Abstract Submitted
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Very-high-Reynolds-number vortex dynamics via Coherent-vorticity-Preserving (CvP) Large-eddy simulations[1] JEAN-BAPTISTE CHAPELIER, Purdue Univ, BONO WASISTHO, Kord technologies, CARLO SCALO, Purdue Univ — A new approach to Large-Eddy Simulation (LES) is introduced, where subgrid-scale (SGS) dissipation is applied proportionally to the degree of local spectral broadening, hence mitigated in regions dominated by large-scale vortical motion. The proposed CvP-LES methodology is based on the evaluation of the ratio of the test-filtered to resolved (or grid-filtered) enstrophy: $\sigma = \widehat{\overline{\xi}}/\overline{\xi}$. Values of $\sigma \simeq 1$ indicate low sub-test-filter turbulent activity, justifying local deactivation of any subgrid-scale model. Values of $\sigma < 1$ span conditions ranging from incipient spectral broadening $\sigma \lesssim 1$, to equilibrium turbulence $\sigma = \sigma_{eq} < 1$, where σ_{eq} is solely as a function of the test-to-grid filter-width ratio $\widehat{\Delta}/\overline{\Delta}$, derived assuming a Kolmogorov's spectrum. Eddy viscosity is fully restored for $\sigma \leq \sigma_{eq}$. The proposed approach removes unnecessary SGS dissipation, can be applied to any eddy-viscosity model, is algorithmically simple and computationally inexpensive. A CvP-LES of a pair of unstable helical vortices, representative of rotor-blade wake dynamics, show the ability of the method to sort the coherent motion from the small-scale dynamics

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