TECHNION Israel Institute of Technology
הטכניון מכון טכנולוגי לישראל

Faculty of Mechanical Engineering
הפקולטה להנדסת מכונות

MECHANICAL ENGINEERING STUDENT SEMINAR

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Online: https://technion.zoom.us/j/94970888242

GPU-Accelerated Large Eddy Simulations of Turbulent Flow Over a Two-Height Urban Canopy

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Urban canopies, with their heterogeneous heights, exhibit complex flow phenomena essential for understanding urban airflow dynamics. Our study employs implicit large eddy simulations (ILES) using the flux reconstruction method and the artificial compressibility approach in the PyFR open-source library. These GPU-accelerated simulations offer detailed and accurate insights into turbulent flow within and above urban-like canopies.

Understanding these dynamics is crucial for urban planning and design, as it impacts air quality, energy efficiency, and overall urban sustainability. We focus on analysing turbulent statistics and examining both small and large-scale coherent motions within a staggered two-height canopy configuration. By comparing flow behaviour and turbulent statistics in the paths of short and tall canopy elements, we investigate the effects of canopy heterogeneity. Additionally, we conduct a parametric study to understand the influence of secondary building height on flow dynamics.

Our research delves into the behaviour of large structured motions (LSMs) above the canopy flow and their penetration into it. Using advanced tools such as two-point correlations and quadrant analysis, we uncover the intricate interactions between these LSMs and the canopy elements. Our findings highlight the significant role of LSMs in shaping flow patterns and turbulent characteristics within the canopy.

We suggest a self-sustaining mechanism for very large structured motions (VLSMs) above canopy-like flows, which may be part of or coexist with the formation mechanism of these VLSMs.

Additionally, we have implemented a scalar transport equation and relevant boundary conditions in PyFR. Preliminary results, including visualisations of scalar transport behaviour, will be presented. This tool serves as a foundation for future research, motivated by the need to understand scalar transport for applications such as pollutant dispersion, heat transfer, and energy efficiency in urban environments.

Seminars Coordinator: Assoc. Prof. Shmuel Gal.