Seminar/Talk

Recent Developments in Overlap Region of Wall Bounded Turbulence

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Utilizing the three-pronged approach of experimental measurements, computational results (DNS) and matched asymptotic analysis, we have reexamined the three canonical wall-bounded turbulent flows of pipe, channel and zero pressure gradient boundary layer. Detailed and systematic study confirmed the non- universality of the Krmn constant (k) reported in 2008 by Nagib & Chauhan Variations of von Krmn coefficient in canonical flows, PoF 20, 101518. Recently, a new matching approach also revealed an inner-outer overlap consisting of a superposition of log-law and a linear term, as detailed in paper by Monkewitz & Nagib The hunt for the Krmn constant Revisited, JFM 967, A15, 2023. DOI: https://doi.org/10.1017/jfm.2023.448. A similar linear term was suggested by Afzal & Yajnik, JFM (1973 & 1970) and Luchini (2017) PRL 118, 224501. In our results, we find that the coefficients of both the log and linear terms are dependent on the pressure gradient of the flow. We utilized experimental data obtained under various favorable and adverse pressure gradients in the NDF wind tunnel at IIT and the MTL wind tunnel at KTH, to extract the parameters of the "Log-Linear" overlap region in pressure gradient boundary layers.After many decades of experience with canonical wall-bounded turbulent flows, we recognize fully developed pipe flow as the ideal flow to compare computations and experiments. With collaborators at several universities, we have conducted experiments, with Ret up to 33,000, and DNS for pipe flow at Ret = 550 & 1,000, with several resolutions, and extended Eddy Turnover Times (ETT) of up to 200. New criteria for resolution and an existing criterion for convergence of DNS are being developed and confirmed, respectively. We find that higher resolution DNS and longer computational times are required for wall-bounded turbulence, compared to values commonly used. Finally, the impact of the new combined log-law and linear term on Textbooks, Lecture Notes, RANS Codes and Turbulence Models will be highlighted.

Monday, March 4, 2024 02:30pm - 03:30pm
Office Bldg West / Ground floor / Heinzel Seminar Room (I21.EG.101)

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