ISU Miller Lecture Presents

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High Resolution Methods for Time Dependent Problems with Piecewise Smooth Solutions

Lecture 4--5pm in Carver 408, Iowa State University Campus
Refreshments will be served in Carver 404, 3:30--4:00pm and after the lecture

Friday, April 25

Lecture Abstract

A trademark of nonlinear, time-dependent, convection-dominated problems is the spontaneous formation of non-smooth macro-scale features, like shock discontinuities and non-differentiable kinks, which pose a challenge for high-resolution computations. We overview recent developments of modern computational methods for the approximate solution of such problems. In these computations, one seeks piecewise smooth solutions which are realized by finite dimensional projections. Computational methods in this context can be classified into two main categories, of local and global methods. Local methods are expressed in terms of point-values(-Hamilton-Jacobi equations), cell averages (-nonlinear conservation laws), or higher localized moments. Global methods are expressed in terms of global basis functions.

High resolution central schemes will be discussed as a prototype example for local methods. The family of central schemes offers high-resolution `black-box-solvers' to an impressive range of such nonlinear problems. The main ingredients here are detection of spurious extreme values, non-oscillatory reconstruction in the directions of smoothness, numerical dissipation and quadrature rules. Adaptive spectral viscosity will be discussed as an example for high-resolution global methods. The main ingredients here are detection of edges from spectral data, separation of scales, adaptive reconstruction, and spectral viscosity.

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