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Role of Swirl in Fuel Injection Systems SAI DARBHA, DANIEL DUKE, Laboratory for Turbulence Research in Aerospace Combustion (LTRAC), Department of Mechanical and Aerospace Engineering, Monash University, Australia, DAVID SCHMIDT, Department of Mechanical and Industrial Engineering, University of Massachusetts, Amherst MA USA — Swirl is present in multi-hole fuel injection systems, owing to flow turning a corner upstream of the injector nozzles. The role of swirl in the nozzle internal flow and on the quality of spray atomization is not fully understood. Experimental work in this area is limited by the lack of optical access due to cavitation at the nozzle injector walls. It is difficult to selectively isolate the effect of swirl in the turbulent two-phase flow in the nozzles, owing to a lack of control on the nozzle inlet conditions in an experimental setting. Therefore, computational fluid dynamics simulations are carried out in a canonical fuel injector geometry to determine the influence of swirl on nozzle internal flow. A homogeneous flow assumption is used in an open source finite volume framework for the simulations, along with URANS turbulence models. A controlled degree of swirl is implemented by varying the boundary conditions at the domain inlet. A parametric sweep of the inlet Swirl number (Sw) is carried out to determine what fundamental fluid-mechanical phenomena give rise to the various cavitation regimes such as geometric and string cavitation, and how these are manifested in fuel injection systems.

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