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Internal Flow Dynamics and Spray Characteristics in Liquid Swirl Injectors JACOB GAMERTSFELDER, PRASHANT KHARE, University of Cincinnati — The focus of this research effort is to investigate the internal flow dynamics and subsequent spray characteristics in swirling liquid fuel injectors. While significant progress has been made in the past to enhance the understanding of the internal dynamics of the vortex generator and resulting liquid sprays, limited studies exist that capture both the detailed mechanistic processes leading to swirling liquid and the resulting spray formation. This effort will fill this gap in the literature. The theoretical formulation is based on three-dimensional incompressible Navier-Stokes equations with surface tension. A volume of fluid (VOF) method is used for interface capturing. The swirl injector geometry consists of three equally spaced (at 120 degrees) tangential inlets of 1 mm diameter, a 6 mm vortex generator and a 2 mm diameter spray nozzle with a L/D ratio of 12. The operating conditions consists of a Weber number of 1556, corresponding to a flow rate of 25.51 g/s at an injector pressure of 0.579 MPa. The ambient chamber pressure and temperature are 4 MPa and 300 K, respectively. Preliminary results show that the swirl generated in the injector leads to the formation of a hollow cone spray that breaks up to form ligaments and droplets. A systematic analysis will be conducted to quantitatively identify the processes leading to the formation of liquid swirl near the injector walls, air core in the center and subsequent spray formation including droplet size distributions, breakup length and spray angles.

Jacob Gamertsfelder
University of Cincinnati

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