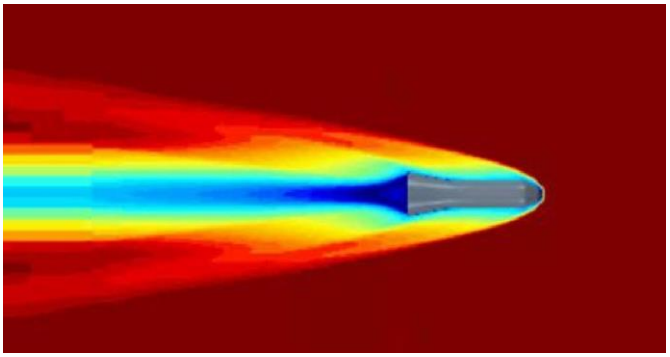
Reference sheet/Success story

Hypersonic

Study of the hypersonic flight of the NASA HB-2 model

Objective

The understanding and prediction of hypersonic phenomena is of paramount importance to the stakeholders of the space sector. Indeed, hypersonic objects are exposed to very specific conditions, such as shocks, heating and the formation of plasma. In order to obtain the most precise analyses on these complex physics, it is necessary to couple experimental wind tunnel tests and digital tests. The objective of this project is to consolidate the robustness of the digital calculation models and thus complete the analyses, especially with respect to measurements that are not experimentally accessible.



Implementation

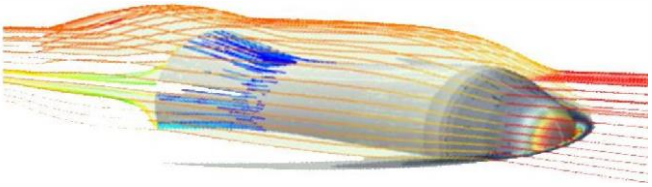
Zelin has set up a calculation process that's dedicated to model this type of flow:

- 3D geometric model of the HB-2
- Material resources: HPC Cluster (200 cores)
- Using the SIEMENS StarCCM+ and OpenFOAM software
- Some analytic examples:
  - Advanced mesh sensitivity (up to 40 million cells)
  - Use of a specifically adapted digital methodology: steady (RANS), AUSM+ scheme
  - Highlighting shocks with a schlieren-like rendering
  - Plasma modeling
  - Geometry modification by the robust multi-parameter optimization method

Result

The digital methodology implemented within the framework of this project showed results that were very close to the test results. By allowing the analysis of additional parameters that were not experimentally accessible, the project also made it possible to significantly supplement the results database associated with this case.

Thanks to the digital results, robust and innovative design improvement methods could be proposed. Moreover, by performing these virtual tests via digital computation (numerical calculation), a substantial saving was realized vis-à-vis the significantly more expensive wind tunnel tests.



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