COUPLED EULERIAN-LAGRANGIAN SIMULATIONS OF AN UNDER-WATER EXPLOSION NEAR A FLOATING TARGET

M.J. Smith[1], J.J. Lee[2]

[1]DRDC - Atlantic Research Centre, P.O. Box 1012, Dartmouth, Nova Scotia, B2Y 3Z7, Canada;
[2]DRDC - Suffield Research Centre, P.O. Box 4000 Stn Main, Medicine Hat, Alberta, T1A 8K6, Canada

ABSTRACT

An experiment involving a 1.1 gram explosive charge detonated in water below a floating steel box is simulated with the coupled Chinook/LS-Dyna code using a two-way coupling scheme in which fluid pressures and structural velocities are exchanged at the fluid-structure interface. The predicted expansion and collapse of the underwater explosion gas bubble is compared with high-speed photography of the experiment, and the predicted response of the box is compared to measurements obtained with digital image correlation (DIC). Simulations are performed for three different target configurations: a rigid-fixed target with all degrees of freedom fixed; a rigid-free target, in which the rigid structure can undergo vertical rigid-body motion; and a responding target capable of rigid-body motion and deformation. The predicted gas bubble collapse and jetting behavior agrees satisfactorily with experimental observations. Introducing target motion and deformation in the simulations shortens the bubble period and lessens the water jet impact loading on the target. The amplitude of the predicted response of the target plate during the shock and bubble response phases agrees well with DIC measurements of the target plate displacement, although there is some discrepancy in the timing of the peaks of the response.