



MECHANICAL ENGINEERING SEMINAR

Monday, November 2nd, 2026 at 14:30, Dan Kahn Building, Auditorium 1

Online: <https://technion.zoom.us/j/99851994269>

Shock Wave Propagation Through a Conduit with an Abrupt Geometry Change

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Hosted by: Prof. Alon Wolf

An abrupt local change in conduit geometry alters the strength of a propagating shock wave and initiates a transient flow start-up process as the shock impulsively accelerates the gas from rest. The resulting wave reflections, shock-shock interactions, flow separation, and strong pressure fluctuations govern dynamic loading in propulsion systems, piping, and protective structures. In this seminar, I will show how we identify the dominant physical mechanisms in these complex transient flows and use this understanding to develop predictive models of shock propagation.

We first consider an abrupt expansion, where the flow continues downstream without a strong upstream reflected shock. Using experiments and large-eddy simulations, we identified a previously unexplained mechanism by which a distorted, decelerated shock regains nearly uniform propagation. Transverse shock reverberations redistribute energy behind the front, causing local acceleration and deceleration until velocity differences diminish over a surprisingly long time. These results led to a new similarity scaling of the wave propagation and an empirical prediction of the eventual shock speed.

We then consider a local constriction in which transverse waves are accompanied by a strong upstream reflected shock, which complicates predictions of the eventual strengths of the reflected and transmitted shocks. However, once choking is established, we can predict both strengths, agreeing to within a few percent with experimentally validated simulations and reduced-order models. The eventual shock strengths depend primarily on the effective throat area at which choking occurs. By contrast, the start-up dynamics and settling time depend strongly on geometry. The eventual shock strengths are therefore only part of the loading problem: geometries that produce similar reflected and transmitted shocks can generate markedly different pressure histories during start-up. Our ongoing research on this topic focuses on how geometry governs these transient pressure histories near the area-change region.

Understanding how evolving flow structures generate pressure fluctuations and forces is a central focus of our laboratory. This connects the shock-driven flows examined here to other phenomena we study, in which transient, localized flow disturbances influence turbulence, phase change, and the motion of immersed bodies.