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Numerical Simulation of the Primary Atomization of a Turbulent Coaxial Liquid Jet using a Conservative Level Set/Ghost Fluid Method
OLIVIER DESJARDINS, VINCENT MOUREAU, EDWARD KNUDSEN, MARCUS HERRMANN, HEINZ PITSCH, Department of Mechanical Engineering, Stanford University — The atomization of liquid flows plays an important role in many engineering applications, and yet the numerical simulation of the turbulent break-up process remains an outstanding challenge. The large density ratio between the liquid and the gas, as well as the large range of scales involved in the atomization phenomenon, render this problem especially difficult. Level set methods have often been used to represent the liquid-gas interface. However, these techniques usually suffer from poor conservation properties. Moreover, the interface typically has to be artificially spread over several computational mesh points. Here, a new method is presented in which a conservative level set approach is combined with a ghost fluid formulation. With this method, a sharp representation of the interface becomes possible, and very good conservation properties are achieved. This approach is validated on a range of test cases with realistic water-air conditions and topology changes. This technique is then used to simulate the turbulent atomization of a water round jet studied experimentally by Marmottant and Villermaux (2004). The main features of the liquid jet are compared to the experiments, and the properties of the numerical approach are discussed.

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