Focus Seminar on Conservation Laws
17.03.16, Seminarraum 7.122

14:00 Prof. Dr. Raimund Bürger (Universidad de Concepción, Chile)
A random sampling approach for a family of Temple-class systems of conservation laws

15:00 Rafael Monteiro (Indiana University, USA)
Transverse steady bifurcation of viscous shock solutions of a system of parabolic conservation laws

Alle Interessenten sind herzlich eingeladen!
A random sampling approach for a family of Temple-class systems of conservation laws

Abstract: Several applications, including the Aw-Rascle-Zhang traffic model and a model of sedimentation of small particles in a viscous fluid, give rise to nonlinear 2 times 2 systems of conservation laws that are governed by a single scalar system velocity, which is associated to a scalar flux function. Such systems are of the Temple class since rarefaction wave curves and Hugoniot curves coincide. Moreover, one characteristic field is genuinely nonlinear (with the exception of a manifold of inflection points of the scalar flux function) and the other is linearly degenerate. For systems of this family, there are two well-known problems. The vacuum state, which may form naturally even from positive initial data, gives rise to potential problems of non-uniqueness and instability. This is resolved by the introduction of two alternative solution concepts of the Riemann problem. The other problem are spurious oscillations produced by Godunov’s method near contact discontinuities. This behaviour actually arises with many standard conservative schemes since the numerical solution invariably leaves the invariant region of the exact solution. It is demonstrated that a strategy consisting of alternating between averaging (Av) and remap steps similar to the approach by C. Chalons and P. Goatin [Commun. Math. Sci. 5:533-551, 2007] generates numerical solutions that satisfy an invariant region property (in contrast to, for instance, Godunov’s method). For the case that the remap step is done by random sampling (RS), techniques due to J. Glimm [Comm. Pure Appl. Math. 18(4):697-715, 1965], R. J. LeVeque and B. Temple [Trans. Amer. Math. Soc. 288(1):115-123, 1985] are combined to prove that the resulting statistically conservative Av-RS scheme converges to a weak solution. Numerical examples illustrate the performance of the Av-RS scheme, and its superiority over Godunov’s method in terms of accuracy and resolution. This presentation is based on joint work with Fernando Betancourt (Concepción), Christophe Chalons (Versailles, France), and Stefan Diehl and Sebastian Farás (Lund, Sweden).
Rafael Monteiro (Indiana University, USA)

Transverse steady bifurcation of viscous shock solutions of a system of parabolic conservation laws

Abstract: I will describe how a recent proof of instability of inviscid slow shocks in magneto hydrodynamics (MHD) motivated an analytical study of the existence of nonplanar viscous shocks and also an extensive numerical study (in joint work with Kevin Zumbrun and Blake Barker) of transitions to instability for viscous multi-D MHD.

The talk will focus on nonlinear, steady, bifurcations for a class of strict parabolic models that features O(2) symmetry in a strip. The applications in mind are “cellular instabilities” occurring in detonation and MHD. Curiously, a similar phenomena in MHD was observed by astrophysicists in late 90’s through numerical studies of slow shocks in white dwarf stars.

Time permitting, I will also show further results on instabilities in MHD that involve both numerical and analytical techniques.