Universität Stuttgart

INSTITUT FÜR AERODYNAMIK UND GASDYNAMIK

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IAG

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Master Thesis

A Reinforcement Learning Based Artificial Viscosity Approach for the Discontinuous Galerkin Spectral Element Method

The accurate simulation of smooth multiscale flow requires 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 numerical viscosity is locally applied in the vicinity of strong discontinuities.

For the accurate and stable simulation of flow problems with discontinuities, the reliable recognition of the troubled cells is crucial. 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, reinforcement learning techniques and a recently proposed DG-FV blending approach. The major goal is the development of an a priori indicator with the properties of an a posteriori indicator to ensure a stable simulation. This indicator has to be generally applicable to different problems and resolutions.

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

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

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Auf das "Merkblatt für die Anfertigung von Bachelor- und Masterarbeiten" wird hingewiesen.