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Time-resolved simulations and experiments of liquid jet break-up
MARCO ARIENTI, MARIOS SOTERIOU, United Technologies Research Center, MARK SUSSMAN, Florida State University — High-speed, high-resolution experimental visualization of the break-up of a liquid jet by a gaseous cross-flow has recently become possible due to advances in video camera technology. These visualizations can now be contrasted to high fidelity CFD simulations which are also just becoming possible due to continuing growth of computational capabilities. Such a contrast is expected to go beyond traditional comparisons of time-averaged quantities and focuses on dynamics. For example, comparisons of the characteristic break-up frequency and of the spatial instantaneous features of the jet may serve as validation of the computational model and to yield insight into the physics of the dynamic interplay between the disturbances induced by the injection device and Kelvin-Helmholtz / Rayleigh-Taylor instabilities at the interface. A state-of-the-art second-order coupled Level Set and Volume Of Fluid method (CLSVOF) that can capture liquid-gas interface dynamics is used for the study. High-speed videos of non-turbulent liquid injection in laminar crossflow are used to validate the time- and grid-converged capability of the code to capture upwind wave structures caused by the centrifugal acceleration of the deflected liquid. The extension to increasing air crossflow is also discussed with focus on the column break-up mechanism.

Marios Soteriou
United Technologies Research Center

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