Bachelor- or Masterthesis

Cyclic boundary conditions in thermal OpenFOAM solver

Channels with periodically repeating geometries are often simulated using periodic or cyclic boundary conditions. This reduces the computational load by simulating a single module versus the whole structure. This is a particularly useful approach when performing large optimisation studies of periodic geometries. In such setups, the flow is usually driven by introducing of a momentum source instead of the pressure gradient and imposing periodic boundary conditions for the velocity.

In case of heat transfer simulations, this is no longer possible. Here, the mean temperature in the fluid is not periodic, but depends on the heat added or removed from the domain via the boundaries. A potential solution has been published recently in the literature [1] based on OpenFOAM for constant wall temperature boundary conditions.

The goal of the present thesis is to implement this approach in the recent version of OpenFOAM and to extend the method to boundary conditions with constant heat flux. The work on this topic first requires a thorough familiarization with the theory of diffusive and convective heat transport, taking into account the aforementioned cyclic boundary conditions. Furthermore, a thorough familiarization with OpenFOAM is expected, which requires knowledge of object-oriented programming with C++.

Finally, the model to be developed will be used to determine correlations for heat transfer in laminar and turbulent flows through and across periodic geometric structures.

The written work to be prepared includes

- Literature review and development of a theoretical approach
- Documentation of the implementation in OpenFOAM
- Documentation and evaluation of the numerical results compared to analytical solutions

1. Coe, M., & Holland, D. (2023). A Cyclic Heat Transfer Solver for OpenFOAM. OpenFOAM® Journal, 3, 225–251. https://doi.org/10.51560/ofj.v3.113

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