Karlsruher Institut für Technologie

Master's Thesis

Using Machine Learning to Discover Limiter Functions

Courses: Mathematics, Computer Science, Physics

Topic

The standard high-order numerical methods for hyperbolic conservation laws require the choice of a so-called limiter function $\phi : \mathbb{R} \to \mathbb{R}$. This function is not arbitrary, but many choices exist (superbee, van Leer, minmod limiter, ...). The high-order numerical methods converge but at finite resolution the choice of the limiter function influences the numerical solution, sometimes quite strongly.
Limiter functions are chosen according to several criteria, among them high order for smooth solutions and total variation boundedness, i.e. little oscillations at discontinuities in the solution.

Task

The task of this thesis project is to investigate, whether new, optimal limiter functions can be discovered using machine learning. To this end, several questions need to be answered:

- How to formulate the optimality of a limiter function in the context of machine learning?
- How to sample sets of problems?
- How to evaluate the quality of a solution?
- How to implement the process efficiently?
- Can clustering algorithms be used to discover new limiters?

The thesis can focus on a subset of these questions.

Contact

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