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The LagRST Model Applied to a q-Vortex[1] MATTHEW CHURCHFIELD, GREGORY BLAISDELL, Purdue University — A turbulence model is needed which is less complicated than existing Reynolds stress models but which captures non-equilibrium effects in flows exhibiting streamline curvature or rotation. In this investigation, we study a non-equilibrium turbulence modeling idea proposed independently by Knight and Saffman and later by Olsen and Coakley. The equilibrium Reynolds stress tensor is computed with a standard two-equation model and the Boussinesq approximation. The actual Reynolds stresses are then solved from a lag equation. In order to study the lag Reynolds stress transport model, an idealized quasi-steady q-vortex problem is considered in which the mean velocity, turbulent kinetic energy and dissipation rate are taken from a DNS solution. The lag equation is solved analytically to obtain the actual Reynolds stresses. The Reynolds stresses predicted with the lag equation exhibit magnitudes comparable to and contours in better alignment with those of the DNS data. In contrast, the Reynolds stresses obtained with the Boussinesq approximation are too great and have contours aligned with the contours of the corresponding components of strain rate tensor, which is inaccurate. The lag model more realistically solves for the non-equilibrium q-vortex Reynolds stresses.

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