water. The data includes global forces/moment/motions and phase-averaged local flow-fields, and uncertainty assessment. The geometry is DTMB model 5512, which is a 1/46.6 scale geosym of DTMB model 5415, with L = 3.048 m. The experiments are performed in a 3.048 × 3.048 × 100 m towing tank. The measurement system features a planar motion mechanism, a towed stereoscopic particle image velocimetry, a Krypton contactless motion tracker, and a 6-component loadcell. The forces/moment and UA are conducted in collaboration with two international facilities (FORCE and INSEAN), including overlapping tests using the same model geometry but with different scales. Quality of the data is assessed by monitoring the statistical convergence. Uncertainty is assessed following the ASME Standards (1998 and 2005). Hydrodynamic derivatives are determined from the forces/moment data by using the Abkowitz (1966) model, with two different '*Multiple-Run* (MR)' and '*Single-Run* (SR)' methods. Hydrodynamic derivatives are compared between the facilities data and as well between different mount conditions. The results indicate that the MR method is more rigorous than the SR that gives considerably larger errors in reconstructing the forces/moment, particularly when the PMM motion is small; the scale effect is small for sway derivatives whereas considerable for yaw derivatives; the linear derivatives values are less sensitive with the mount conditions, whereas the non-linear derivatives are considerably different between the mount conditions (fixed vs. free) with correlated with the heave, pitch, and roll motions. Phase-averaged flowfield results indicate maneuvering-induced vortices and their interactions with the turbulent boundary layer. The test program is undertaken to create a validation dataset for unsteady Reynolds-averaged Navier Stokes maneuvering simulations.