



MMAE SEMINAR

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E-1 BUILDING – ROOM 119
3:30 – 4:30 PM

New Technologies for Fluid Dynamics Experiment and Optical Diagnostics

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Abstract

Modern technologies offer new opportunities for the experimentalists in a broad variety of research areas including hydrodynamics. A significant, several folds, improvements in accuracy, precision, reproducibility, control, data acquisition rate, and information capacity of the experimental data sets over the current state-of-the-art are envisaged using the new approaches and techniques bringing the quality of experiments to a new level of standards. Application of the new technologies in experimental diagnostics can help to bridge the current quality gap between the observations and the computational fluid dynamics large-scale simulations allowing direct and unambiguous comparison of the data and the modeling results which is detrimental for the code validation.

One of the new technologies, which will be described in the talk, is the ultrahigh performance digital holographic data storage. The state-of-the-art motion control, electronics, and optical imaging allow for realization of turbulent flows with very high Reynolds number ($>10^7$) in a relatively small laboratory-scale form-factor and quantification of their properties with extremely high spatio-temporal resolutions and bandwidth. Digital holographic technology can provide complete three-dimensional mapping of the flow velocity and density fields at high-data rates (over 1,000 frames per-second) over large spatial area (~50 cm) with high spatial (1 to 10 microns) and temporal (better than few ns) resolutions and can thus provide extremely accurate quantitative description of the fluid flows, including multiphase and unsteady conditions. These unique experimental and metrological capabilities enable the studies of spatial and temporal properties of the transports of momentum, angular momentum, and energy and the identification of scalings, invariants, and statistical properties of the complex multiphase and unsteady turbulent flows. The technology can be applied for investigations of a large variety of hydrodynamic problems including the fundamental properties of non-Kolmogorov turbulence, flow-particle interactions, accelerating and rotating flows, boundary layer, Rayleigh-Taylor instability and turbulent mixing, magneto-hydrodynamics, and laboratory astrophysics.