Karlsruhe Institute of Technology

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master thesis

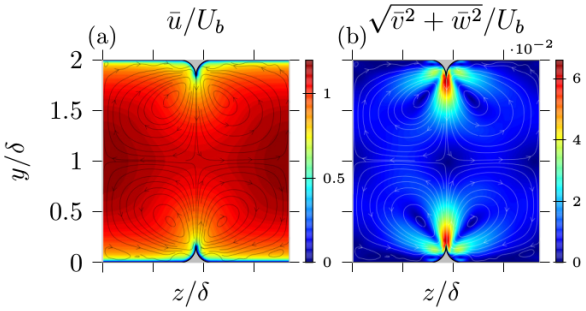
Impact of secondary motions on heat transfer in a turbulent channel flow.

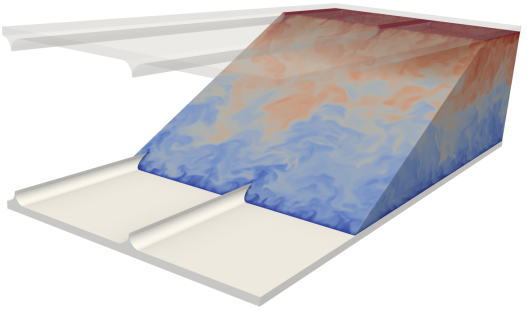
Background

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

In this project we investigate the influence of secondary motions on the temperature field subjected to different boundary conditions. It is expected that depending on boundary conditions the turbulent temperature field might be differently affected by the presence of secondary motions. Two types of boundary conditions are to be investigated - prescribed constant temperature gradient (upper and lower wall with constant, but different temperature) and constant heat source condition. The investigation will be performed with the DNS solver SIMSON, while postprocessing can be implemented in MATLAB or python. The results have to be validated against literature. Additionally it is planned to investigate turbulent flow in an open channel (wall-symmetry) and full channel (wall-wall) configuration in order to investigate the effect of symmetry plane.





Requirements

basic knowledge in fluid mechanics

Beneficial Skills

basic knowledge about turbulent flows,
numerical fluid mechanics and programming

Start: immediately

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