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Addressing the likelihood of cumulative nonlinear distortion in supersonic jet noise using the effective Gol'dberg number WOUTIJN J. BAARS, University of Melbourne, CHARLES E. TINNEY, MARK F. HAMILTON, University of Texas at Austin — When replicating full-scale jets by way of sub-scale experiments, it is routine to aim for aerodynamic similarity; this is achieved by matching the jet's geometry, Mach number, temperature ratio and Reynolds number. We here compute the effective Gol'dberg number (Λ) to assess acoustic similarity for supersonic jets—whether the wave propagation obeys by linear or nonlinear theory. Cumulative nonlinear wave distortion may only appear when the jet flow and ambient surround are sufficient incubators for distortion. Noticeably, the imperative conditions for sustaining this distortion do not scale following aerodynamic similarity laws. A method for computing Λ encompasses a ray tube situated along the Mach angle where the sound is not only most intense, but advances from undergoing cylindrical- to spherical-decay in its pressure amplitude. Hence, values of Λ are computed separately for the cylindrically and spherically spreading regions, for a plethora of experimental databases. The findings demonstrate how for sub-scale jets, cumulative nonlinear distortion may be present in the region of cylindrical spreading alone. It is revealed that nonlinear distortion is likely to sustain in the region of spherical pressure decay when full-scale jets are concerned.

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