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UNSTEADY COUPLED HEAT TRANSFER SIMULATIONS OF HYPERSONIC GAP FLOWS

Abstract

The paper focuses on the aerothermodynamic problems in the hypersonic gap flows, which widely exist in the hypersonic vehicle surfaces. Firstly an unsteady coupled heat transfer (CHT) solver, solving the compressible Navier-Stokes equations and the solid thermal conduction equations alternately, is developed with the finite difference method. Then the developed CHT solver is employed to predict the gap flows and transient heat transfer in the hypersonic flows. And the CHT solver is validated by the comparison between the numerical results and the measured ones. Finally there are unsteady coupled heat transfer simulations of hypersonic tile-to-tile gap flows. The computing domain contains the external and internal fluid flow ones and the solid ones. The distributions of the flow parameters, including pressure, velocity and temperature, and the transient wall heat flux are obtained. And the thermal response of the solid is also discussed. The results could be applied to the design of hypersonic vehicle thermal protection system.