UNIVERSITY OF MARYLAND

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ACTIVE AND INACTIVE MOTIONS IN WALL-BOUNDED TURBULENCE

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Aerospace Engineering Conference Room
3164 Glenn L. Martin Hall

Speaker

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ABSTRACT

Reynolds shear stress is the key momentum transport term in wall turbulence and as a consequence has been the focus of numerous theoretical modelling attempts in the past. Here, we investigate the seminal proposal by Prof. A. A. Townsend (Townsend 1961, JFM; Townsend 1976, CUP) that wall bounded flows are comprised of active and inactive motions; the active motions being those that are solely responsible for producing Reynolds shear stress and follow self-similarity when normalised with distance from the wall and friction velocity. This talk discusses a novel methodology proposed recently in Deshpande, Monty & Marusic (2021, JFM A5) which successfully segregates the active and inactive contributions to the total turbulent kinetic energy. The effectiveness of this methodology will be demonstrated by applying it to multiple published numerical and experimental wall-turbulence datasets, spanning over a decade change in friction Reynolds number. Active contributions to the streamwise, spanwise and wall-normal turbulence intensities are estimated individually and found to exhibit self-similar characteristics consistent with Townsend's hypothesis. The Reynolds shear stress, estimated solely from the active contributions, is also found to closely match the one obtained conventionally from the dataset, providing direct empirical support for the concept of active and inactive motions.

BIO

Rahul studied Mechanical and Aerospace Engineering at the Indian Institutes of Technology (IITs), for his Bachelors and Masters degrees in 2014 and 2016, respectively. The following year, he worked as a Project Engineer at India's National Wind Tunnel Facility in Kanpur, to further his Masters research on bluff-body drag reduction. In 2017, Rahul joined the University of Melbourne in Australia to pursue his PhD under the supervision of Profs. Ivan Marusic and Jason Monty. He was awarded his PhD in June 2021 for thesis titled "Three-dimensional structure and scaling of a canonical turbulent boundary layer", which was judged as the best thesis in thermo-fluids by the University. Since then, he has been working as a post-doctoral research fellow in the Melbourne fluids group, investigating active and passive turbulent drag reduction techniques and non-canonical wall-bounded flows.

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