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Multiphysics control of a two-fluid coaxial atomizer supported by electric-charge on the liquid jet NATHANAEL MACHICOANE, RODRIGO OSUNA, ALBERTO ALISEDA, University of Washington — We present an experimental setup to investigate multiphysics control strategies on atomization of a laminar fluid stream by a coaxial turbulent jet. Spray control (i.e. driving the droplet size distribution and the spatio-temporal location of the droplets towards a desired objective) has many potential engineering applications, but requires a mechanistic understanding of the processes that control droplet formation and transport (primary and secondary instabilities, turbulent transport, hydrodynamic and electric forces on the droplets, ...). We characterize experimentally the break-up dynamics in a canonical coaxial atomizer, and the spray structure (droplet size, location, and velocity as a function of time) in a series of open loop conditions with harmonic forcing of the gas swirl ratio, liquid injection rate, the electric field strength at the nozzle and along the spray development region. The effect of these actuators are characterized for different gas Reynolds numbers ranging from 10^4-10^6. This open-loop characterization of the injector will be used to develop reduced order models for feedback control, as well as to validate assumptions underlying an adjoint-based computational control strategy. This work is part of a large-scale project funded by an ONR MURI to provide fundamental understanding of the mechanisms for feedback control of sprays.

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