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Linear global modes in a high Reynolds number Mach 0.9 turbulent jet OLIVER SCHMIDT, AARON TOWNE, TIM COLONIUS, Caltech — A global linear stability and resolvent analysis of the mean flow from a carefully validated Mach 0.9 turbulent jet large eddy simulation (LES) is conducted. Spatiotemporal Fourier decomposition of the simulation data reveals the presence of large scale coherent structures at small azimuthal wavenumbers. The latter wave packets appear as discrete sets of lightly dampened modes in the linear global stability analysis. Their common feature is a spatial separation into an upstream traveling acoustic perturbation in the potential core region, and a Kelvin-Helmholtz-like vortical perturbation which is advected downstream. The least stable branch of discrete modes observed at Strouhal numbers $0.38 < St < 0.42$ exhibits the same acoustic super-directivity as found in the LES and various experimental studies, and hence establishes a direct link between global linear instabilities and low-angle acoustic radiation. Branches at higher frequencies and azimuthal wavenumbers show multi-directive acoustic emission patterns. This observation is of particular interest since high angle, broadband radiation is commonly attributed to stochastic fluctuations of the turbulent jet shear layer.

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