This is a numerical simulation of noise generation from an over-expanded supersonic jet. The computation uses the time marching Dispersion-Relation-Preserving (DRP) scheme. Unlike CFD schemes, DRP scheme, a CAA scheme, is designed to compute accurately fluid flow and sound propagation simultaneously. It is proven mathematically that DRP scheme would reproduce the sound wave speed, wavelengths and other wave characteristics as those of the governing PDE. Since a finite computational domain is used, radiation and outflow boundary conditions are imposed at the exterior boundaries. For over-expanded supersonic jets, the nozzle exit pressure is not the same as the ambient pressure. To ensure this is reproduced in the simulation, a set of improved radiation boundary conditions is adopted. This movie shows Mach wave radiation in the downstream direction and screech tone radiation in the upstream direction (see the circular bands of sound waves in the lower left side of the movie). The Mach wave and screech tone radiation in the simulation are found to be in good agreement with experiment.

Reference: AIAA Paper 2023-4519 “Jet Noise Reduction: A fresh start”

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