Karlsruhe Institute of Technology

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master thesis – numerical

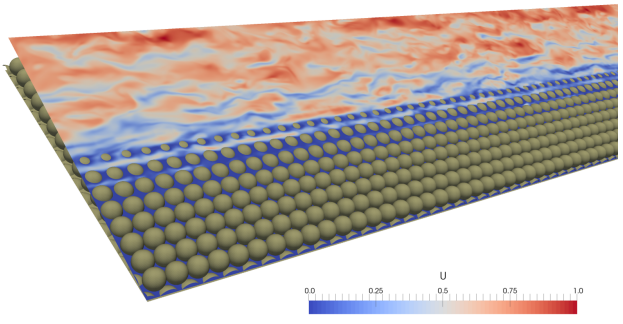
DNS of rough surfaces with immersed body method

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 well known that roughness can deeply influence integral flow properties such as friction factor and heat transfer coefficient and also the turbulence statistics. As a matter of fact, roughness topology plays an important role in the way roughness modifies the flow. However detailed study of roughness topology is far beyond the ability of simplified computational approaches - such as effective or sand roughness method. In this sense, Direct Numerical Simulation (DNS) is highly beneficial since it enables full resolution of the flow around roughness elements at the wall. DNS using immersed boundary/body methods is highly used in the literature since creating boundary-conformal grids are extremely difficult - if possible - for general roughness.

Content of the Thesis

A resolution dependence and domain size study has to be carried out for the available DNS implementation, where roughness elements are resolved using immersed body method. Due to the large simulation size, the computation will be executed on a HPC cluster in parallel mode. Based on the results, the effect of resolution and domain size is to be analyzed for several validation cases in order to clarify the impact of these parameters and optimize the trade-off between computational costs and accuracy. The final aim of the thesis is to develop a simplified volume-force based model for the representation of the surface roughness.



Requirements

basic knowledge in fluid dynamics

Beneficial Skills

numerical fluid mechanics,
Linux, Fortran and Matlab

Start: immediately

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