Karlsruhe Institute of Technology

Institute of Fluid Mechanics
Building 10.23, 6th floor, Kaiserstraße 10, D-76131 Karlsruhe, Germany
http://www.istm.kit.edu

December 16, 2019

master/bachelor thesis

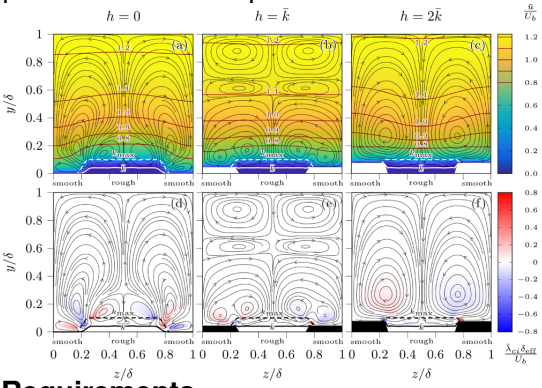
RANS-based simulation of secondary flows over rough surfaces.

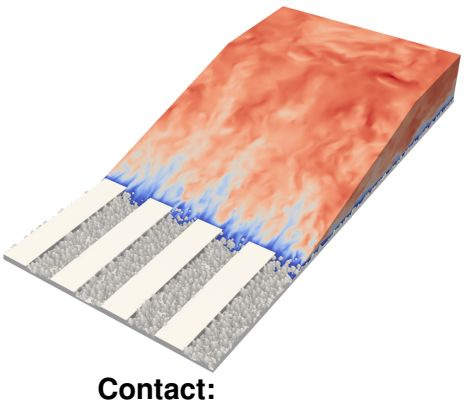
Background

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

Seeking for an alternative approach for investigation of turbulent flows with secondary motions a set of simulations of a flow over inhomogeneous rough surfaces is to be carried out using OpenFOAM simulation toolbox. Since 2D RANS approach is to be utilized to reduce computational costs, the Reynolds stress transport turbulence model has to be used in order to be able to resolve the anisotropy of the turbulent stresses. The results of the simulations have to be compared to the results computed using previously carried out fully resolved Direct Numerical Simulation (DNS). The simulations can be also extended to 3D cases with resolved roughness stripes (as shown in picture below). The main aim is to characterize the RANS approach in comparison to DNS in terms of secondary flow prediction and computational costs.





Requirements

basic knowledge in fluid mechanics

Beneficial Skills

basic knowledge about turbulent flows,
numerical fluid mechanics and programming

Start: immediately

Contact:
Alexander Stroh

Institute of Fluid Mechanics
Kaiserstraße 10, Building 10.23,
6th floor, Room 607

☎ +49 721 608 43528
✉ stroh@kit.edu