

A Theoretical Model for Resonances in Flow Past a Cavity

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Acoustic resonances leading to high unsteady pressure levels may occur in flow past cavities. The resonance involves a coupling between the downstream-propagating instability wave on the shear layer spanning the open face of the cavity, and acoustic waves propagating inside and outside the cavity. The elements of the disturbance field are coupled by the scattering processes at the upstream and downstream ends of the cavity. We develop a theoretical prediction method that combines propagation models in the central region of the cavity with scattering models for the end regions. The scattering processes are calculated using the Wiener-Hopf technique. The global analysis leads to a prediction for the resonant frequencies which has much in common with the Rossiter formula, but contains no empirical constants. The analysis also determines the temporal growth (or decay) rate of each mode, thereby providing the stability boundaries in parameter space.

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