MODELING AND SIMULATION OF SUPERCAVITATING FLOWS

Context:

This study is a part of a collaboration between laboratories LEGI (Laboratoire des Ecoulements Géophysiques et Industriels), ILM (Institut Lumière Matière) and Pprime. The main objective is the investigation of supercaviting flows by using micro geometries such as micro-metric size objects placed in a channel [1].

Vehicles operating at high speeds in water are typically accompanied by high levels of skin friction drag and cavitation. Cavitation, however, instead of being an unwanted accompaniment to high speed underwater travel, can actually be employed to reduce skin friction drag and provide order-of-magnitude increases in speed compared to those achieved with conventional, fully-wetted undersea vehicles [2].

Fig. 1 High-speed vehicle in supercavitation regime [2].

This work consists in performing numerical simulations of supercavitating configurations and by comparing results with the experimental data obtained at LEGI and ILM. Different geometries will be investigated such as, round, rectangle, beveled 2D objects or hydrofoils.

Simulations will be performed with the 1-fluid RANS compressible code CaviFlow validated in various cavitation cases [3-4]. The mass transfer is modelled through a source term appearing explicitely in a void ratio transport equation. A special focus will be done on the performance and heat transfers.

Work schedule:

- Preparaton of simulations: geometries, meshes and initial conditions.
- Run simulations at different operating points and check the influence of parameters.
- Perform analysis of results and comparaison with the experimental data.
- Estimation of heat transfers.

Expected skills: Fluid Mechanics (hydro/aero), CFD, Compressible Numerical Methods

Contract details:
- 6 month CDD contract, 570 euros/month.
- As the study is funded by a DGA grant, only European citizens may apply to that offer.
- Organization: the internship will be located in Poitiers under the supervision of Eric Goncalves and in collaboration with Gilles Ledoux, Damien Colombet and Frédéric Ayela.

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References:
[1] Qiu, X., Cherief, W., Colombet, D., & Ayela, F. (2017). A simple process to achieve microchannels geometries able to produce hydrodynamic cavitation. Journal of Micromechanics and Microengineering, 27(4).
[2] Kunz, Lindau, Billet, Stinebring (2001). Multiphase CFD modeling of developed and supercavitating flows.Lectures series VKI, Bruxelles.
[3] Goncalves and Charriere (2014). Modelling for isothermal cavitation with a four-equation model. Int. Journal of Multiphase Flow, vol. 59.
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