Fluid-Structure Interaction Analysis: Design of Check Valves for Wave Energy Converters

Background and motivation

Wave Energy Convertors (WEC) are devices converting ocean wave energy into electricity. Inside the water tube of WEC, a check valve is installed to stabilize flow. The valve design affects the stabilization because flow patterns are dependent on the valve shape. The flow variations such as fluctuating pressure in turn influence valve motions. In other words, a strong interaction exists between the flow and the valve. However, the interaction is difficult to predict. Given rapid and large valve motions, the mesh for the Computational Fluid Dynamics (CFD) simulation can be highly distorted in a short time. This eventually results in the divergence of the simulation. Therefore, a robust CFD method that can handle large structure displacements with high accuracy is demanded. To this point, the research group proposing this project has developed a set of simulation frameworks recently and applied them to designing real WEC valves.

Objectives

This thesis work aims to

1) Simulate a benchmark check valve and a real one using the FSI methods that were already developed by us.
2) Analyze the interaction between the flow and the valve.
3) Determine the optimal stiffness of the spring that loads the valve.

Methods

The FSI will be simulated using high-fidelity CFD methods integrated with a deformable meshing approach. The check valves are specified to fulfil the operation conditions of NoviOcean, the WEC invented by Novige AB.

Number of students: 1 student.

Prerequisites: computational fluid dynamics, or finite element analysis.

Tasks

- Valve design parameterization.
- Mesh generation and quality check.
- Simulations on the SNIC cluster Tetralith.
- Regular meetings with the other group members.

In this project, the student will have a close collaboration with the company Novige AB. Project presentations and direct technology iterations with their technology chief and CEO will be frequently need.

Contacts

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