Universität Stuttgart

INSTITUT FÜR AERODYNAMIK UND GASDYNAMIK

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IAG

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Master Thesis

A Reinforcement Learning based Approach for the a priori Shock-Capturing in a High-Order Discontinuous Galerkin Spectral Element Scheme

The accurate simulation of smooth multiscale flow processes demands high-order methods to solve the governing PDE system. A representative of such a high-order method is the discontinuous Galerkin spectral element method (DGSEM). Despite the numerous advantages of the DGSEM in smooth regions of the solution it fails at strong discontinuities and shocks. To overcome this inherent drawback a local and low order Finite-Volume (FV) subcell scheme is used in the vicinity of strong discontinuities.
Crucial for the accurate and stable simulation of flow problems with discontinuities is the accurate and reliable recognition of the troubled cells where the FV scheme has to be applied. Numerous indicators have been developed to handle this task. However, they often require empirical parameter tuning to the specific discretization and problem.
Therefore, this thesis aims on the development of a new indicator based on deep learning and reinforcement learning techniques. The major goal is the development of an indicator which ensures a stable simulation and is generally applicable to different problems and resolutions. Dependent on the progress, a more sophisticated indicator will be developed which avoids non-physical oscillations.

Work Packages

- Literature study
- Development and implementation of a deep learning based reinforcement learning framework for shock-capturing
- Validation of the proposed framework in 1D and 2D.

Prerequisites:

- Basic knowledge in Linux, Fortran, Python
- Knowledge in numerical methods for partial differential equations
- Self-reliant, strong interest in (Fortran and Python) code development

Advisors: Msc. A. Schwarz, Msc. J. Keim, C.-D. Munz

Starting Date: as soon as possible

Auf das “Merkblatt f ür die Anfertigung von Bachelor- und Masterarbeiten” wird hingewiesen.