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Solenoidal Synthetic Turbulent Velocity Field for LES Inflow and Initial Conditions ADRIAN SESCU, The Johns Hopkins University, RAY HIXON, The University of Toledo, CHARLES MENEVEAU, The Johns Hopkins University — Current numerical techniques for the prediction of realistic turbulent flows require turbulent inflow or/and initial conditions that at least must match a given set of statistics and satisfy the divergence-free condition. These techniques are increasingly coupled with aeroacoustic calculations wherein the propagation of acoustic waves has to be accurately captured, as opposed to traditional CFD methods where the acoustic waves are simply damped out. This work proposes a method to generate a divergence-free turbulent velocity field based on the assumption that turbulence can be considered as a summation of random eddies satisfying specific statistics. The streamfunction concept and the requirement that the individual eddies must satisfy the linearized momentum equations about the mean flow are used to enforce the divergence-free condition. Experimental benchmark data for spatially decaying turbulence and nonhomogeneous rotor-wake turbulence from NASA's Fan Source Diagnostic Test are used to evaluate the proposed synthetic eddy method.

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