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Aufgabenstellung Masterarbeit für M.Sc. Aerospace Engineering
Nrupa Chandra Girish Chandra
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Studiengang: M.Sc. Aerospace Engineering

Dt. Titel: **KI Getriebene Beschleunigung von Cut-Cell Integration**
Engl. Titel **AI-Powered Acceleration of Cut-Cell Integration**

Betreuer: Prof. Dr.Ing. Martin Oberlack
Dr.-Ing. Florian Kummer
M.Sc. Matthias Rieckmann
M.Sc. Muhammed Toprak

Aufgabenstellung (Assignment):
In recent years, the Chair of Fluid Dynamics has developed a software, known as the BoSSS code, for the numerical simulation of multiphase flows with the aid of the extended discontinuous Galerkin method (XDG).
This method relies heavily on the computation of volume and surface integrals, by using numerical quadrature. As the grid in the XDG method is not adapted to incorporate the interface position (i.e., non-conforming mesh), the respective phase volumes can take arbitrary shapes in cells containing the interface. The derivation of suitable quadrature rules for these dynamically shaped phase volumes is a complex and costly procedure.
The aim of this thesis is to investigate whether it is possible to significantly accelerate the derivation of quadrature rules, or even the integration directly, with the help of machine learning methods.

The work steps are:

- Literature research on quadrature rules within cut-cell methods
- Literature research on and suitability testing of machine learning methods
- Construction of a learning and test environment for machine learning algorithms in context of cut-cell quadrature
- Training of machine learning models to compute 2D cut-cell quadrature rules
- Implementation or proof of concept of the ML tool in BoSSS and assessment of an extension to 3D quadrature rules

The thesis will be written in English. The start date for the thesis is 30 December 2024.

Darmstadt, den 25.11.2024

Prof. Dr.Ing. Martin Oberlack

Dr.-Ing. Florian Kummer

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