

# WATER WAVE SIMULATIONS CREATED BY A SUBMARINE

PHILIPPE DESTUYNDER<sup>1</sup> AND CAROLINE FABRE<sup>2</sup>

<sup>1</sup> APPLIED MATHEMATICAL DEPARTMENT, CNAM, PARIS, FRANCE

<sup>2</sup> MATHEMATICAL LABORATORY, UMR8628, UNIVERSITY PARIS-SUD, FRANCE

## 1. ABSTRACT

In hydrodynamics, it is known that three kinds of waves can appear at the surface of the water : gravity waves, ripples and acoustic waves. They are also present in the wake created by a submarine (or any other ship moving forward). Moreover, because of the interaction between the surface and the atmosphere, Stoneley waves can appear.

When a ship is moving forward, a part of its energy is transferred to these waves. One major difficulty is that instabilities occur even for very small velocities of the ship. This is widely increased by the slamming movement (strongly nonlinear) which spills over energy onto high frequency waves (with short wave lengths) which are very unstable. One can introduce nonlinear terms on the surface in order to stabilize them.

The goal of this talk is to describe these phenomena and to suggest a first step in the numerical formulation using finite element methods and transparent boundary conditions (there are several waves!) in order to solve the model in a close neighbourhood of the ship.

