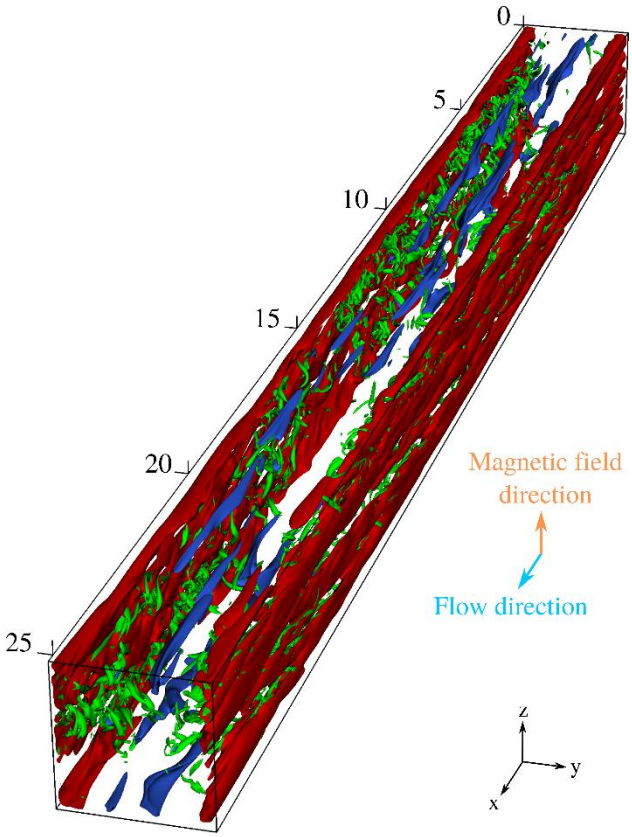
Master thesis (Masterarbeit)

Computational fluid dynamics (Numerische Strömungsmechanik)

Stability analysis of magnetohydrodynamic (MHD) duct flow

Background: In most everyday situations, fluid flows may be classified as either laminar or turbulent (see figure). Due to their different transport properties, it is of utmost importance to know under what conditions either type may be expected for a given application.

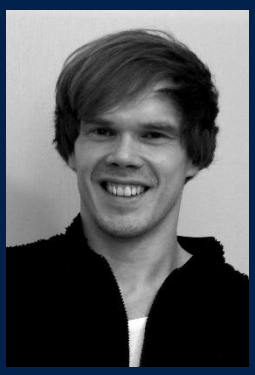
Motivation: For electrically conducting fluids in ducts subject to magnetic fields, the likelyhood of a laminar or a turbulent flow is dictated by three parameters – the Reynolds number, the Hartmann number and the disturbance level. In many cases the two flow types can co-exist, which complicates accurate predictions of flow properties. The aim of this master thesis is two-fold: (1) Investigate if the MHD duct for certain parameters becomes linearly unstable with exponentially growing eigensolutions, and (2) determine the parameter values for which no disturbance growth is possible and all perturbations decay.



Approach: The above problems will be addressed by numerically solving eigenvalue problems that govern the dynamics of perturbations superimposed on the laminar state. To this end, the student is required to familiarize her-/himself with the relevant literature, derive the appropriate eigenvalue problems, and implement and solve the problems at hand in MATLAB/Python.

Target group: Students with a strong background in physics and/or applied mathematics, with a special interest in laminar-turbulent transition and computational fluid dynamics. Depending on the ambition level of the student, as well as on the quality of the results, the outcome of the study will be submitted to a scientific journal, which makes the proposed project suitable for a motivated M.Sc. candidate possibly interested in pursuing a Ph.D.

Contact person/
Ansprechpartner:



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