NRG is the sole nuclear service provider in the Netherlands. Our customers include major international companies. Our motive is to ensure a renewable energy supply, a cleaner environment and better health. Our business is to provide specialised, technical services in the areas of risk, safety and optimisation of business operations in the nuclear, oil and gas and petrochemical sectors. We are leaders in the field of Computational Physics for research and innovation for many nuclear applications. Further international development is one of our key ambitions. Our offices are located in Arnhem and Petten. The team is based in Petten, near Alkmaar.

Within our unit Research and Innovation, we are currently seeking for a

MSc THESIS STUDENT: High fidelity simulation of resolved interface multiphase flow

The project:

In the design and operation of a nuclear facility, it is important to understand the behavior of multiphase flows. Examples are the formation of vapor in boiling flows, the entrainment of air in cooling systems or the behavior of fission products in fluids. Better prediction of the flow and heat transport in the considered configurations will contribute to an improved design, safety, and operation of nuclear reactors. A key aspect in achieving such improved predictions is the development of high fidelity benchmark simulations in simple settings. These benchmarks can then be used for the development and validation of coarser models, which are then, in turn, applied to more realistic settings. In this project, we will perform high fidelity simulation of multiphase flow with resolved interfaces, using the Basilisk code. Goal is to first develop experience and confidence with the Basilisk code in simple cases, e.g., in the dam break problem and in rising bubble cases. Later in the project, we will perform high fidelity simulations of Taylor bubbles in co-current turbulent flow, and compare the results against similar simulations performed with OpenFOAM (see Fig. 1).

Fig. 1: OpenFOAM simulation results of a Taylor bubble moving in a turbulent co-curent pipe flow.

The project will be aimed at the use and functionality of CFD software, and therewith will have a focus on numerical mathematics. It is anticipated that further code development of Basilisk is required in this project, in order to successfully achieve the proposed goals.

Your responsibilities:

The project is designed to be a research case. In that role, you will have the following tasks:

1. Learning Basilisk. Basilisk is an open source flow solver that employs the Volume of Fluid approach for the modelling of two-phase flow.
2. Identification and development of a number of simple test cases, to be simulated with Basilisk and to be post-processed
3. Validation of the Basilisk solver in the setting of single phase turbulent channel and pipe flow
4. Development of Taylor bubble case and comparison against either data from literature or NRG's OpenFOAM simulation results

Your profile:

- MSc. student in applied science, with specialization in CFD
- Good knowledge of numerical methods and scientific computing
- Required computer experience: Linux and (some knowledge of) C
- Fluency in written and spoken English
- Good analytical and problem solving skills
- Dedicated, good communication and social skills

Our offer:

- A challenging thesis project to be executed within a successful team with an informal atmosphere and an excellent reputation
- Strong support from enthusiastic members of the CFD team
- Monthly allowance/stipend
- Housing and transportation compensation for the period of stay

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