ESTIMATION OF HEAT FLUX FOR LAUNCH VEHICLE

VERTICAL:
AEROSPACE & DEFENCE

SERVICE:
ENGINEERING SERVICES

TECHNOLOGY:
CFD

Our customer belongs to a defense establishment and is pioneering the design of vehicles flying at hypersonic speeds. These vehicles experience large aero-thermal loads, which leads to severe heating. They often require use of special material as protective coating. Selection of protective material depends on accurate estimation of heat flux. Unfortunately, apart of high fidelity CFD simulation, there is no other means to estimate the magnitude of heat flux of complex & large vehicles.

Zeus Numerix did a meticulous CFD simulation involving very refined meshes, flow resolution at hypersonic speeds & generation of heat flux data at critical locations. The stringent requirement of 1 micron near wall cell height was tackled on proprietary structured multi-block mesh generator, GridZ™, where it was achieved on a complex topology grid. Grid independence study revealed the high sensitivity of heat flux on near wall mesh refinement. Proprietary compressible solver, FlowZ™, successfully handled stiff flow physics of turbulent hypersonic regime on HPC resources from CDAC.

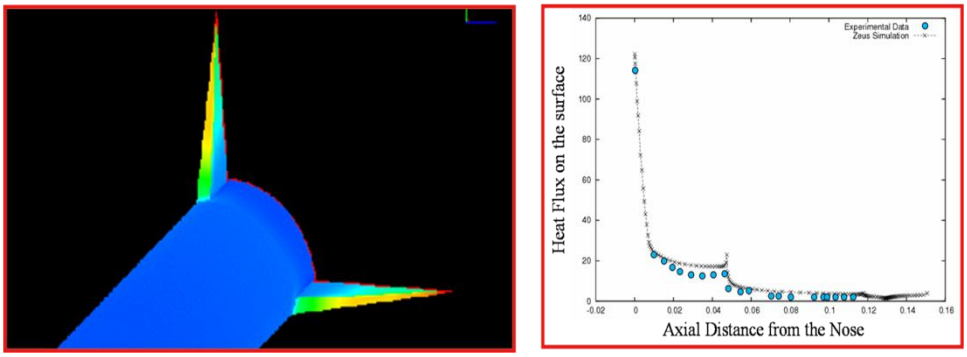

Figure 11: (a) Heat flux distribution at fin leading edge (b) Validation against experimental data

Customer was delivered the magnitude of heat flux at the nose and near the fins, the two critical regions. The major revelation from the study was that the heat flux experienced at fin leading edge is larger than that at nose tip. Study enabled customer to choose most appropriate material for protective coating.

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