Reynolds-stress and triple-product models applied to flows with rotation and curvature

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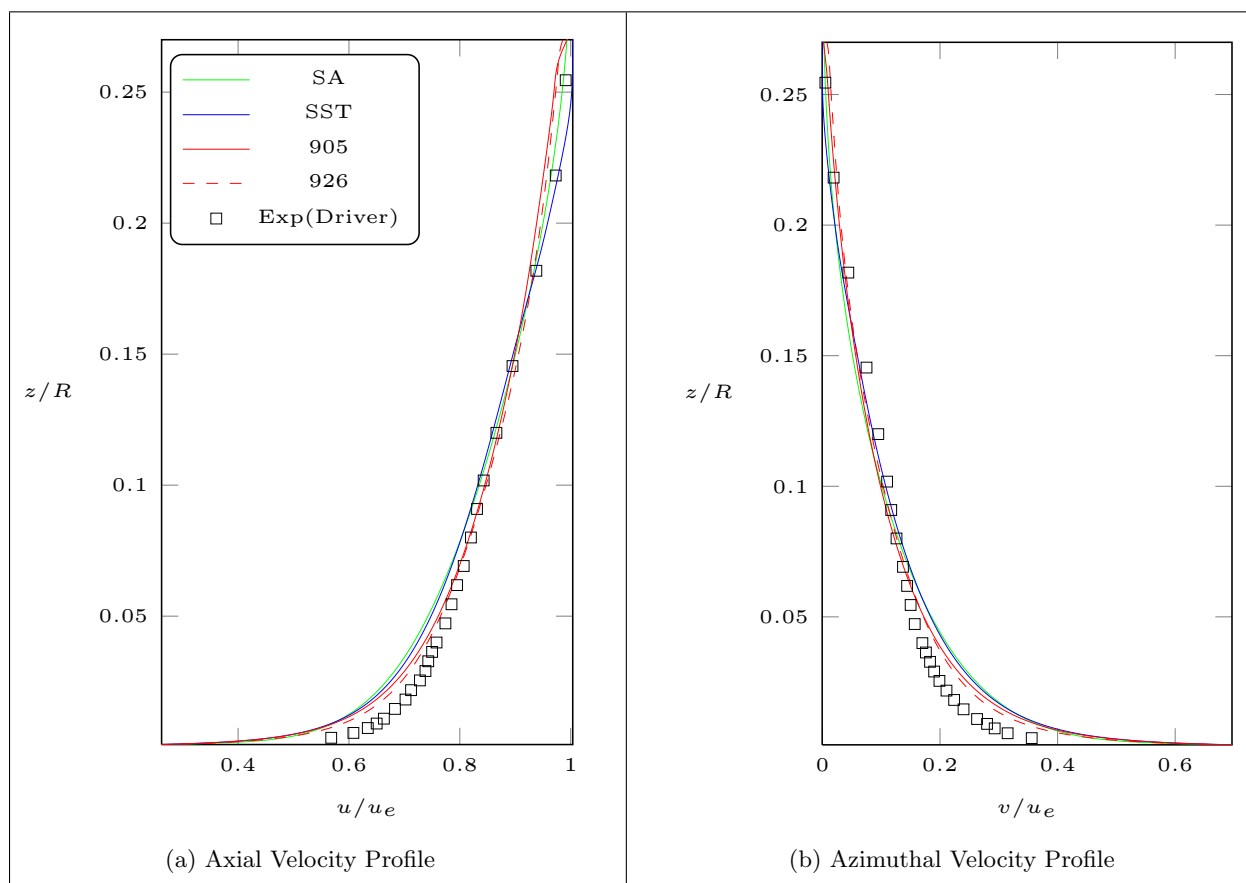*NASA Ames Research Center*

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Figure 1: Spinning Cylinder Flow Predictions for Various Turbulence Models, X=-4.72R

Predictions for Reynolds-stress and triple product turbulence models are compared for flows with significant rotational effects. One of the turbulent flows is the spinning cylinder flow[1–3] when a fully developed eseentially flat plate flowfield encounters a step change in the surface speed. This flowfield configuration introduces a destabilizing, turbulence enhancing combination of curvature and rotation. Comparison of predictions for the two components of velocity 4.72R upstream of the end of the spinning section are shown in Figure 1.

A second flowfield that will be investigated is the alter ego of this flowfield, the rotating pipe,[4–7] which subjects an essentially fully developed pipe(x=200R) flowfield to a rotating section of pipe. The flow in the

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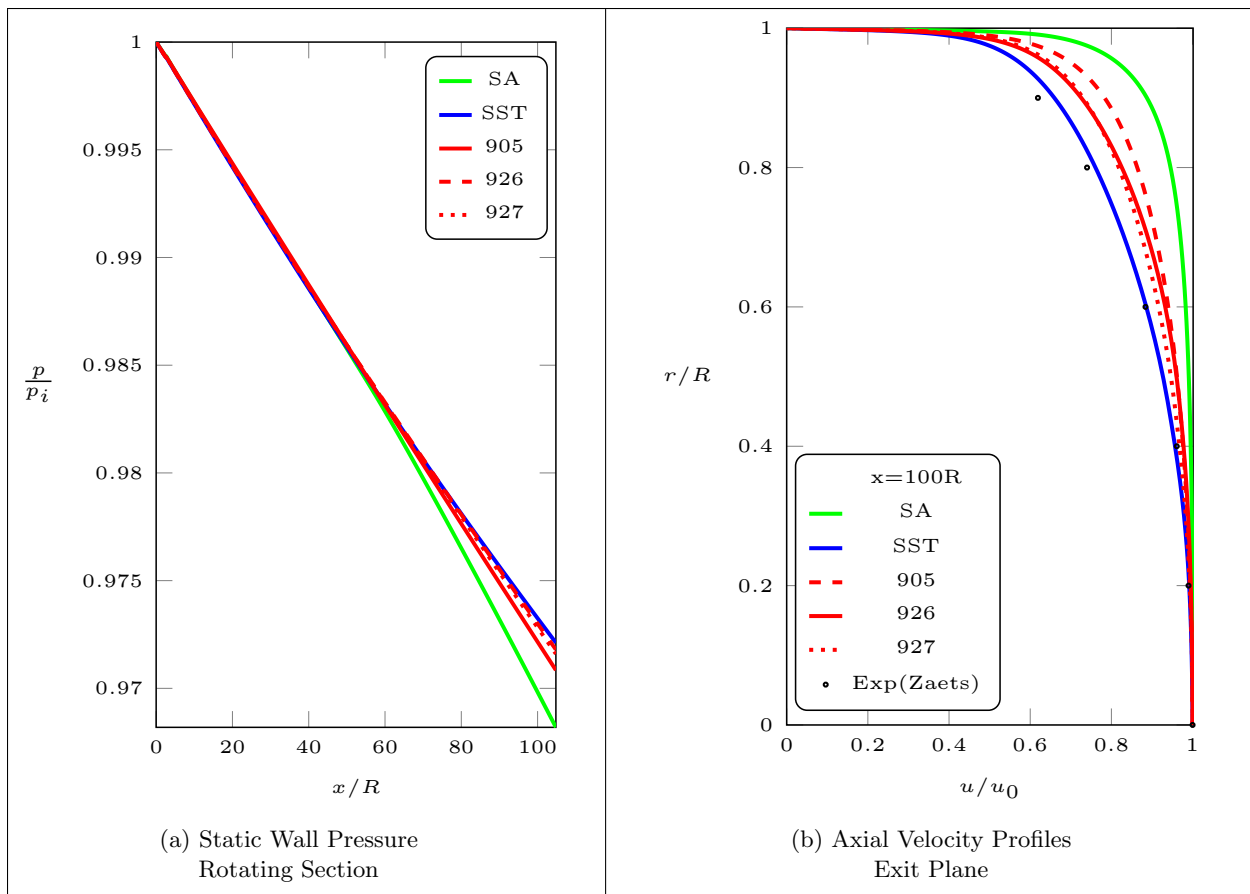*Research Scientist, NASA Ames Research Center, Associate Fellow AIAA

Figure 2: Rotating Pipe Flow Predictions for Various Turbulence Models

rotating wall section is inherently stabilizing, and lowers the turbulent intensity as the flow progresses down the rotating section.

In figure 2a, the predictions for the wall static pressure from the Spalart-Almaras turbulence model, the Menter SST model, and three Lag Reynolds-stress models[8] are compared over the rotating section of the pipe. The turbulence models give different predictions for the axial skin friction in this section of the pipe, and hence predict different wall pressure distributions. The axial velocity distribution at the exit plane of the pipe (100 radii downstream of the rotation start) shown in figure 2b show similar differences.

The final paper will have comparisons for these models and the new triple product model[9] for at least these flowfields.

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