144c Reynolds Stress Closure for Strongly Swirling Flows

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The Reynolds Averaged Navier-Stokes (RANS-) equation for the mean velocity field is statistically unclosed. Previous research by Parks *et al.*(1998) has identified a class of algebraic closures that relate the turbulent flux of momentum to a prestress induced by fluctuations in the instantaneous Reynolds stress and fluctuations in the pressure field. The new approach shifts the turbulence closure problem from the anisotropic component of the Reynolds stress to the anisotropic component of a prestress with the result that the turbulent momentum flux is not frame indifferent at the mesoscale relevant to turbulent flows.

The closure hypothesis yields an explicit non-linear algebraic relationship between the turbulent momentum flux and a non-negative, symmetric, dyadic-valued operator that depends on the mean velocity gradient and a relaxation time associated with the local space-time structure of the turbulence. The eigenvalues of the resulting turbulent momentum flux are non-negative for all flows. B*enchmark* experimental and computational data are used to determine the parameters in the new closure. The application of the closure to homogeneous shear in noninertial frames and other flows in inertial frames will be presented and compared with direct numerical simulations.

Parks, S.M., K. Weispfennig, C. A. Petty, 1998, "An Algebraic Preclosure Theory for the Reynolds Stress"**,** *Physics of Fluids*, **10**(13), 645-653.