Bernoullis Tafelrunde

Graduate Student Seminar

Wednesday, 17 June, 12:15-13:00
Seminarraum 05.002, Spiegelgasse 5

Martin Almquist

Uppsala University

High-Order Accurate Energy-Stable Finite Difference Methods

Abstract

Simulating wave phenomena is fundamentally important in acoustics, electromagnetics, and fluid mechanics. These phenomena are often modelled by time-dependent partial differential equations (PDEs). Solving wave-propagation PDEs efficiently requires numerical techniques capable of accurately propagating disturbances over long distances. High-order finite difference methods (HOFDMs) are well suited for problems of this type. However, not all high-order spatial discretizations are applicable. Some schemes, although stable in the classical sense, may exhibit nonphysical solution growth in time, thereby limiting their efficiency for long-time simulations. Thus, it is important to use HOFDMs that do not allow nonphyiscal growth in time?a property termed time stability.

The SBP-SAT technique leads to provably time-stable HOFDMs. By combining summation-by-parts (SBP) operators and boundary conditions imposed by the simultaneous approximation term (SAT) method, it is possible to derive an energy estimate for the discrete solution, which mimics the energy estimate satisfied by the continuous PDE.