4. Time-Domain Simulation of a Berthing Ship

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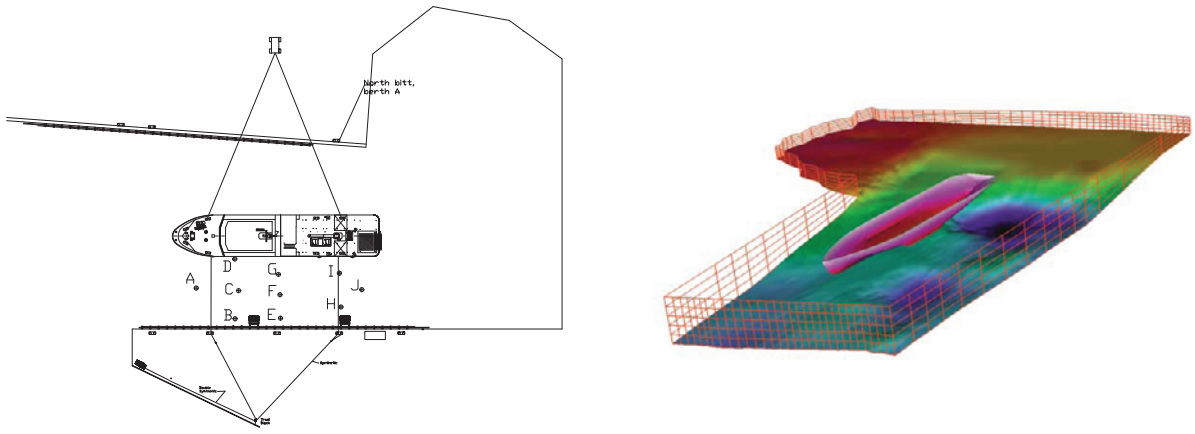
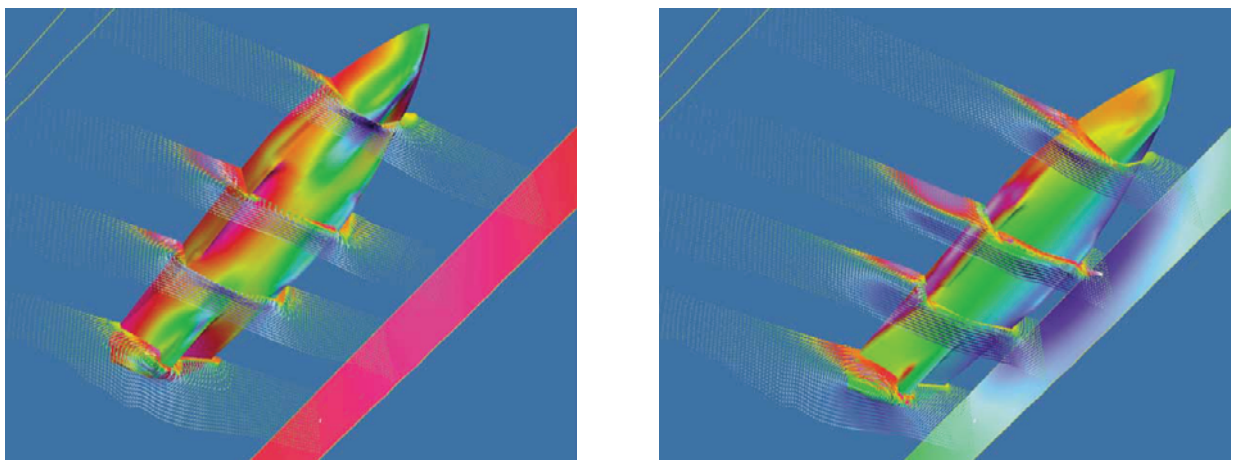


(a) Experimental setup (b) Harbor bathymetry

4.1 Experimental setup and computational domain



(a) t = 255.8 sec (b) t = 349.7 sec

4.2 Velocity vectors and surface pressure distributions

Numerical simulations were performed for turbulent flows induced by the berthing operation of a full-scale ship. Detailed comparisons have been made with the field measurements which were conducted by D. A. Davis, E.T. Huang and W.G. Hatch of Naval Facilities Engineering Service Center in a small harbor at Port Hueneme, California. 4.1 (a) shows the experimental setup with two form fenders mounted near the harbor quay wall. In the present simulation, the form fenders are modeled by elastic elements with a spring constant of 35,000 lbs/ft. The water depth shown in 4.1 (b) varies between 7 ft and 38 ft under mean low water (MLW) level condition. The present method solves the Reynolds-Averaged Navier-Stokes (RANS) equations in conjunction with a chimera domain decomposition approach to simulate the entire berthing process including the hydrodynamic coupling between the ship and the fender systems. 4.2 shows the velocity vectors and surface pressure on ship hull and quay wall at t = 255.8 sec and 349.7 sec (during fender impact) to illustrate the general characteristics of the transient flow field induced by the berthing ship. It is interesting to note that the low pressure region (blue color) shifted towards the quay wall clearance area after the ship touched the fenders. This pressure change is responsible for the drastic increase of hydrodynamic forces during the fender impact.