Bachelor/Master thesis

Numerical Methods for Flow Simulations

Course of study:	Computational Engineering Science / Computer Science
Kind of thesis:	Programming and Simulation
Programming language:	C++
Start:	anytime, duration 3-6 months

Problem

Atmospheric entry is the movement of human-made objects as they enter the atmosphere of a celestial body from outer space. It is crucial for the success of the mission to accurately predict the flowfield around the space craft which is flying at a very high speed (e.g. 10km/s).

At MathCCES, we develop mathematical models for the simulation of atmospheric reentry flows. It is important to test these models against standard approaches. For this purpose, we also need to develop dedicated computational tools to solve the modelled PDEs. The goal of this thesis is to implement and test numerical methods for these kinds of flow simulations, based on an existing code project developed at MathCCES.

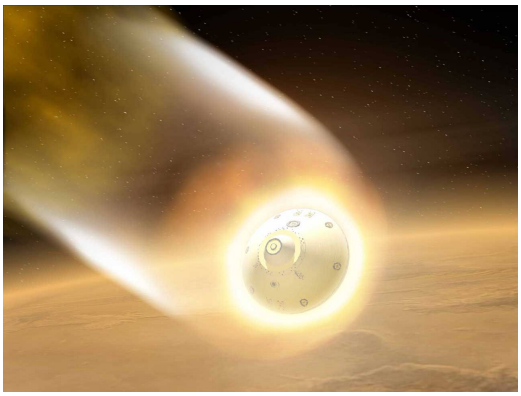

Abbildung 1: Illustration of space capsule reentry.

Preliminary work

Grid management and I/O routines are readily implemented. Furthermore, interfaces for visualization of simulation data via external tools (e.g. Paraview) are finished. First solution methods are available to enable testing.

Task

The thesis could include some of the following topics:

- high-order time discretization (e.g. Runge-Kutta methods)
- adaptive time-stepping
- error estimation
- high-order space discretization (e.g. WENO schemes)
- mesh adaptivity

Other topics related to numerics are possible (e.g. analysis and visualization of data, GUI design). The specific tasks can be discussed in agreement with supervisor and student.

Supervision

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