

MESH ADAPTATION OF ABLATING HYPERSONIC VEHICLES

Jerome Breil^{1*}, Claire Roche¹ and Marina Olazabal¹

¹ CEA CESTA, 16 Av. des Sablières, 33114 Le Barp, jerome.breil@cea.fr

Keywords: *Adaptive mesh refinement, Mesh generation, Mesh movement, Hypersonic*

The ablation of a vehicle during atmospheric reentry leads to a degradation of its surface condition. Ablated wall interacts with the boundary layer that develops around the object. The deformation can be seen as a ripple or a roughness pattern with different characteristic amplitudes and wavelengths. The effect of this defect on the flow is taken into account either by means of modelizations or by direct simulation by applying the strains to the mesh.

Mesh adaptation techniques [1] can be used in order to take into account wall deformations during a simulation. The principle is to start from an initially smooth mesh, to apply a strain law, then to use regularization and refinement methods. The meshes will be adapted for use in a parallel CFD Navier-Stokes code. A refinement of the mesh close to the wall is required to correctly capture the boundary layer [2], but also to accurately represent the geometry of the wall deformation. For the numerical methods used, a constraint of orthogonality is added to the mesh impinging on the wall. The developments are for the moments, carried out in an independent external tool. The regularization methods are compared on results of simulations with different meshes. The method can be easily coupled with a CFD code and can be extended to 3D geometries.

REFERENCES

- [1] Yao, J. *An Efficient Line-Sweep Mesh Relaxation Method with Locally Conservative Interface Reconstruction*. Lawrence Livermore National Laboratory, (2011).
- [2] Prahladh S Iyer, Suman Muppidi and Krishman Mahesh *Boundary layer transition in high-speed flows due to roughness*. AIAA 2012-1106, (2012).