MECHANICAL ENGINEERING STUDENT SEMINAR

Thursday, February 6, 2025, at 13:00, D. Dan and Betty Kahn Building, room 217.
Online: https://technion.zoom.us/j/94205568076?from=addon

Turbulent flow across an axisymmetric expansion in a round pipe

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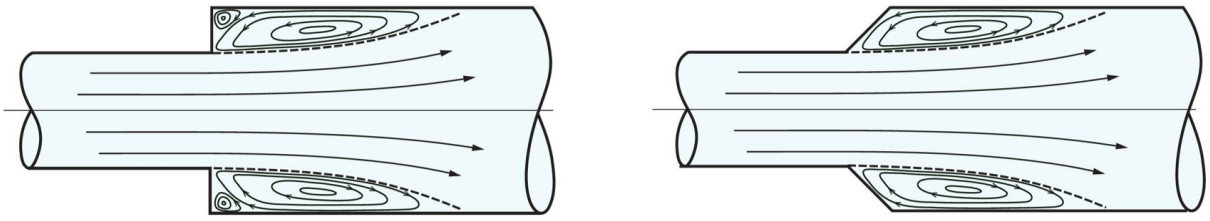
This study provides an empirical comparison of turbulence measurements between abrupt (90°) and gradual (45°) axisymmetric area expansions in a pipe. The experiments were performed in a refractive index-matched closed loop flow tunnel using high-resolution stereo PIV in a section fitted with an area expansion ratio of 2.56 and with step-height Reynolds numbers of 25,000 and 35,000. Both expansion angles show comparable reattachment length and similar mean flow profiles. However, we have found that the separated flow that forms in the gradual expansion case is more structured and follows the contours of the wall better but, at the same time, creates stronger interaction between the return flow and the free stream, leading to an increase in the out-of-plane velocity fluctuations near the separation corner, elevates the shear layer and thus results in higher TKE production and Reynolds stresses. Comparing the Reynolds stresses anisotropic maps reveals that larger regions of uniaxial Reynolds stress occur in the gradual expansion case, offering foundational insights into how expansion geometry shapes turbulence structure, intensity, and anisotropy. Furthermore, Lagrangian coherent structure analysis reveals that gradual cases exhibit larger, more coherent structures. This study provides the first experimental comparison of turbulence in abrupt and gradual pipe expansions, offering foundational insights into how expansion geometry shapes turbulence structure, intensity, and anisotropy.
In addition, tomographic imaging was employed to track the trajectories of spheres introduced far upstream in the flow as they move through the area expansion region. Preliminary results demonstrate the complexity of sphere trajectories, with some spheres entrained into the recirculation region while others bypassed it and continued downstream.



Note: The seminar will be given in English