Schreuder, Martin. "Simulation of damage stability in waves - demonstration of the time-domain simulation program developed at KTH." Illustrations.

Program Description

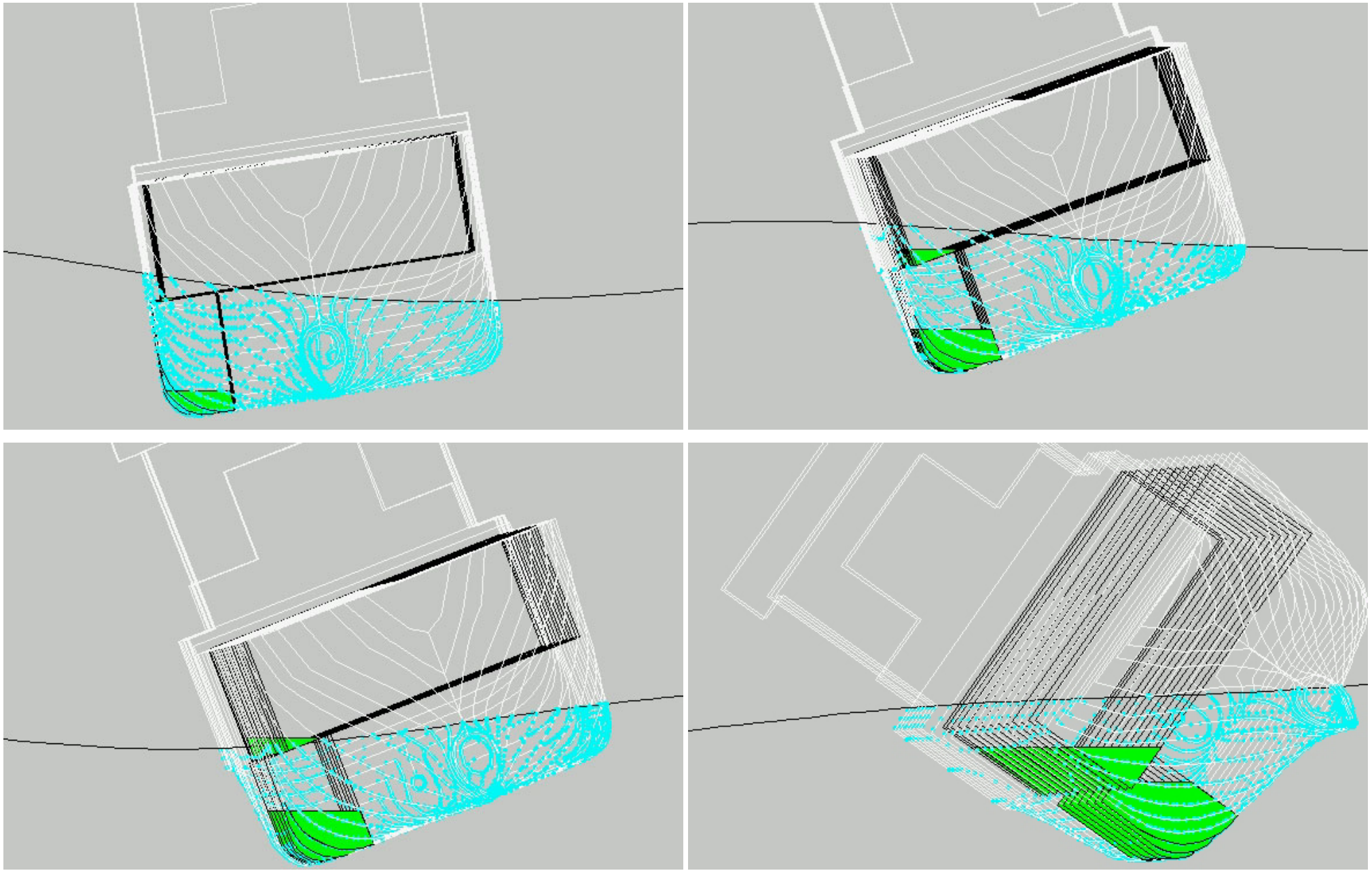
The present program is at this time restricted to zero ship speed in regular or irregular seas. Five degrees of freedom are simulated (no surge) with hydrodynamically coupled equations of motion.

Forces due to the undisturbed wave potential, the Froude-Krylov forces, are treated in a non-linear fashion by instantaneous integration over the wetted hull. By this method, an exact static stability calculation is made if the wave height is set to zero. The floodwater is also treated exact in the static case.

The hydrodynamic coefficients for diffraction and radiation force calculations are obtained from a standard linear sea keeping computer program. The floodwater excitation forces are defined by the ship position and floodwater volume. They are derived by quasistatic considerations in each time step. The added masses in the radiation force equations are updated thru the mass and center of gravity of the floodwater. The water inflow is determined by damage extension and location thru Bernoulli's equation.

At each time step of the simulation the underwater hull geometry is extracted, Froude-Krylov and diffraction forces calculated together with quasistatic forces from the floodwater. These forces are the excitation forces in the equations of motion, which are solved by the fourth order Runge-Kutta method to obtain the ship position for the next time step.

This cyclic process is stopped when the stipulated simulation time is reached or if the ship capsizes. The initial conditions are automatically calculated at the beginning of the simulation and are based on a standard frequency domain sea keeping calculation. With this technique, steady state is reached faster in moderate sea conditions where the linear sea keeping program still gives accurate results.



Four snapshots from a capsize simulation in irregular seas.