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Title

Development of a photon Monte Carlo radiative heat transfer solver for CFD applications

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Abstract

Radiative heating plays an important role during atmospheric re-entry, where neglection of its effects can lead to a significant underprediction of re-entry vehicle heat loads [1]. Other aerospace domains where prediction of radiative heating can be of importance are rocket combustion [2] and high enthalpy shock tunnel experiments [3]. Photon Monte Carlo is a state of the art method for performing radiative heat transfer simulations, but the associated computational cost is high, due to the need to model the motion of a large number of computational photon particles.

In the present work, we detail the development of an efficient parallel Monte Carlo solver to be used both as an independent tool as well as in conjunction with the HyperCODA CFD code [5]. The radiative transport code is based on the open-source Direct Simulation Monte Carlo solver SPARTA [6], allowing for easy modification, extension, and interfacing with other software tools. Results of simulations for analytic test-cases and re-entry flows will be presented, along with analysis of computational performance and possibilities for further development of the code.

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