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Local and global stability analysis of compressible channel flow over wall impedance IMAN RAHBARI, CARLO SCALO, Purdue University — The stability properties of compressible channel flow over porous walls is investigated via Local (LSA) and Global Stability Analysis (GSA) for laminar and turbulent base flows at $\mathrm{Re_b} = 6900$ and $\mathrm{M_b} = 0.85, 1.5, 3.5$. Linearized Navier-Stokes equations are discretized via a sixth-order fully collocated Padé scheme leading to a Generalized Eigenvalue Problem (GEVP) solved using a parallel sparse eigenvalue solver based on the shift-invert Arnoldi method. The adopted discretization guarantees spectral-like spatial resolution. Fully sparsity of the system is retained via implicit calculation of the numerical derivatives ensuring computational efficiency on multi-processor platforms. The global eigen-spectrum exhibits various sets of modes grouped by streamwise wave-numbers, which are captured via LSA, as well as global acoustic modes. Consistently with the findings of C. Scalo, et al. Phys. Fluids (2015), two unstable local modes are found for sufficiently high wall permeability: one standing-wave-like and one representing a bulk pressure mode, both generating additional Reynolds shear stresses concentrated in the viscous sublayer region. Stability properties of the flow over non-modal streamwise impedance distributions are also discussed.

Iman Rahbari
Purdue University

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