Fluid Dynamics Seminar

Date: Wednesday, November 15, 2017 at 13:00
Location: ZARM, Room 1730

Dense 3D Lagrangian Particle Tracking using Shake-The-Box - A new key for turbulence research

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The novel 3D Lagrangian Particle Tracking method "Shake-The-Box" (STB) is able to extract particle trajectories from volumetric flow measurements at unprecedented numbers. STB overcomes the ill-posed reconstruction problem for 3D particle distributions at high seeding densities present for each single time-step (as known for tomo-PIV and PTV) by pre-solving the problem for each predicted time-step in a cascade of reduced complexity along a time series of images. It 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 in order to gain a continuous interpolation of the flow field with minimized deviation to the measurement data. As a result one gets the full time-resolved velocity gradient tensor and pressure field with high spatial and temporal resolution.

The STB method can be applied as well to short recording sequences, acquired with multi-pulse techniques, allowing investigating high-speed flows at Reynolds numbers relevant for research in aerospace engineering.

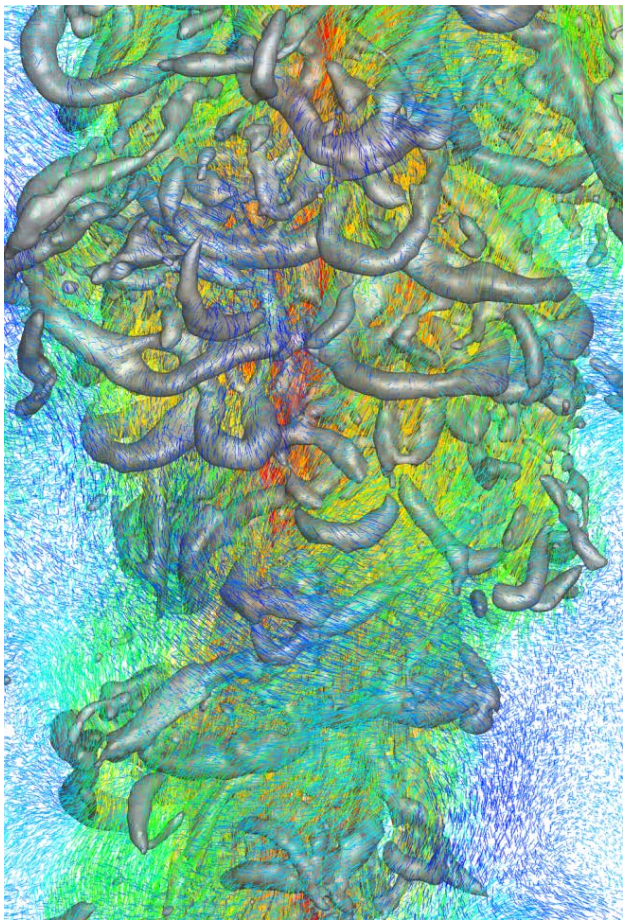

Figure: *Thermal plume represented by ~300,000 Lagrangian particle tracks in a 0.6 m³ volume, color coded with vertical velocity. Isosurfaces of Q-criterion show vortical structures.*

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).

Examples of flow analyses and turbulence characterization based on experimental data will be demonstrated.