הטכניון מכון טכנולוגי לישראל TECHNION Israel Institute of Technology

Faculty of Mechanical Engineering הפקולטה להנדסת מכונות

MECHANICAL ENGINEERING MSc SEMINAR (30 min.)

Thursday, May 21 2026 at 13:30-14:00, Lady Davis Building, Auditorium 250

Shock propagation through a local Constriction

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Shock waves have been studied for well over a century, and the physics of shock waves forming in steady flows is today considered well understood. The propagation of unsteady shock waves is a far more challenging problem, and more so when such waves travel through confined geometries like pipes, ducts, and tunnels, where our ability to predict what happens when the shock encounters even the simplest change in geometry remains frustratingly incomplete. This gap in understanding carries real consequences: when a shock wave propagates within a confined conduit, its energy has nowhere to escape, producing intense pressure loads, structural vibrations, and potentially catastrophic forces on surrounding infrastructure. The question at the heart of this study is deceptively simple: when a shock wave propagating through a conduit meets a local constriction, what does that geometry do to it, what ultimately governs the strength of the reflected and transmitted waves that emerge on either side, and can we predict this from geometry alone?

High-fidelity numerical simulations, validated by shock tube experiments, were employed to study the interaction of a shock wave moving within a conduit with a local, symmetrical constriction while systematically varying blockage ratio, constriction length, and geometry. The analysis reveals that the key to understanding far-field shock behaviour lies in the transient start-up process: the initial shock–geometry interaction impulsively drives flow separation, vortex formation, and complex internal wave structures that redistribute energy within the flow, and it is these early-time mechanisms that ultimately set the reflected and transmitted shock strengths observed far upstream and downstream. Despite considerable differences in early-time dynamics across configurations, the long-time behaviour follows simple and robust trends, with blockage ratio emerging as the primary governing parameter while the influence of geometry and constriction length is present but secondary. These findings motivate reduced-order predictive models that estimate far-field shock strengths directly from geometric parameters, establishing a direct and quantifiable link between local shock-geometry interaction and global flow behaviour, and offering both physical insight and, for the first time, practical predictive capability.

Seminars Coordinator: Prof. Sefi Givli

Note: the seminar will be given in English