Karlsruhe Institute of Technology

Institute of Fluid Mechanics
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Master-Thesis – numerical

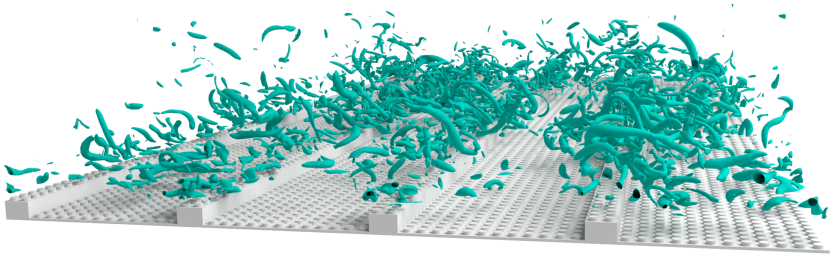
Secondary flows in a turbulent pulsating channel flow

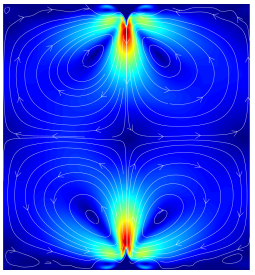
Motivation

Improvement of thermohydraulic efficiency in engineering applications remains one of the most important tasks of fluid mechanics research. Secondary motions of Prandtl's second kind generated by streamwise-aligned ridges at the wall surface are known to be able to increase transverse mixing and heat transfer in turbulent flows. The increase in skin friction coefficient and the heat transfer enhancement in this case remain very similar, so the Reynolds analogy factor $Ra = 2St/C_f \approx 1$ barely changes. This presents an advantage in comparison to inhomogeneous rough surfaces, which also significantly increase heat transfer while the drag, however, increases even more, so Ra drops. Another possibility to manipulate heat transfer is to introduce temporal variation or pulsation into the streamwise pressure gradient applied to a system - this measure is also known to be able to increase heat transfer.

Content of the Thesis

In the thesis we carry out simulations of pulsating turbulent channel flow and investigate the effect of wall structuring on such flow configuration. In the first step the variation of pressure gradient and time-dependent statistical averaging has to be implemented into a spectral solver SIMSON. A variation of amplitude and frequency of the pulsation will be then investigated and compared to similar literature studies for validation. Finally, surface structuring will be introduced into the simulation via an existing immersed-boundary-method (IBM) implementation and investigated with respect to its effect on turbulent properties of the flow including drag and heat transfer.





Requirements:
Basic knowledge in CFD

Beneficial Skills:
Fortran, python or matlab

Start: immediately

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