Dynamic structural response of marine structures under hydrodynamic loads

Summary

New Goal Based Standard issued by International Maritime Organization will change the philosophy how the ships are designed. The central element for optimal ship design will be a fluid-structure interaction (FSI) model, where ship's structural response and hydrodynamic loads are evaluated simultaneously. In addition to ship structures, such interaction model is required also for other complex marine structures such as wind turbines, for example. The objective of the doctoral dissertation is to develop a model for dynamic response of marine structures using two-way partitioned approach for fluid-structure interaction. The model should be universal in nature to be applicable for a range of marine structures and limit states. The focus of the thesis is on the structural response and on the coupling schema between the structural and fluid domain. The fluid forces will be provided by the computational fluid dynamics simulations that are out of the scope of the thesis.

Research field:	Building and civil engineering and architecture
Supervisor:	Kristjan Tabri
Availability:	This position is available.
Offered by:	School of Engineering Department of Civil Engineering and Architecture
Application deadline:	Applications are accepted between June 01, 2020 00:00 and July 03, 2020 23:59 (Europe/Zurich)

Description

To achieve the objective, the structural mechanics model of marine structure is either established using coupled beam (CB) or (non)linear finite element (NLFE) method. The structural response model and the interaction schema should be applicable for different design states. Focus will be on (i) vibratory response for fatigue/serviceability limit state implying the loads and response of small magnitude and large number of cycles and on (ii) ultimate limit state implying large magnitude and few load cycles. The structural response model and the interaction schema should allow for different level of geometric discretization ranging from a structural element, e.g. active fin stabilizer, to a global structure such as ship hull or fixed installation. Thereby, the thesis should identify main parameters (mesh resolution, material characteristics, integration parameters etc) defining the outcome for different discretization levels and limit states.

Why is the research necessary?

- More optimized and efficient marine structures are to be designed in ever shorter lead time. Thus, more universal approaches and tools are required
- Simultaneous treatment of fluid loads and structural response is required for many applications in marine engineering (vibratory response, global bending of the structures)
- In certain marine applications the hydrodynamic loads can be underestimated if the loads are evaluated separately from structural response
- The goals of the research correspond with the priorities of the EU (greener and safer surface transport, sustainable energy resources)

The thesis includes:

- assessment of different models and concepts used to model structural response and marine hydrodynamics;
- development of numerical simulation environment that couples the CB or NLFE to CFD analysis;
- characterisation of parameters for different problems in marine engineering;
- experimental validation of FSI process in a model test basin.

Requirements for the candidate:

1. Holds a degree in either marine technology, mechanical engineering or technical physics

2. The completed curriculum of the master’s degree must include structural mechanics, computational mechanics, marine hydrodynamics or fluid hydrodynamics
3. Experience of working with a FE packages (FEMAP, NASTRAN, ABAQUS, ANSYS, LS-DYNA etc.)
4. Experience in hydrodynamic analysis or CFD is not directly required, but will be considered as an advantage

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