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Towards direct numerical simulation of pressure swirl injectors with realistic geometries MARK CZAJKOWSKI, OLIVIER DESJARDINS, Cornell University — Atomization of hydrocarbon fuels is of critical importance to the transportation sector, in particular for aircraft gas turbine engines. In this work, simulations of a Delevan pressure swirl injector with realistic geometry was investigated. Results were compared with simulations performed by Fuster et al. (Int J Multiphase Flow, 2009) of a swirl jet at lower density ratios. The pressure swirl injector is used for many applications and is a component within air-blast injectors commonly found in gas turbines and aeroengines. Direct numerical simulation of the pressure swirl injection process has the potential to provide much-needed information about the complex physics of atomization in swirling flows, but has yet to be used due to the interaction of a complex turbulent multiphase flow with complicated injector geometries. A variety of novel numerical methods are used to facilitate the numerical simulations including a conservative implementation of immersed boundaries used to represent the injector geometry, an accurate interface transport scheme with mass conservation properties based on a discontinuous Galerkin discretization of the conservative level set method, and a novel discretization of the Navier-Stokes convective term allowing for robust simulations at high density ratios. Simulations were conducted by combining the methods with a fully parallelized computational code called NGA.

Mark Czajkowski
Cornell University

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