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Experimentally Informed Turbulent Diffusivity Modeling for an Angled Jet in Cross-Flow JULIA LING, FILIPPO COLETTI, SAYURI YAPA, GIANLUCA IACCARINO, JOHN EATON, Stanford University — A key source of error in many turbulent heat transfer simulations is the modeling of the turbulent heat flux. This heat flux is often approximated using the gradient diffusion hypothesis with a fixed turbulent Prandtl number based on empirical values from simple turbulent flows. However, in more complex configurations, this model is known to be inaccurate. A methodology has been developed which uses experimental data to determine optimal uniform anisotropic turbulent diffusivity values for an angled jet in cross-flow. This configuration has applications in film cooling for gas turbine blades. The measurements, obtained by magnetic resonance imaging techniques, provide 3D time-averaged velocity and concentration fields. The mean velocity field is fed into a Reynolds-Averaged Advection Diffusion solver, which uses a spatially-uniform anisotropic turbulent diffusivity model to solve for the mean coolant concentration distribution. This distribution can be compared to the experimentally-obtained concentration field by means of an error metric that quantifies the difference between the computational and experimental concentration fields. By minimizing this error, an optimal value of the anisotropic turbulent diffusivity is determined.

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