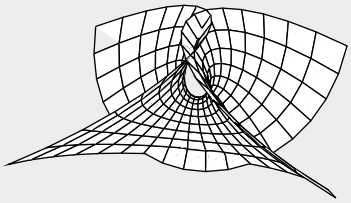

Oberseminar Mathematische Strömungsmechanik

Institut für Mathematik der Julius-Maximilians-Universität Würzburg

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The Vlasov equation, convergence theory, and the effectiveness of conservative methods

Abstract:

Classic convergence theory tells us that we can make the error of a numerical method arbitrarily small by increasing the number of grid points and time steps. However, this viewpoint is only useful if we can afford the computational cost required to reduce the error below the desired tolerance. A six-dimensional Vlasov equation discretized using 200 grid points in each direction, for example, requires at least one petabyte of memory (even more for implicit methods). Clearly, this is not feasible except perhaps on the largest supercomputers in the world. Thus, in many situations we are forced to operate far away from the asymptotic regime where classic convergence theory applies. It is perhaps surprising that even in this case we often are able to produce simulations that faithfully describe the physical behavior of the problem at hand, even though the point-wise error measured in any given norm is large.

A crucial building block to make this possible are so-called conservative methods. These methods built some of the underlying physics (i.e. certain properties of the partial differential equation) directly into the numerical scheme. For example, one can construct numerical methods that conserve certain invariants such as mass or energy. We will show that conservative methods often work significantly better compared to traditional methods.

room 40.03.003 (Emil Fischer Str. 40)

Wednesday, Jan. 15, 2025 at 12:30 pm

Zu diesem Vortrag sind Sie herzlich eingeladen.

gez. Christian Klingenberg