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Title

Coupling of particle and continuum methods for the simulation of radiative and particle laden flows

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Abstract

For simulation of flow conditions at high altitude, of particle-laden flows or of radiative heat transfer [1], particle-based methods are the numerical method of choice. One big challenge is to provide a coupling interface to the general numerical tool-chain to established numerical methods for the continuum regime. Ideally, this coupling is performed without the need to rely on file input and output (IO) operations as the IO bandwidth constitutes a key limiting factor on current high performance computing (HPC) systems. This contribution demonstrates an in-memory coupling interface of a state-of-the-art Direct Simulation Monte Carlo (DSMC) solver based on the open source code SPARTA [2] to the coupling software FlowSimulator DataManager (FSDM) [3]. The interface provides interpolation methods to couple with different numerical solvers usually applied within the continuum range at aircraft flow conditions.
In this contribution we describe the extension FlowSimulator Coupling Layer for SPARTA (FSClappSPARTA) which allows coupling of SPARTA to the FSDM ecosystem by means of in-memory coupling. This extends the applicability of the FSDM-based tool-chains to applications for which particle-based methods are required, e.g. particle-laden flows or radiation simulations based on a Photon Monte Carlo method [5]. We describe the coupling process of the DSMC solver Sparta to the CFD code HyperCODA [4] and vice versa. This method allows the two-way coupled simulation of particle-laden flows as well as the inclusion of radiative heat fluxes. The corresponding data fields can be exchanged between the different solvers providing input for the particle acceleration in SPARTA as well as providing source terms for the flow solver due to the presence of particles. Results of the first two-way coupled simulations will be presented as well as ideas for further development of the coupling interface.

References

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