

# Entropy Viscosity Schemes

Bachelor/Master Thesis

## Project description

Solving systems of nonlinear hyperbolic equations is very challenging, because the solution can develop discontinuities (shocks) in finite time. This requires a stabilization of the numerical method, which is usually achieved by adding a sufficient amount of numerical viscosity. This, however, becomes difficult for higher-order schemes, which rely on an engineering fix (limiters).

Recently, an alternative methodology has been proposed. Starting from any scheme (even a naive unstable scheme), one adds sufficient viscosity so as to satisfy the entropy dissipation inequality at shocks.

The task in this project is to implement, test, and possibly to extend this methodology.

## Tasks

- Implement entropy viscosity method for 1D scalar conservation laws
- Perform tests. Study different methods and tuning parameters
- Extend to systems and/or multiple dimensions
- Investigate non-conservative systems

## Prerequisites

- Course Partial Differential Equations (CES) or similar
- Programming skills in MATLAB

## Literature

- J.-L. Guermond, R. Pasquetti, B. Popov: *Entropy viscosity method for nonlinear conservation laws*, *J. Comput. Phys.* 230 (2011) 4248-4267.

## Contact

Prof. Dr. Martin Frank  
Mathematics (CCES)  
Email: frank@mathcces.rwth-aachen.de