Anisotropic Turbulent Flow Simulations using the Isotropic LANS-α Equations

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Direct numerical simulation of most engineering and geophysical turbulent flows requires intensive computations. Large Eddy Simulations (LES), Reynolds Averaged Navier-Stokes Equations (RANS), and the Lagrangian averaged Navier-Stokes-α (LANS-α) equations are among the numerical techniques to reduce the computational intensity of turbulent flow calculations. In this talk a dynamic procedure for the Lagrangian Averaged Navier-Stokes-α (LANS-α) equations is developed where the variation in the parameter \( \alpha \) in the direction of anisotropy is determined in a self-consistent way from data contained in the simulation itself. In order to evaluate the applicability of the dynamic LANS-α model in anisotropic turbulence, a priori test of the dynamic LANS-α in channel flows is performed at various Taylor Reynolds numbers between 180 and 550 based on the wall friction velocity to find the variation of \( \alpha \) in the wall-normal direction. It is found that in the wall region the parameter \( \alpha \) rapidly increases away from the wall and saturates to an almost constant value in the outer region. An appropriate scaling for \( \alpha \) is also identified. As a result, the isotropic LANS-α equations can now be easily used in anisotropic channel flows with a universally damped \( \alpha \).

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