Abstract Submitted
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Eddy viscosity for resolvent analysis of turbulent jets[1] ETHAN PICKERING, GEORGIOS RIGAS, Caltech, OLIVER SCHMIDT, University of California, San Diego, DENIS SIPP, ONERA - The French Aerospace Lab, TIM COLONIUS, Caltech — Resolvent modes of turbulent jets have shown striking qualitative agreement with data-deduced modes, found via spectral proper orthogonal decomposition (SPOD), of high-fidelity, large-eddy simulations (LES), however, quantitative comparisons are still lacking. The discrepancy is linked to the presence of spatially colored noise inherently contained within SPOD modes but absent in resolvent analyses. Considering SPOD presents the optimal basis to describe statistical variability of turbulent flows, we present an optimization that aligns resolvent analysis towards SPOD through the introduction of an eddy-viscosity model to the resolvent operator. The optimization is applied to Mach 0.4, 0.9, and 1.5 round, isothermal, turbulent jets, using five eddy-viscosity models: linear damping, a spatially constant eddy-viscosity field, a turbulent kinetic energy-based viscosity field, a RANS derived viscosity field and a fully optimized field. Alignments between modes substantially increase (> 90% for many cases) in the most energetic region of frequency-wavenumber space ($St = 0 - 1, m = 0 - 2$) across all Mach numbers. Additionally, we find optimal alignments are relatively insensitive to the choice of eddy-viscosity model, rather, the inclusion of an eddy-viscosity model is the critical choice.

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