An outflow buffer zone based on the jet mean flow self-similarity

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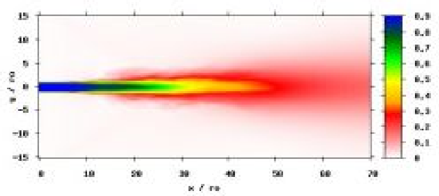
ABSTRACT

In this work, implicit large-eddy simulations of a Mach 0.9 round jet at Reynolds number 65,000 will be carried out with a multi-block message passing interface parallel solver. A well-suited buffer zone based on the jet mean flow self-similarity will be constructed to accurately model the turbulence development, the acoustic waves propagation and the lateral inflow motion induced by the jet flow entrainment. Stringent requirements of aeroacoustic computations are satisfied by the use of sixth-order compact schemes for spatial discretization and filtering, and a fourth-order Runge-Kutta method for time integration. The high-order acuracy of the numerical schemes allows suppressing high-frequency oscillations provided by unresolved scales, mesh non-uniformities and boundary conditions. The jet mean flow self-similarity is attained by matching self-similar parameters (virtual origin, mean velocity decaying and spreading rate) in the whole turbulence mixing region, including the outflow buffer zone (for x/ro ranging from 50 to 70, where ro is the jet radius). Instantaneous and mean flow characteristics of the jet are in good agreement with theoretical, experimental and numerical results from the literature at similar flow conditions. From the best of the authors knowledge, this is the first time that a buffer zone based on the self-similarity is used for aeroacoustic computations. In the final manuscrict, important features of the jet, such as self-similarity of the Reynolds stresses, far-field sound pressure level, pressure and energy spectra will be investigated.



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