CHALMERS

MECHANICS AND MARITIME SCIENCES R.E. Bensow

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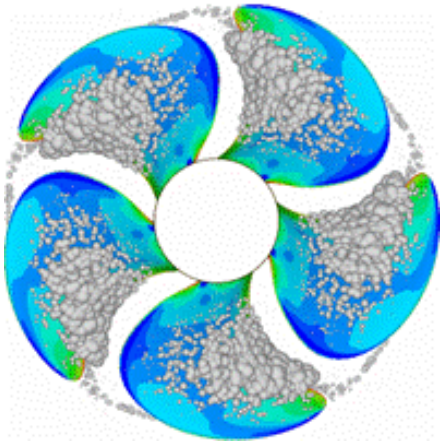

Master thesis project:

Turbulence effect on bubble transport and dynamics

Background

Turbulent cavitating flows are common in marine industry, and during the last decade a large research effort has been seen in advancing the techniques for simulating cavitation. One possible approach to simulate multiphase cavitating flows, which gained in popularity in recent years, is to track cavitating bubbles in the flow via Lagrangian Particle Tracking (LPT). In this method the main flow is still solved using Navier-Stokes equations while the vapour bubbles are tracked individually as small particles. This is attractive since the dynamics of small bubbles are influencing cavitation nuisance, such as noise and erosion. However, large vapour structures cannot be handled by this approach.

In an ongoing European research project, CaFE, we are developing a hybrid method that uses a more traditional model for large cavities and then switch to LPT for small structures. This thesis project will directly support this development.

Objective and method

Different forces are exerted on the bubbles when forming their trajectories, like drag and buoyancy, and some of them are directly related to the velocity of the surrounding fluid. One of the important effects in turbulent flows is the fluctuating velocity that is not directly calculated by most of turbulence models. In fact, RANS models only calculate the mean flow velocities and LES models only resolve large flow fluctuation and subgrid turbulent fluctuations are modeled. Thus, we need additional statistical models to consider the effect of turbulent fluctuations on bubble trajectories. These models are usually known as stochastic models.

This master project will be performed using the OpenFOAM software. The first step is to improve the current stochastic model in OpenFOAM, more suitable for isotropic flows, and adapt it for our applications. Validation may be performed by comparing the performance of some different stochastic models with benchmark data available in literature. Turbulence also affect the large bubble breakup which might be investigated in this project as well.

Through this project you will get experience with both turbulent flow modeling and LPT approach, which gained popularity in multiphase flow modeling in recent years.

Miscellaneous

The master thesis project is 30 credits and suitable for one-two students. Some basic programming in OpenFOAM will be necessary in the project.

Prerequisites

- Background in Mechanical Engineering, Naval Architecture or similar
- Knowledge in computational fluid dynamics

Contact

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