



SEMINAR

APPLIED MATHEMATICS AND MECHANICS

FS1029

13 May 2026

A DCAMM seminar No. 803 will be presented by

Professor Dr. rer. nat. Andreas Schröder
German Aerospace Center (DLR) in Göttingen and Brandenburg Technical University
Cottbus – Senftenberg, Germany

The title of the lecture is

3D Lagrangian Particle Tracking and Data Assimilation in Fluid Mechanics

Abstract:

Dense 3D Particle Tracking allows characterizing unsteady and turbulent flows within the Lagrangian and Eulerian frame of reference at high spatial and temporal resolution. The 3D Lagrangian Particle Tracking (LPT) method “Shake-The-Box” (STB) has been continuously developed during the past decade and is able to reliably and efficiently extract particle trajectories at unprecedented numbers from few camera projections in volumetric flow measurements. STB delivers accurate data on particles position, velocity and acceleration (material derivative) along densely distributed tracks. The STB method can be applied as well to short recording sequences, acquired with a multi- or two-pulse technique, allowing investigating high-speed flows at Reynolds numbers relevant for research in aerospace engineering. Based on large amounts of measured 3D Lagrangian trajectories in many time series highly resolved particle transport- and residence time investigations as well as one- and two particle dispersion statistics can be calculated inside the measurement volume. Furthermore, the temporally fitted particle trajectory data can be used for one- and multi-point statistics of velocity and acceleration in binning procedures delivering grid resolutions down to subpixel (typically $\sim\mu\text{m}$) size. Using the particles velocity and acceleration information as input to FlowFit (FF3.0) or PINN data assimilation methods continuous interpolations of the time-resolved flow fields delivering the 3D VGT and pressure data at high spatial resolution with minimized deviation to the measurement data can be determined while simultaneously Navier-Stokes-constraints are enforced during the optimization process.

The recent developments have transformed 3D Lagrangian Particle Tracking from a tool to measure tracer particle properties in small volumes (a few cubic centimeters) to a fully integrated environment, capable of delivering spatially highly resolved time-series within scalable volumes from a few cubic millimeters up to several cubic meters. The combination of advances both on the software side with the introduction of the Shake-The-Box (STB) method (Schanz et al 2016, Schröder and Schanz 2023) and efficient data assimilation techniques (FF3.0 or PINNs) and the hardware side (high frequency pulsed- LED and laser-illumination, Helium-filled soap bubble (HFSB) seeding, light sensitive high-resolution- and high-speed cameras) enabled a rapid expanse in flow measurement capabilities allowing for corresponding investigations of turbulent flow and transport phenomena in various wind tunnels and other fluid flow facilities.

DATE:	Thursday, 28 May 2026
TIME:	11:00 – 11:45
PLACE:	Building 414, Room 061B DTU, Technical University of Denmark
Virtual participation:	Link

Danish pastry, coffee and tea will be served 15 minutes before the seminar starts.

All interested persons are invited.

Clara Velte/Jan Becker Høgsberg

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