

Shock Leakage Through a Vortex-Laden Mixing Layer Causing Jet Screech

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The unsteady interaction between shock-cells and vortices in a mixing layer of a supersonic jet generates intense shock noise causing jet screech. We develop a linear geometrical theory for weak shock motion consisting of the eikonal equation and the Blokhintzev invariant for unsteady flows and study this shock noise phenomenon. The equation for the shock-front normal shows that the local vorticity in the mixing layer behaves as a barrier; hence, the standing shock periodically leaks near the saddle points between convective vortices and radiates as intense tonal sound in the far field. We perform direct numerical simulation of a two-dimensional supersonic mixing layer and validate the model of shock leakage by exhibiting good agreement between the geometrical theory and the full simulation in terms of shock-front as well as shock noise amplitude.

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