Dipartimento Meccanica Matematica Management

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Research project

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Title: Radiation modeling for atmospheric entry flows

Description:

Numerical modeling of hypersonic flows plays a crucial role in advancing the design of spacecraft entry capsules. Entering in a planetary atmosphere, a plethora of phenomena occurs around a space vehicle, i.e., internal modes excitation, molecules dissociation, particle ionization, and radiation emission.

These elementary processes are characterized by a strong non-equilibrium thermodynamic state in the region right after the shock, being thermal and chemical relaxation times of the same order of the fluid dynamic one. Therefore, accurate prediction of flows behavior under such extreme conditions requires advanced theoretical and computational tools.

In recent years, the fluid dynamic group at Politecnico di Bari, in collaboration with CNR-ISTP, has developed a CFD solver of the Navier-Stokes equations coupled with a vibrationally and electronically resolved State-to-State approach for modeling thermochemical non-equilibrium for atmospheric entry in different planets (Earth, Mars, Ice Giants).

Under these conditions, radiative heating can become comparable to the convective one. To capture this effect, the next step will be to develop and implement a radiative model within the CFD solver. This includes the modeling of both spectral energy distribution and the transport of electromagnetic energy through the flow field. Code development will be followed by systematic verification and validation activities.

Candidates should provide detailed CV

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