

Mathematics Colloquium at IUB

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(Caltech)

will speak on

Discrete Simplicial Fluid Simulation

Date: Monday, October 9, 2006

Time: 17:15

Place: Lecture Hall Research II, IUB

Abstract:

In this talk I will introduce an algorithm for the numerical simulation of incompressible fluid dynamics (Euler as well as Navier-Stokes) based on the machinery of Discrete Exterior Calculus (DEC). DEC aims to develop formal and computational machinery which mimics smooth exterior calculus in the setting of simplicial complexes. The starting point is a general tetrahedral mesh which represents a domain of computation in 3D. The role of exterior forms (and the entire machinery of vector calculus) is played by discrete quantities on all simplices (vertices, edges, triangles, and tetrahedra) while the differential becomes the adjoint of the (simplicial) boundary operator. In this setting it becomes straightforward to ensure that various identities of vector calculus, for example, are exactly preserved rather than only approximated in the infinitesimal limit. In the case of Euler fluids, for example, we show that it is easy to ensure that the discrete circulation is a conserved quantity of the simulation as is the case in the smooth setting (Kelvin's circulation theorem).

The majority of the talk will focus on DEC and how this machinery is developed from very basic principles. No prior familiarity with the subject is assumed. Fluid simulation will serve as an example of how this machinery can then be put to work for significant partial differential equations of broad interest.

Colloquium Tea at ca. 16:45 in the Tea Room of Research II, close to the lecture hall. Everybody is welcome!

M. STOLL