INTERNSHIP FOR ENGINEERING SCHOOL OR MASTER DEGREE

2025

Free surface modelling in Large Eddy Simulation using a Lattice Boltzmann Method approach.

Laboratory:

Laboratoire Universitaire des Sciences Appliquées de Cherbourg (LUSAC)
Team: Flows and Environment

Contact:

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CONTEXT:

Against a backdrop of decarbonation of energy production, Marine Renewable Energies are on the rise. Some of these technologies have already reached a certain maturity, such as offshore wind turbines, while others are still at the prototype stage, such as wave and tidal energy. But whatever the technology, all would benefit from advanced modeling methods to better predict their behavior. Over the years, the Flow and Environment team at LUSAC laboratory has developed expertise in modelling MREs such as tidal turbines. One of the simulation methods used is the Lattice Boltzmann Method (LBM) coupled to Large Eddy Simulation (LES). It has already been applied successfully to modeling tidal sites and tidal turbines [1][2]. In addition to predicting turbulence effects, the forecasting of free surface interactions, such as waves, is also important in the MREs development process. The aim of this internship is to carry out simulations using a free surface model combined with our LBM-LES code. The scenarios considered at the moment are interactions with non-moving objects such as pylons, like in [3].

CONTENT:

You will work on the simulations of cylinders interacting with laminar or turbulent flows using an already existing Volume of Fluid (VoF) method coupled with the Lattice Boltzmann Method. Calculations will be performed using the LBM library coded in C++ PALABOS [4]. You will run simulations to compare results obtained with a VoF model with experimental and/or numerical reference data. Data visualization and post-processing of results will be carried out mainly using Paraview. Simulations will be run in a Linux environment, on our local cluster and/or on the CRIANN cluster.

KEYWORDS:

MRE, free surface, volume of fluid, large eddy simulation, lattice Boltzmann method, C++ programming.

PROFILE:

The candidate should follow a Master degree or Engineering School in hydrodynamic, aerodynamics or fluid mechanics. Good writing skills are expected. A taste for numerical simulation and programming is necessary and expected.

DATES AND DURATION:
Starting in March/April 2025 for a duration of 6 months.

SALARY:
4.35 €/hour (≈ 620 €/month).

LOCATION:
Cherbourg, Normandie, France.

REFERENCES:

[1] Philippe Mercier and Sylvain Guillou, "The impact of the seabed morphology on turbulence generation in a strong tidal stream", Physics of Fluids 33, 055125 (2021).

[2] Grondeau, Mikaël, Sylvain Guillou, Philippe Mercier, and Emmanuel Poizot. 2019. "Wake of a Ducted Vertical Axis Tidal Turbine in Turbulent Flows, LBM Actuator-Line Approach" Energies 12, no. 22: 4273.

[3] Basile et al. Flow Field around a vertical cylinder in presence of long waves: an experimental study. *Coastal Engineering, volume 173, 2022.*

[4] Jonas Latt, Orestis Malaspinas, Dimitrios Kontaxakis, Andrea Parmigiani, Daniel Lagrava, Federico Brogi, Mohamed Ben Belgacem, Yann Thorimbert, Sébastien Leclaire, Sha Li, Francesco Marson, Jonathan Lemus, Christos Kotsalos, Raphaël Conradin, Christophe Coreixas, Rémy Petkantchin, Franck Raynaud, Joël Beny, Bastien Chopard. “Palabos: Parallel Lattice Boltzmann Solver”, Computers & Mathematics with Applications, Volume 81, 2021, Pages 334-350.