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# Data-Driven Shock Capturing for the Discontinuous Galerkin Spectral Element Method

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Strong gradients in the solution are a frequently phenomenon observed in many compressible flow applications. In physical terms, these discontinuities are typically called shocks. Since they are confined to a small region with a very steep gradient, they pose severe difficulties for standard numerical simulation tools, which in some way rely on classical smoothness assumptions. Especially for high order methods, these shocks trigger Gibb's oscillations which lead to instabilities. In order to suppress those instabilities, stabilization techniques must be applied locally. Ideally, these stabilization techniques are tailored to the shock structure.

In [1], a data-driven indicator has been introduced that localizes shock structures within high-order elements of a discontinuous Galerkin method. The indicator is learned via a supervised learning strategy from analytical functions. Inspired by edge detection from image analysis, a convolutional network is used for this task. With the information about the shock localization on a sub-cell level, a shock-tailored artificial viscosity method can be introduced [2]. We use radial basis function interpolation to construct a shock-aligned, high order smooth artificial viscosity field. It is shown that such a high order smooth artificial viscosity field is superior to standard piecewise linear approaches.

In this talk, the shock indicator and the novel artificial viscosity method are presented. Moreover, we will show applications to complex multi-dimensional flow problems and recent developments towards a reinforcement learning strategy for discretization-aware shock capturing.

## REFERENCES

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