DY 32: Poster - Turbulence

Time: Tuesday 18:15–21:00 Location: Poster C

DY 32.1 Tue 18:15 Poster C

Advanced stochastic methods for description of wind gusts — •Christian Behnken[1,2], Ali Hadjihosseini[1,2], Matthias Wächter[1,2], and Joachim Peinke[1,2] — [1]ForWind — [2]Institute of Physics, Carl von Ossietzky University of Oldenburg, 26111 Oldenburg, Germany

Since the share of wind energy in the global energy production is increasing, there is a demand for methods able to capture short time dynamics of wind speeds, which are of great importance for load situations and energy conversion of wind turbines. Firstly, a stochastic analysis of measured wind speed increments has been performed, showing pronouncedly heavy-tailed distributions of wind speed increments for different time scales. Secondly, setting up a coupled system of Langevin equations for these increments, we can estimate drift and diffusion coefficients directly from data which allow for a quantification of the dynamics of increments along the wind profile. Furthermore a stochastic method based on multi-point statistics of increments, joint probabilities and the Markov property is introduced as a tool to reconstruct and model time series of complex systems containing extreme events for a range of scales. It has been shown that the underlying stochastic processes of such time series are governed by a Fokker-Planck-Equation which enables one to statistically capture extreme events accurately. Particularly because there is still no widely accepted definition of wind gusts this might turn out as a promising approach not only for grasping wind gusts, but as well for forecasting of such.

DY 32.2 Tue 18:15 Poster C

Rotation rate of particle pairs in turbulent flow — •Ali Ghaemi and Abdallah Daddi-Moussa-Ider — Biofluid Simulation and Modeling, University of Bayreuth, Germany

The dynamics of solid particles in turbulent flow plays a key role in many environmental phenomena. For instance, the eruption of volcanoes releases particles with different sizes into the atmosphere which then are transported with turbulent currents. In this work, the statistics of particle pair orientation is numerically studied in homogeneous isotropic turbulent flow. We show that the Kolmogorov picture fails to predict the observed probability density functions (PDFs) of the pair rotation rate and the higher order moments accurately. Therefore, a multifractal formalism is derived in order to include the intermittent behavior that is neglected in the Kolmogorov phenomenology. The PDFs of finding the pairs at a given angular velocity for small relative separations reveals extreme events with stretched tails and high kurtosis values. Furthermore, The PDFs are found to be less intermittent and follow a complementary error function distribution for larger separations.

DY 32.3 Tue 18:15 Poster C

Modelling of a coupled mechanical-hydrodynamic system for flow control — •Max Huber[1,3], Andreas Zienert[2], Hans-Reinhard Berger[1], and Jörg Schuster[3] — [1]Institute of Physics, Technische Universität Chemnitz, Chemnitz, Germany — [2]Center for Microtechnologies, Technische Universität Chemnitz, Chemnitz, Germany — [3]Fraunhofer Institute for Electronic Nano Systems, Chemnitz, Germany

Reduction of drag and noise as well as lift enhancement for airplane wings can be achieved with actice flow control, using synthetic jet actuators (SJA). These devices consist of a closed cavity with a small orifice and a movable piezoelectric diaphragm. The oscillation of the diaphragm generates the synthetic (i.e. zero net mass flux) jet that transfers momentum to the surrounding medium.

The present work introduces an analytical model to study the interaction between the driving force of the SJA, the pressure inside the cavity and the flow velocity through the orifice. For this purpose, the oscillating diaphragm is treated as a spring pendulum. Fundamental equations from hydrodynamics describe the flow of the fluid.

Besides, simulations based on finite element method (FEM) were carried out to solve the Navier-Stokes equations. While the straightforward analytical approach describes pressure and flow velocitiy in the SJA and its orifice, FEM shows the train of vortices outside the SJA which is the cause of the momentum flux.