6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11 15 June 2018, Glasgow, UK

AN EULERIAN MODEL FOR HYPERSONIC DISPERSED TWO PHASES FLOW TAKING INTO ACCOUNT DROPLET BREAK-UP

G.Marois[1], P.Villedieu[2], J.Mathiaud[1], D.Hebert[1] and J.L.Rullier[1]

[1] CEA-CESTA, Le Barp, France, gentien.marois@cea.fr
[2] INSA-TOULOUSE

Key words: *multiphase flows, gas-particle mixtures, break-up model*

Interactions between gas-particle mixtures and shock waves appear in a large range of scientific and engineering applications, from planetary explorations to motors design. Studies of gas-particle mixtures are fairly recent and complex because they involve a lot of physical phenomena. The work presented here deals with the interaction of a gas-particle mixture with a hypersonic bow shock. A new model of break-up is also described.

Particles are supposed to be at equilibrium with the gas before their interaction with the bow shock. Due to their inertia, they are in strong imbalance with the post-shock gas : they undergo a very strong drag force, an intense evaporation and catastrophic break-up.

At the droplet scale, a detached shock is created which leads to the break-up of the particle. A new model of break-up has been created based on experimental results and numerical simulations. This model takes into account three main stages, as depicted in Fig.1:

1. distortion of the mother droplet without loss of mass;
2. production of small particles striped from the mother droplet;
3. break-up of the residual droplet and production of new particles.

For the sake of numerical efficiency, the Eulerian (for the gas)-Eulerian (for particles) approach has been chosen.

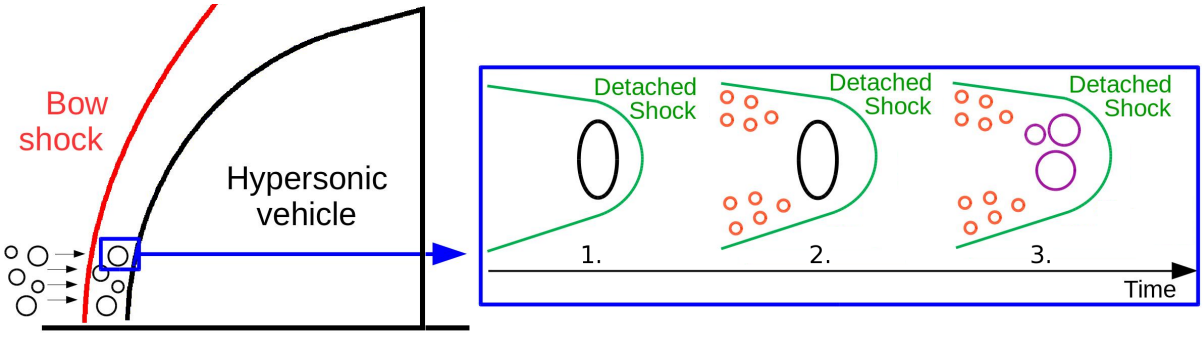

Figure 1: : Steps of break-up

The numerical procedure and its implementation in CEA CFD code have been carefully validated through a series of validation tests based on analytical solutions and Eulerian (for the gas)-Lagrangian (for particles) computations. Particle collection efficiency on a supersonic vehicle has also been calculated. The new model is compared with Reinecke's and Chauvin's ones.