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CFD Validation and Replication of Turbulent, Compressible Shear Layer Data[1] LUCY BROWN, KRISTEN MATSUNO, SANJIVA LELE, Stanford University — Shear layers are a phenomenon in fluid mechanics in which two flows traveling at different velocities interact to form a spatially-developing region of mixing and turbulence. Shear layers have many engineering applications, including high-speed jets and scramjet engines. As flows increase in speed, their behavior is complicated by the effects of compressibility. One key parameter in this study, the convective Mach number, is a measure of the difference in speeds of the two flows. Previously, researchers at the University of Illinois Urbana-Champaign (Kim, Elliott and Dutton, AIAA J, 2020) ran laboratory experiments of shear layers at various convective Mach numbers. My work investigates the best techniques through which we can replicate experimental results using computational fluid dynamics (CFD). Through this investigation, I validate Kim, Elliot, and Dutton's results through various measures of shear layer thickness, Reynolds stresses, and normalized velocity profiles. Additionally, my results provide insight into which turbulence models best represent compressible shear layers. Finally, I describe my CFD process from meshing to post-processing in MATLAB. Through this project, I aim to expand the literature on turbulent, compressible shear layer modeling.

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