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Stability analysis of an impacting T-junction pipe flow[1] KEVIN CHEN, CLARENCE ROWLEY, HOWARD STONE, Princeton University — The flow through a T-shaped pipe bifurcation (with the inlet at the bottom of the "T") is a common occurrence in both natural and man-made systems, including blood vessels, industrial pipe networks, and microfluidic channels. Despite the ubiquitous nature of the geometry, many questions about the flow physics remain. We analyze the stability of Navier–Stokes equilibria by executing numerical continuation on the Reynolds number (based on the average inlet velocity), using a combination of linear extrapolation and the Newton–GMRES algorithm. We find that the qualitative nature of the equilibria's local bifurcations is highly sensitive to the grid resolution. On a sufficiently resolved grid, a rapid succession of supercritical Hopf bifurcations begins at $Re \approx 550$. Visualizations of the neutrally stable eigenmodes reveal the physical nature of the instabilities. We also compare equilibria computed with different radii of curvature at the square corners of the "T." Next, a wavemaker analysis reveals the locations in the T-junction where the stability is most sensitive to localized changes in the dynamics, e.g., via a change in geometry.

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