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SEMINÁRIOS DE ANÁLISE

Dia 07 de Fevereiro (quinta-feira), às 16h, na Sala B3-01

Finite volume methods for partial differential equations with intrinsic constraints

(Joint work with Manuel Torrilhon, Princeton University and Michel Fey, ETH Zurich)

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Abstract:

Many partial differential equations describing evolutions have solutions which satisfy an intrinsic constraint.

Examples are the Maxwell Equations, ideal MHD equations, nonlinear system for the wave equation, Einsteins Equations. Numerical schemes for such equations often freeze the transport velocity locally in time and use a scheme to perform a linear transport in each step. In order to design schemes for evolutions with inherent constraints we consider in addition to the well known linear transport equation two special linear transport equations, each satisfying an inherent condition. In one, the divergence of the transported quantity is constant, in the other the curl stays constant. As an example we mention the ideal MHD equations where the divergence of the magnetic field stays constant and the field equations in the elasticity theory, where the curl of the deformations stays constant.

A general framework allows toconstruct numerical methods that preserve exactly the discretized constraint on arbitrary grids by special fluxdistributions. Assuming at first in two space dimensions a rectangular grid numerical upwind schemes are developed. It turns out that there is a duality between the equations preserving the divergence and the ones preserving
the curl. Applications to the MHD equation are presented.

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