

High-Order Summation-by-Parts Finite Difference Methods: Theory and Application

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In this series of lectures we will introduce the concept of high-order summation-by-parts (SBP) finite difference methods developed during the past 15 years.

The topics are:

1. A short review on high-order finite difference methods:
 - Well-posedness of partial differential equations (PDE)
 - Numerical PDE: Consistency, Stability, Convergency and Phase Error Analysis
2. SBP Difference operators for approximating $\frac{d}{dx}$ in wave problems
 - Low-order methods for wave equations
 - Penalty methodology for imposing boundary conditions
 - High-order methods for wave equations
3. Runge-Kutta (RK) Methods:
 - Classical Methods
 - Low-storage methods
 - m -stage m -th order strong-stability-preserving (SSP) RK
 - Accuracy issues related to imposing time-explicit boundary conditions
4. SBP Difference Operators for $\frac{d^2}{dx^2}$
 - Schemes for solving heat equations
 - Artificial viscosity
5. High-order SBP schemes for system of wave equations
6. Discussion