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Investigating the Turbulence Physics of a Supercritical Carbon Dioxide Round Jet[1] JULIA REAM, Florida State University, MARC HENRY DE FRAHAN, MICHAEL MARTIN, SHASHANK YELLAPANTULA, RAY GROUT, National Renewable Energy Laboratory — In this investigation, we study Supercritical Carbon Dioxide (sCO2) jets to gain a better understanding of the underlying physics associated with supercritical fluid flow. sCO2 is a promising working fluid for advanced cycles including those for power generation (e.g., Brayton cycle) due to increased power density. Open questions remain about how the fundamental physics of these flows are impacted by non-ideal variation in the physical properties. We use a second order finite volume method with adaptive mesh refinement as implemented in the first-principles simulation code PeleC to establish the impact of a cubic equation of state on turbulent flow physics. The Soave-Redlich-Kwong equation of state is used to close the system of equations. We simulate a sCO2 turbulent round jet at 600 K and 10 MPa. We then examine velocity and Reynolds stress profiles at different downstream locations and contrast these with established theory. These conditions are above the critical point of 304.25 K and 7.39 MPa, where new insight is needed for engineering design. We then explore cases in which the temperature of the jet and that of the ambient fluid differ, capturing effects of widely varying thermal properties of supercritical fluids.

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Julia Ream
Florida State University

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