INTERMITTENCY STUDY IN COMPUTATIONAL FLUID DYNAMICS BY USING AN INFLOW MODEL BASED ON CONTINUOUS TIME RANDOM WALKS

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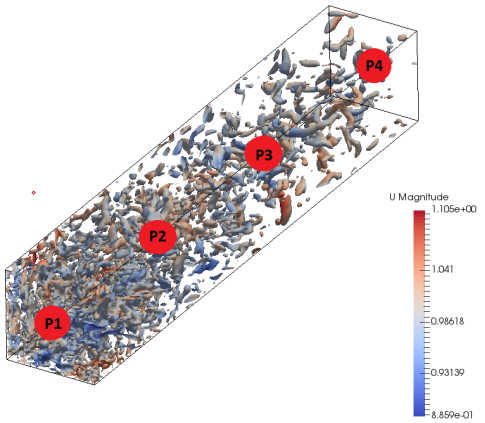
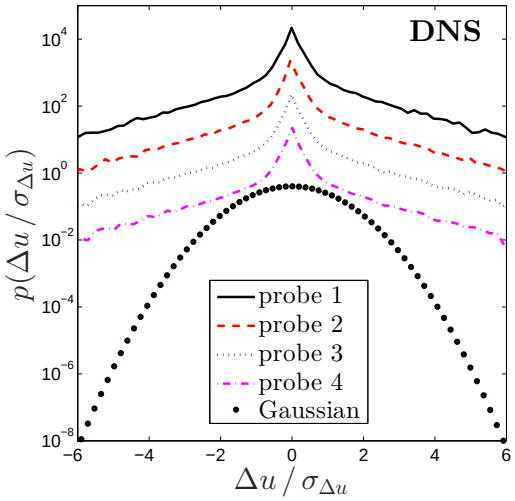
In this paper the evolution of stochastically generated wind-like fields in a channel will be studied by means of Computational Fluid Dynamics (CFD). The used CFD tool is the open-source code OpenFOAM [1]. As a generation algorithm Continuous Time Random Walks (CTRW) were used, which are spatially correlated coupled Ornstein-Uhlenbeck processes, but with a skewed Lévy-distributed time variable, see Kleinhans[2] and Muecke et. al. [3]. By introducing CTRW's spatially and temporally correlated wind fields can be achieved which also have intermittent statistics. Therefore first order statistics are Gaussian distributed, while the velocity increments have a heavy tailed probability density function. Those velocity increments are defined on the time scale τ with velocities u as

$$\Delta u_\tau(t) = u(t+\tau) - u(t) \tag{1}$$

A channel flow with periodic boundary conditions is simulated with CTRW fields as an inflow and also as an actuator. At different probe locations properties like energy spectra, turbulent kinetic energy and increment probability density functions are analysed and compared for a Direct Numerical Simulation and a Large Eddy Simulation. Furthermore a comparison to experimental data for decaying turbulence has been done.



(a) Simulated channel with CTRW inflow and probe locations for statistical analysis



(b) Velocity increment statistics for a DNS simulation for probe locations shown in a

References

[1] Openfoam. http://www.openfoam.com.
[2] David Kleinhans. *Stochastische Modellierung komplexer Systeme - Von den theoretischen Grundlagen zur Simulation atmosphÃd'rischer Windfelder*. PhD thesis, WestfÃd'lische Wilhelms-UniversitÃd't MÃijnster, 2008.
[3] T. Mücke, D. Kleinhans, and J. Peinke. Atmospheric turbulence and its influence on the alternating loads on wind turbines. *Wind Energy 2011*, **14**:301–316, 2011.