



# Lothar-Collatz-Kolloquium für Angewandte Mathematik

## Donnerstag, den 03. Juli 2025, um 17:15 Uhr, im Hörsaal 5

### Prof. Dr. Andrew Winters\*

(Linköping University, Sweden, Department of Mathematics)

## "Waves, math, and computers - how we model our world"

### Zusammenfassung/Abstract:

Waves are ubiquitous in science, engineering, and daily life. They appear in technologies like radio and ultrasound imaging, in the design of cars and airplanes, in natural phenomena such as river currents and ocean tides, and even in the study of stars and galaxies. Understanding waves is essential to how we explore and interact with the world. Traditionally, their behavior is described by physical laws, which are grounded in observation and experiment.

Applied and computational mathematicians translate these physical laws into mathematical language, creating models that predict how waves behave across space and time. However, these models are often too complex to solve by hand or using standard analytical tools. In many cases, physical experiments are impractical - too expensive, dangerous, or impossible. As a result, researchers rely on powerful computing tools to simulate wave behavior numerically.

This lecture explores how mathematics and scientific computing come together to approximate solutions to wave-related problems. We emphasize that converting mathematical models into computer-executable code is a subtle and delicate task. It requires preserving the essential physical features of waves to ensure that simulations remain realistic and meaningful. To achieve this, we introduce specialized algorithms and mathematical techniques designed to respect the underlying physics. These methods form the foundation of modern, high-accuracy computational tools capable of tracking wave behavior over large distances and long time scales.

Finally, we demonstrate how physical insight, mathematical formulation, and computational implementation combine to produce reliable simulations, with applications spanning many areas of the natural sciences.

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