PhD Student Position within the SDL Engineering for Energy and Mobility (3 years, 67% salary level E13)

We are seeking for highly motivated candidates that are interested to work on mathematical modeling and Computational Fluid Dynamics (CFD) for incompressible flows. Insufficient resolution of fine vortex structures in turbulent flows is one of the key problems in CFD. Knowledge about these structures is necessary to model the fine scale turbulence, which is important to solve a broad range of engineering problems. The main goal of the present doctoral research is a further development and validation of a new computational fluid dynamics method referred to as the $V\pi$LES using a combination of grid free (particles) and grid based (Finite Volume Method) techniques. A fundamental assumption of the $V\pi$LES is the decomposition of any physical quantity into the grid based (large scale) and the fine scale parts, whereas large scales are resolved on the grid and fine scales are represented by particles method. $V\pi$LES is expected to increase the accuracy of simulations of turbulent flows including resolution of fine scale motions while keeping the costs of computations either comparable with or even lower than those of existing methods. The details of the $V\pi$LES method can be found in Samarbakhsh, S. and Kornev N. (2019). Int. J. Heat and Fluid Flow, 80, 108489; Kornev N., Samarbakhsh S. (2019). Int. J. Heat and Fluid Flow, 75, 86-102; Kornev N. (2018). Computational Particle Mechanics, 5(3), 269-283.

After successful application of the $V\pi$LES method to wall free turbulent incompressible flows it is intended to extend and to validate the method in the following directions: wall bounded flows and turbulent mixing of passive scalars.

The following code developments are already available: parallel implementation of the hydrodynamic part of the new method in OpenFOAM, serial implementation of both hydrodynamic and mixing parts in an in-house finite difference method code developed for the simplest canonic flows. The PhD student should implement the mixing part into OpenFOAM and validate the $V\pi$LES method for different flow configurations. If necessary the method should be improved based on these validations. Important topic of the work is the parallelization of the $V\pi$LES code and development of fast efficient algorithms.

The doctoral research will be done in a tight cooperation between the groups of the University of Rostock (URO) and the Steinbuch Centre for Computing of the Karlsruhe Institute of Technology (SCC KIT) utilizing specific expertise of each partner. At the end of the work, PhD thesis should be prepared on the basis of the research results.

One day per week, the PhD student should provide training and support to HoreKa-supercomputer users within the NHR (https://www.nhr.kit.edu/). This work includes preparation of materials for- and participation in user trainings, regular software installations and software maintenance in software repositories such as Git and continuous integration, e.g. of the OpenFOAM and ParaView packages, and process user requests related to these packages.

The successful candidate should have a master degree in one of the following (or other similar) fields: mechanical-, process- or marine engineering, applied- or techno-mathematics, or physics. Experience in numerical methods, parallel computing, Computational Fluid Dynamics (CFD), programming languages, such as C++ or Python, would be beneficial.

The position is available starting from 01.12.2021.

Applications including a detailed CV and the titles of the Bachelor- and Master theses should be sent via e-mail to Dr.-Ing. Jordan Denev from SCC at KIT (jordan.denev(a)kit.edu) until 14.11.2021.