Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Computation of Viscous Free-Surface Hydrodynamics for Ships during Free-Roll, Wave-Excited Roll and Prescribed Motions KEVIN SMITH[1], ERIC PATERSON[2], Penn State — Prediction of ship motions in waves and the role of viscous effects remains an important problem in naval hydrodynamics. A computational fluid dynamics (CFD) solver has been developed which can simulate the unsteady turbulent boundary layer, wave field, and 6DOF dynamics of a floating body in waves. The solver is based upon the Reynolds-averaged Navier-Stokes equations, and volume-of-fluid (VOF) and dynamic-meshing algorithms. It is used to study free-roll, wave-excited roll, and forced heave and sway motions. Solution validation is achieved by comparing roll-amplitude decay, natural frequency, and response amplitude operator (RAO) for a 2D box barge in regular waves to experimental data. As a practical example, a ship hullform, with and without bilge keels, is studied when undergoing prescribed roll, sway, and heave motions. Details of the fluid dynamics and forces and moments will be correlated to motion amplitudes and frequencies.

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Date submitted: 24 Jul 2008 Electronic form version 1.4