NUMERICAL SIMULATIONS OF HEAT AND MASS TRANSFER AT ABLATING SURFACE IN HYPERSONIC FLOW

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In this paper numerical modeling of heat and mass transfer in 3D hypersonic flow is presented taking into account Thermal Protection System destruction.

The simulation method is based on numerical solution of three-dimensional heat equation within TPS, calculation of heat- and mass flux on the flow-wall interface, estimation of the surface recession rate, and re-shaping of both surface and interior. Ansys Fluent is used for solving the heat problem, which is capable of working on unstructured grids.

For validation of the developed method 3D unsteady numerical simulation of thermal state within a sphere-cone shaped hypersonic vehicle was carried out. Data on hypersonic flow necessary for the surface model were taken from the calculations done with JIHT RAN PlasmAero code. Unstructured tetrahedral mesh with about of 100,000 grid cells was used for this test. Time-dependent temperature and heat flux fields were calculated. As well, surface recession rate and body re-shaping was assessed in calculations.