

Hybrid treatment of atomized droplets

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Atomization of liquid fuel has a direct impact on the production of pollutant emission in engineering propulsion devices. Due to the multiple challenges in experimental investigations, motivation for numerical study is increasing. Such numerical studies often focus on tracking liquid/gas interface until evaporation of injected liquid fuel. As the size of the droplets reduces with the primary breakup of liquid fuel, it becomes increasingly challenging to track the interface of the droplets. Our purpose is to increase the accuracy of the treatment of droplets in atomized jet.

Of the many existing interface tracking methods, Level-Set¹ and Volume of Fluid² are commonly used. The droplet tracking depends on the mesh resolution thus, an increment in the mesh resolution may solve this issue but increases the use of computational resources. To resolve this issue, adaptive mesh refinement is a feasible solution³. Due to its cost of simulation, a coupled tracking method between Eulerian and Lagrangian grid has been implemented⁴ tracking droplets with a Lagrangian Point Particle method (LPP). Hence, to ensure a smoother transition, another size of droplet transformation had been added to the Eulerian-Lagrangian coupling method⁵. Therefore, the idea of a rank scale method based on the cell number inside of a diameter to ensure an accurate tracking of each droplet has been implemented in the code and is the purpose of this communication.

The method is based on a coupled CLSVoF⁶ method with Immersed Boundary Method⁷ (IBM) and Lagrangian Point Particle. Adding the IBM to the Lagrangian tracking method increases the accuracy thanks to a conversion from Eulerian to Lagrangian for interactions size droplets. On figure 1, an overview of simulation results for shear layer validation test case is provided.

Some other validations test cases have been performed to validate the efficiency of the model. An atomized jet simulation shows the loss of numerical cost and a gain of mass conservation.



FIGURE 1 – Navy Blue : CLSVoF, Green : IBM, Red : LPP

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