MAX-PLANCK-INSTITUT
FÜR DYNAMIK KOMPLEXER
TECHNISCHER SYSTEME
MAGDEBURG

CSC Seminar

SPEAKER

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TITLE

Towards learning energy-preserving integrators using symplectic neural networks

ABSTRACT

Symplectic integrtation techniques, i.e. symplectic Runge-Kutta methods, are known to be an important tool for solving Hamiltonian systems. Given a known Hamiltonian H, they can make accurate long term predictions. If no special structure of the Hamiltonian is assumed, symplectic Runge-Kutta methods are implicit schemes, i.e. every step requires the solution of possibly multiple non-linear equations. To speed up these predictions, we want to learn explicit symplectic integrators using neural networks that are symplectic by design (SympNets).

Since the true flow of any Hamiltonian system preserves the corresponding Hamiltonian, energy-preservation is a very desirable property for any integration technique that one wants to use on Hamiltonian systems. But in 1988 Ge Zhong showed that any algorithm that is symplectic and preserves the Hamiltonian exactly is the flow of the systems up to time reparametrization. So there is no hope for finding a neural network architecture (or any other algorithm) that is both energy-preserving and symplectic by design. In this talk we want to discuss how one can still make use of Zhong's result to learn strongly symplectic and weakly energy preserving integrators in an (almost) unsupervised manner.

Tuesday, March 4, 2025 at 2 pm

seminar room Prigogine