FEW ASPECTS IN THE MODELLING OF HYDRODYNAMICS OF SHIPS

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Abstract The development of huge ships like tankers, requires more accurate computations of the loadings to which they are submitted during their trips. The problem is mainly a dynamical one, coupling a structure and a fluid. The behaviour of the ship is represented by a linear model assuming that the deformations are small enough. The water is compressible but unviscid. On the surface of the water there is a capillary phenomenon which is locally negligible, but necessary in order to ensure the integrity of the whole free surface. Concerning the boundary conditions several difficulties appear. First of all the contact area between the hull of the ship and the water is an unknown, leading to a non linearity which is modeled by a variational inequality. Then the instabilities occuring on the free surface of the water require to take into account non linearities in the surface water model. Finally, it is necessary to eliminate as far as possible reflection of waves on the remote boundary of the computational domain. Up to now, most of scientific contributions for this challenging engineering problem don't consider all these difficulties together. For instance those using a time Fourier transform leading to Helmholtz's model are not adapted to the slamming (which implies a large range of frequencies) and the series representing the Green's kernel used in boundary integral formulations don't converge easily in a numerical approximation. The presence of geometrical singularities increases this difficulty. Therefore, a lot of simplifications have been used in order to derive simplified models which are not able to simulate the global phenomenon. But they can give few indications in the buiding process of these huge ships. This talk is a presentation of some of these difficulties and few ways to overcome them.

The outline suggested is the following one:

(1) The full model ;
(2) Mathematical results known and those to be proved (existence, stability...) ;
(3) The slamming on the free surface of the water ;
(4) Singularities at the bow and at the stern of the hull and their influences ;
(5) Computation of the dynamical pressure in the water ;
(6) Some numerical simulations.

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