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DIRECT NUMERICAL SIMULATIONS OF FUEL SECONDARY ATOMIZATION

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The fragmentation of droplets due to the effects of an external flow, namely secondary atomization, is a phenomenon of great importance in various applications involving sprays: surface coatings, spraying of agrochemicals, airborne spread of pathogens, and fuel injection. In the latter case, particularly, the flow properties are particularly difficult to replicate under laboratory conditions.

In this context, Direct Numerical Simulations (DNS) can be used to complement the experimental data and perform a more in-depth analysis of the fragmentation process in those regimes where it is not possible to carry out precise measurements. In this work, we apply the Volume of Fluid (VOF) method, with Adaptive Mesh Refinement (AMR) implemented in Basilisk [1], to perform DNS of individual droplets immersed in a gas stream. We study various flow conditions related to diesel fuel injection, where the density ratio between phases is low and the Weber and Reynolds numbers are moderate.

We describe the deformation process under each regime and compare the results with predictions reported in the literature. We also analyze the fragmentation process; to reduce the impact of the numerical breakup inherent to the VOF technique, we apply the Manifold Death [2] (MD) fragmentation model. We report the effect that the Weber and Reynolds numbers have on the deformation and breakup characteristic times. We statistically describe the cloud of droplets produced by the atomization process, comparing the results with and without the MD model to assess the accuracy of the distributions predicted by the simulations.

REFERENCES

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