Karlsruhe Institute of Technology

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Master Thesis at KTH Stockholm

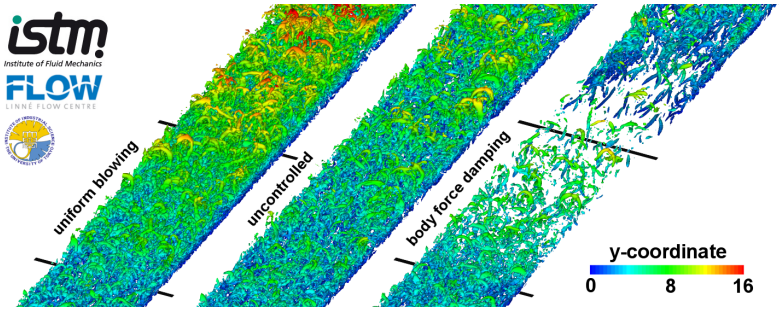
Inhomogeneous blowing in spatially developing turbulent boundary layers

Background

Turbulence control techniques leading to skin friction drag reduction are of great economical and ecological interest. One of the most simple and effective control techniques is uniform blowing applied at the wall surface. Application of a weak blowing (0.5% of the mean flow) in a turbulent boundary layer can reduce the skin friction drag up to 70%. However, any practical realization of such a flow control scheme will have to be based on holes in a wall through which the blowing is realized. Therefore, blowing will not be uniform in space. Within the present master thesis, the effect of a spatially inhomogeneous blowing in a turbulent boundary layer is investigated in terms of its impact on the flow control performance.

Content of the Thesis

The investigation of heterogeneously distributed blowing in a spatially developing turbulent boundary layer is to be carried out utilizing direct numerical simulation. The main focus is set on the spanwise heterogeneity of the applied blowing and its effect on the downstream behaviour of the flow. In addition, the question of the optimal blowing distribution for drag reduction is addressed. Based on a literature study and scale estimations for relevant blowing slot dimensions in aerodynamic applications, a DNS based parameter study is to be designed. The main part of the thesis consists of generating a database with an available DNS code and evaluating the data with the goal to identify the physical flow mechanisms that influence skin friction drag. An extension towards the use of optimization algorithms to identify the ideal blowing distribution might be considered.



Time Schedule

familirization with the topic at ISTM (1 month)
carrying out the work at KTH, Stockholm (5 months)

Beneficial skills

CFD, Linux, Fortran, Matlab

You will learn

methods of scientific research, flow control, HPC

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