

## Simulation of a Detonation Propagation in a Two-phase Gas/liquid Cross Flow Injection

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Gaseous detonations for propulsive application or energy generation are studied around the globe with the promise to increase the engine or energy production efficiency. However, for real engine utilization where the volume and weight are limited, increasing the energy density by using liquid fuel is required. Liquid fuel detonation introduces more complications than gaseous detonation such as droplets distribution and size effects, partial evaporation, and poor oxidizer/fuel mixture. If a few simulation studies were carried out on the subject, the field still suffers a lot of unknown.

The purpose of this research is to create a simulation code to study detonation in a liquid fuel injection cross-flow for rotating detonation engine. The two-phase liquid-gas flow simulation applies an Eulerian/Eulerian approach with an adaptive mesh refinement (AMR) method to reduce the computation cost. The governing equations are the two dimensional Navier-Stokes equations with nine species mass conservation equations. The detailed chemical reaction model for hydrogen combustion is the UT-JAXA model.

For the code construction, the current condensed phase is water and the spray is represented by a single droplet size owing to the locally monodisperse formulation of the employed mesoscopic Eulerian/Eulerian approach. A quasi-steady model for one droplet surrounded by hot gas computes the evaporation. Firstly, the jet penetration and evaporation will be evaluated, and then a primary and secondary break-up model will be implemented. Particular attention is taken for the injection sub-model since it is understood to be one of the main detonation engine problems. A plain orifice injector sub-model estimates the initial bulk size and spray angle.

For the moment, the code is able to perform simulation for two-dimensional gaseous detonation in a hydrogen/oxygen or hydrogen/air cross-flow with the AMR method. A simulation campaign is carried out to set the AMR parameters such as the gradient amplitude for refinement and derefinement conditions or injectors space gap allowing the detonation propagation. Later, the simulation will be compared with the literature, and with experiments for validation.