Modeling of Primary Spray Breakup using a Refined Level Set Grid Method

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In non-premixed combustion turbulent mixing is the rate determining process. Since in many applications fuel is supplied as a liquid the fuel concentration field in the combustion chamber in a first step mixing is controlled by the the break-up of liquid jets into spray and evaporation of the droplets. The simulation of turbulent liquid jets and sheets are a challenging task, since the liquid/gas interface exhibits a wide range of scales. In this approach, the level set method is used to track the liquid/gas interface during the primary breakup. In order to capture the transition to the secondary atomization, a sub-grid scale modeling approach is presented. Since the level set and the flow are solved on two separated grids, under-resolved liquid mass tracked on the level set grid will be transported to the flow solver grid where their further behavior is modeled as Langrangian particles from that time on. To overcome the well known problem of mass conservation using the level set approach, a Refined-Level-Set-Grid method (RLSG, Marcus Herrmann, Stanford University) is presented, where the level set equations are solved on a second grid with extensive refinement in a narrow band of the interface. Test cases highlighting the performance of the RLSG method will be discussed.