FRIDAY 20, JANUARY 2017

ADVANCED TOOLS AND METHODS FOR THE STUDY OF MULTISCALE PROBLEMS

INVITED LECTURES

Shake-The-Box – Dense Lagrangian particle tracking for turbulence research

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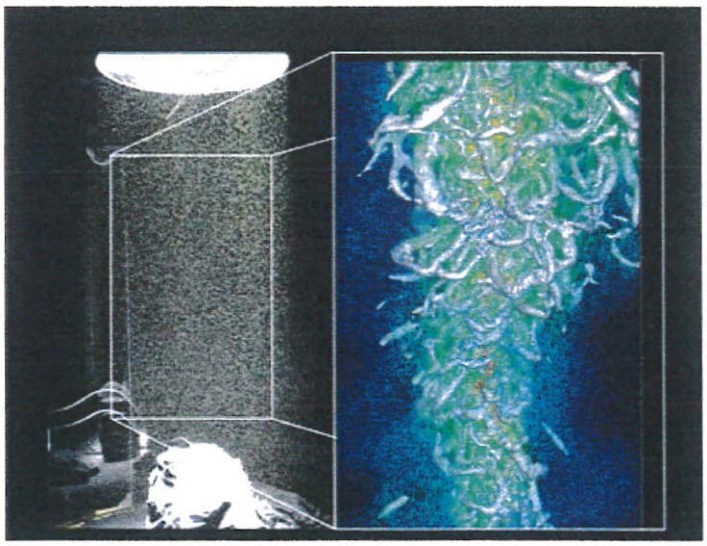

Shake-The-Box (STB) is a novel time-resolved 3D Lagrangian particle tracking method for densely seeded flows. The STB algorithm has been developed at DLR Göttingen in the past three years and uses the prediction of 3D particle distributions for each subsequent time-step as a mean to seize the temporal domain for accurate track reconstructions based on time series of particle images from few camera projections. Exploiting the temporal information enables the processing of densely seeded flows (up to and beyond 0.1 particles per pixel with a nearly complete suppression of ghost particles). Such high particle trajectory densities are a necessary precondition for interpolating the corresponding time-resolved 3D velocity vector field onto a regular grid using Navier-Stokes-constraints. Such a non-linear data assimilation method named FlowFit has been developed at our group in parallel to STB and tested already successfully: For example, unsteady 3D pressure distributions have been calculated from interpolated 3D acceleration fields. The STB method has been applied to wall bounded turbulence in air and water and to a m^3-scale experiment using Helium–Filled-Soap-Bubbles (HFSB) as tracers. The results demonstrate that with STB valuable data for turbulence characterization with outstanding temporal and spatial resolution especially in (wall bounded) shear flow can be obtained.

Figure caption: Dense Lagrangian tracks (~300,000 per time step) colour coded by velocity and iso-contours of Q-values from STB measurements (and Flow-Fit interpolation) in a large scale thermal plume using HFSB

TEC21 1st Winter School on Multi-scale modeling and multi-physics couplings in solid and fluid mechanics
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Shake-The-Box - Dense 3D Lagrangian particle tracking for turbulence research

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Outline

- Shake-The-Box – Dense Lagrangian particle tracking
- FlowFit – Continuous interpolation using NavierStokes- regularization
- Large-volume investigation using Helium-filled soap bubbles and LEDs
  - Thermal plume
  - Impinging jet in air
- Kármán flow with homogenous turbulence in GTF3
- Investigation of the turbulent boundary layer near-wall region
- Outlook

1st WINTER SCHOOL

MULTI SCALE APPROACHES AND MULTI PHYSIC COUPLINGS IN FLUID AND SOLID MECHANICS

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