IUB International University Bremen

Mathematics Colloquium at IUB

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will speak on

Computational Dynamics via Set Oriented Numerics – from Transport Phenomena to Multiobjective Optimization

Date:	**Monday, October 31, 2005**
Time:	**17:15**
Place:	**Lecture Hall Research II, IUB**

Abstract:

Over the last years so-called *set oriented* numerical methods have been developed in the context of the numerical treatment of dynamical systems. The basic idea is to cover the objects of interest – for instance *invariant manifolds* or *invariant measures* – by outer approximations which are created via adaptive multilevel subdivision techniques. These schemes allow for an extremely memory and time efficient discretization of the phase space and have the flexibility to be applied to several problem types.

In this talk we will show that set oriented techniques can particularly be useful for the approximation of *transport processes* which play an important role in many real world phenomena. We will mainly focus on two related applications: first we analyze the transport of asteroids in the solar system – this work is particularly motivated by the explanation of the existence of the asteroid belt between Mars and Jupiter. Secondly we show how to analyze transport phenomena in ocean dynamics. Here the related mathematical models depend explicitly on time and this makes the numerical treatment inherently more difficult. However, we will demonstrate the strength of an appropriate set oriented approach by a study of transport in Monterey Bay which is based on real data.

In addition we will illustrate how to make use of these set oriented numerical techniques for the solution of *multiobjective optimization problems*. In these problems several objective functions have to be optimized at the same time. For instance, for a perfect economical production plan one wants to simultaneously *minimize cost* and *maximize quality*. As indicated by this example the different objectives typically contradict each other and therefore certainly do not have identical optima. Thus, the question arises how to approximate the "optimal compromises" which, in mathematical terms, define the so-called *Pareto set*. In order to make our set oriented numerical methods applicable we will first construct a dynamical system which possesses the Pareto set as an attractor. In a second step we will develop appropriate step size strategies. The corresponding techniques are applied to the optimization of an active suspension system for cars.

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

M. STOLL