Mia Abrahamsen Prsic, postdoctoral fellow at the Department of Marine Technology, Norwegian University of Science and Technology, 7491 Trondheim, Norway

Title: Hydrodynamic loads on submerged complex structures under the influence of waves and currents

Research topics:

The main goal of the postdoctoral research is to provide deeper understanding of the hydrodynamic forces exerted on the subsea modules during the structures' deployment. Due to the complexity of the structures, it is generally too demanding to model the realistic subsea modules, either experimentally or numerically. However, it is possible to represent the dominant parts of the structures by selected generalised elements, such as porous plates and cylindrical structures representing simplified module cross-sections.

Such elements are systematically examined, in different combinations, increasing the complexity, to explore the governing physical effects relevant for the hydrodynamic loads. Modelling is performed for the generalised structures subjected to the forced oscillations, representing the waves exerted on the fully submerged subsea modules.

The experimental results offer a systematic overview over the hydrodynamic coefficients for the various basic elements and their combinations, and are performed for a broad span of sea states that a real subsea module can experience.

CFD simulations complement the experiments by providing an insight in the details of the flow around the structures and the interactions in the flow field. Numerically simplified CFD models allow quick and efficient calculations of more complex structure combinations, and can thus be recommended for the practical, industrial use. They are compared to the detailed, three-dimensional turbulence CFD models to understand the limitations and advantages of various simplified approaches.

Industrial goals:

Increasingly complex marine operations require safe and robust planning and all-year accessibility, relying on accurate calculations of the hydrodynamic loads. The goal of our project is to contribute to the current rational methods and recommended practice by systematic understanding of the hydrodynamic forces on various elements and flow interactions in the structures, providing guidelines for reliable use of the experimental and the numerical procedures.

Scientific questions:

What types of generalised, basic structures can be used to represent the dominant parts of the large, complex, three-dimensional subsea modules? How accurate are such representations?

What are the main physical parameters and effects influencing the hydrodynamic forces on such basic structures and their combinations?

When can the specific basic elements be observed as the individual contributors to the hydrodynamic forces of the complex modules, and when are the interactions between the various structural elements important?

How precise and how applicable are various types of CFD calculations, varying from the detailed to the numerically simplified, fast models, when applied for the modelling of the basic structures and various combinations, subjected to the oscillatory flow?

Cooperating companies: SINTEF Ocean

Supervisor: Prof. Trygve Kristiansen