Karlsruhe Institute of Technology

Institute of Fluid Mechanics istm

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master thesis

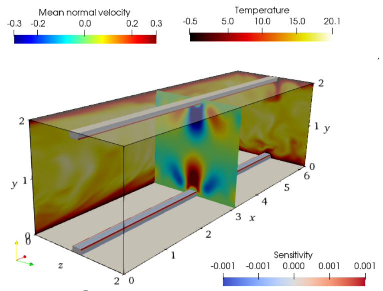
Optimization of rib geometry for secondary-motion-based heat transfer enhancement.

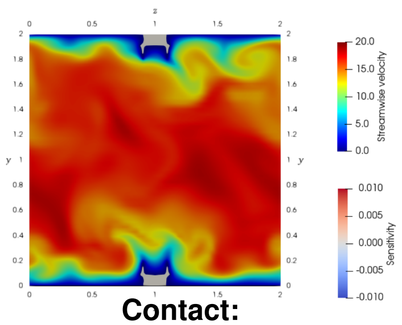
Background

Turbulent flows over rough surfaces are important in the industry since almost every industrial surface is to a certain extent rough. Examples include pipe flow, gas turbines and IC engines to name a few. It is also well known that heterogeneously distributed roughness can introduce large scale secondary flows of Prandtl's second kind, which extend out of the roughness sublayer and significantly alter the mean-velocity profile, friction factor and heat transfer coefficient. However, the underlying mechanism of the secondary vortex formation and it's influence on the temperature field is not yet entirely clear. This understanding could also significantly contribute to an improvement of climate and meteorological models.

Content of the Thesis

According to recent investigations an introduction of streamwise elongated ribs into a fully developed turbulent channel flow can significantly increase the heat transfer coefficient through introduction of large-scale secondary motions. However the enhancement of the heat transfer is always linked to an increase of the skin friction coefficient. In order to mitigate the drag increasing effect it is planned to optimize the rib geometry using DNS-RANS coupled adjoint-based algorithm. The work will be carried out with cooperation partners at the University of Tokyo. The project starts with application of the ready-to-go tools to the problem setup. Various cost-functions and initial geometries have to be investigated. Depending on the progress, a new implementation of the algorithm into OpenFOAM-based tool will be considered in order to be able to run optimization at higher Reynolds numbers.





Requirements

basic knowledge in fluid mechanics

Beneficial Skills

basic knowledge about turbulent flows,
numerical fluid mechanics and programming

Start: immediately

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