Department of Mathematics

University of Houston

Scientific Computing Seminar

Prof. Rémi Abgrall
Institute of Mathematics & Institute of Computational Sciences
University of Zurich

Some considerations about conservation in numerical schemes

Thursday, November 8, 2018
1:30 PM- 2:30 PM
Room 646 PGH

Abstract: In this talk, I will start by revisiting the celebrated Lax Wendroff theorem that states that schemes in conservation form are the right candidate for the numerical approximation of conservation law.

In the multidimensional case, there is however more flexibility, since, in the conservation law:

$$u_t + \text{div } f(u) = 0, f = (f^{(1)}, \cdots, f^{(d)})$$

one can also exploit the intrinsic nature of the divergence operator: of course it is the sum of the partial derivative $f^{(j)}_{x_j}$, it is mainly the trace of the gradient of the tensor f.

In this talk I will describe another way to translate conservation, and the 1D Lax Wendroff case is a particular case of, as well as the multidimensional versions, see [1]. Under standard assumptions, it is possible to show that numerical solutions will converge to a weak one.

Going further, I will also show how one can exploit this remark to incorporate additional conservation laws. For example, one can construct systematically numerical approximation that are also entropy conservative, or entropy dissipative with a controlable dissipation of entropy [5]. One can also exploit this idea to construct numerical schemes that are locally conservative, though one is directly integrating a non conservative version of: this has been exploited in Lagrangian hydrodynamics with S. Tokareva [3], but also in the Eulerian setting with P. Bacigaluppi and S. Tokareva [2]. This idea can also be exploited to construct schemes that locally preserve the kinetic momentum [4], etc

• This is a joint work with P. Bacigaluppi, Maria Han Veiga (both at University of Zurich) and S. Tokareva (LANL)

References:

1 R. Abgrall, Some remarks about conservation for residual distribution schemes, Computational Methods in Applied Mathematics, vol 18(3), pp 327-35, 2018.

2 R. Abgrall, P. Bacigaluppi and S. Tokareva, A high-order nonconservative approach for hyperbolic equations in fluid dynamics, Computers and Fluids, vol 169, pages 10-22, 2018

3 R. Abgrall and S. Tokareva, Staggered grid residual distribution scheme for Lagrangian hydrodynamics, SIAM J. Scientific Computing, 39(5), A2317-A2344, 2017

4 R. Abgrall and M.H. Veiga: A technique to locally conserve kinetic momentum in compressible flow approximation, in preparation

5 R. Abgrall, A general framework to construct schemes satisfying additional conservation relations, application to entropy conservative and entropy dissipative schemes, J. Comput. Phys, vol 372(1), 2018

This seminar is easily accessible to persons with disabilities. For more information or for assistance, please contact the Mathematics Department at 743-3500.