Karlsruhe Institute of Technology

LOMONOSOV MOSCOW STATE UNIVERSITY

Institute of Fluid Mechanics

http://www.istm.kit.edu

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master thesis in cooperation with MSU (Moscow, Russia)

Formation of secondary flows over heterogeneous rough surfaces

Background

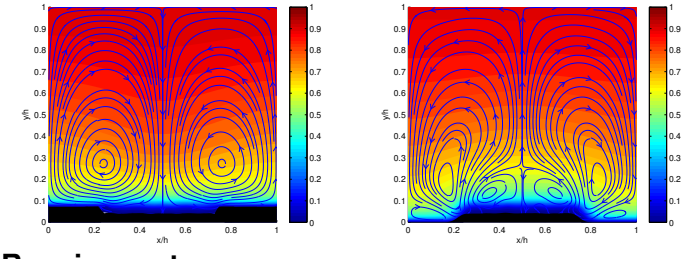
Turbulent flows over rough surfaces are important in the industry since almost every industrial surface is to a certain extent rough. Examples include pipe flow, gas turbines, IC engines and open channels to name a few. It is also well known that heterogeneously distributed roughness can introduce large 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 dependence on the rough surface properties is not yet entirely clear.

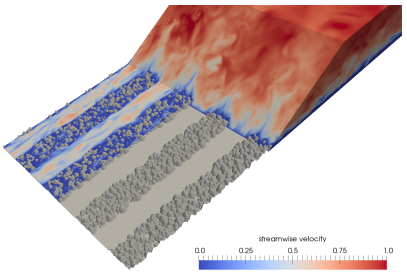
Content of the Thesis

An investigation of heterogeneously distributed roughness has to be carried out with the available implementation (Incompact3D) utilizing direct numerical simulation (DNS), where roughness elements are resolved using immersed body method. A methodical variation of roughness distribution parameters with corresponding evaluation and analysis of secondary flow topology for time-averaged and instantaneous velocity fields has to be performed. Based on the vorticity transport equation, the effect of roughness surface properties on secondary vortices formation is to be analyzed in order to clarify the impact of roughness spacing, mean roughness height and statistical moments of roughness height distribution. The final aim of the thesis is to link the roughness properties to the topology of secondary motions.

Cooperation with Moscow State University

The thesis will be carried out in cooperation with the Lab of General Aerodynamics at the Moscow State University, the highest-ranking Russian educational institution. The work program includes a 3-5 months stay in Moscow.





Requirements

basic knowledge in turbulent flows

Beneficial skills

CFD, Linux, Fortran, Matlab/Python, Russian

Time Schedule

familiarization with the tools (1-3 months Karlsruhe)
performing simulations & analysis (3-5 months Moscow)
Start: immediately

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