MSc thesis project 2022 on the Division of Marine Technology
Department of Mechanics and Maritime Sciences
Chalmers University of Technology

Fluid-Structure Interaction of Ships in Waves

Background and motivation

Due to the economies of scale, the size of modern merchant ships has been increasing rapidly. Accidents and incidents have been reported along with the fast increase of ship size. the major factors that contribute to these accidents is the hydroelasticity responses, such as springing and whipping, happen more frequently even in sea states that were regarded as moderate before.

Fig 1. Ship structural damage caused by a sever wave loading.

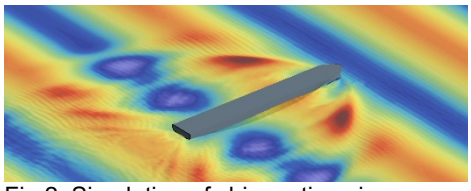
Fig 2. Simulation of ship motions in waves.


Fig 3. The model used in the JIP project.

No numerical tools are commonly accepted to be able to estimate wave and vibration induced loads on ships with agreeable accuracy. In view of this, a Joint Industry Project (JIP) was initiated by the major classification societies, aiming to conduct a global comparative study of the existing numerical methods for hydroelastic analysis, and to provide large-scaled hydroelastic model tests as a standard database for verification and validation. Several well-reckoned universities and research institutes worldwide, including Chalmers, are the JIP participants.

Objectives

The thesis project aims to develop a numerical approach to simulate the hydroelastic behavior of large ships in waves. It is achieved by simulation of Fluid-Structure Interaction (FSI) of the hull in regular waves.

Methods and tools

The ship motions and the corresponding wave loads will be simulated using a Computational Fluid Dynamics (CFD) solver, STAR-CCM+. The computed wave loads will be used as the input for the structural analyses, to be carried out using a Finite Element Method (FEM) code, ABAQUS. The numerical results achieved from this study will be compared with those from the other JIP participants and will be validated by the model tests.

Prerequisites

- Background in Mechanical Engineering, Naval Architecture, or similar.
- Knowledge and interest in Computational Fluid Dynamics as well as structural analysis.

The MSc thesis project should incorporate the following tasks:

- Literature studies will be firstly conducted that form the basis of state-of-the-art knowledge within the research subject of hydroelasticity.
- Decoupled fluid-structure analysis.
- Coupled fluid-structure analysis.
- Comparison with the model tests.
- Write a thesis report and present it on a public seminar.

Contact

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