Carl von Ossietzky
Universität
Oldenburg

Institut für PHYSIK

PHYSICAL COLLOQUIUM

INVITATION

Monday, 23.05.2022, 4.15 p.m., Room W02 1-148 and per
video conference: **https://meeting.uol.de/b/anj-2vc-j6s-fwe**

speaks

Prof. Dr. Andreas Schröder,
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR),
Institute of Aerodynamics and Flow Technology, Experimental Methods

BTU Cottbus-Senftenberg,
Department of Image Based Measurement Techniques,
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about

"Shake-The-Box – 3D Lagrangian Particle Tracking in fluid mechanics"

Dense 3D Particle Tracking allows characterizing unsteady and turbulent flows within the Lagrangian and Eulerian frame of reference. The 3D Lagrangian Particle Tracking (LPT) method "Shake-The-Box" (STB) has been continuously developed during the past few years and is able to reliably extract particle trajectories from volumetric flow measurements at unprecedented numbers. STB overcomes the ill-posed reconstruction problem for 3D particle distributions at high particle image densities present for each single time-step (as known for tomo-PIV, IPR and classical PTV) by pre-solving the problem for each predicted time-step in a cascade of reduced complexity along a time series of particle images. With the help of an advanced implementation of the IPR technique STB delivers accurate data on particles position, velocity and acceleration (material derivative) along densely distributed tracks. Subsequently, data assimilation approaches can be applied to the dense and scattered input data. An example is the "FlowFit" (FF) method, which uses Navier-Stokes-constraints for an iterative non-linear optimization process resulting in a continuous interpolation of the flow field with minimized deviation to the measurement data. With FF the full time-resolved 3D velocity gradient tensor and pressure fields with high spatial and temporal resolution are available.
The STB method can be applied as well to short recording sequences, acquired with a multi-pulse technique, allowing investigating high-speed flows at Reynolds numbers relevant for research in aerospace engineering.

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Recent developments of STB and FF will be presented here, along with data from accuracy studies using synthetic experiments and a range of experimental applications to turbulent flows in small and large scale volumes (up to cubic-meter-scales using HFSB seeding). The combined availability of a large number of samples of dense 3D Lagrangian particle tracks and the full velocity gradient tensor allows for a multitude of evaluation options, e.g.:

- extracting instantaneous 3D pressure fields and determining related loads on surfaces
- investigating the spatial and temporal development of coherent flow structures
- computing profiles and fields (mean velocity, Reynolds stresses, acceleration) in sub-pixel resolution
- computing other one- and two-point–statistics (e.g. Joint PDFs, two-point-correlations, dissipation rate) in an adaptive (and conditional) bin-averaging approach
- determining conditional analysis and statistics of flow events in a combined Lagrangian and Eulerian frame

Examples of the listed approaches for flow analyses and turbulence characterization based on experimental data will be demonstrated.

All interested persons are cordially invited.

Dr. Gerd Gülker