Karlsruhe Institute of Technology

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

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Master's thesis – numerical

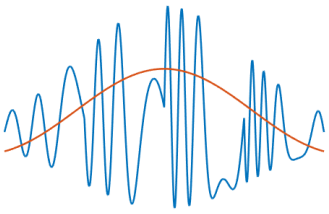
Amplitude modulation in turbulent Couette flows

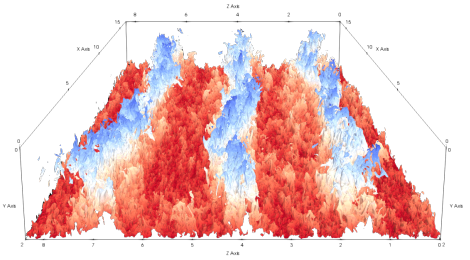
Background

The velocity signal of a turbulent flow at a given point can be divided into large- and small-scale parts by filtering. It is well known in literature that, when the large-scale signal is positive, the small-scale one has an increased amplitude; vice versa, when the first is negative, the amplitude of the second is reduced (see picture). This takes the name of amplitude modulation - or *AM*, just like for radio broadcasting; the aim of this thesis is its numerical investigation in Couette flows. We want to test the predictions of Agostini and Leschziner (2019, *The connection between the spectrum of turbulent scales and the skin-friction statistics in channel flow at* $Re_\tau \approx 1000$, Journal of Fluid Mechanics) concerning amplitude modulations for such flow.

Content of the Thesis

DNS data for Couette flows at $Re_\tau \approx 500$ is already available; the first step of the thesis consists in revealing the presence of amplitude modulation by calculating a particular correlation. The same is then done on a minimal streamwise unit simulation (to be performed). Finally, a program for the computation of conditional statistics needs to be written; this program is then used to verify the conjectures of Agostini and Leschziner (2019).





Left: amplitude modulation between a large- (orange) and a small-scale signal (blue). Right: large-scale structures (blue streaks) appear among a chaotic field of small scale structures.

Requirements:
Solid knowledge of fluid mechanics
Programming (C, FORTRAN or similar)

Beneficial Skills:
Basic knowledge of bash (Linux command line)
Basic Python/MATLAB

Start: immediately

Contact:
M.Sc. Andrea Andreolli

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

☎ +49 721 608-44179
✉ a.andreolli@kit.edu