

ACMS Applied Math Seminar

Dinshaw Balsara

University of Notre Dame

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154 Hurley Hall

3:30 PM – 4:30 PM



General Purpose Alternative Finite Difference WENO (AFD-WENO) for Conservative Systems and Systems with Non-Conservative Products

In their landmark sequence of papers (Shu and Osher 1988, 1989) the authors presented two highly efficient finite difference WENO schemes. The latter finite difference WENO scheme (Shu and Osher 1989) has become wildly successful and garnered thousands of citations. We call that the FD-WENO scheme. However, in Shu and Osher (1988) they also presented an alternative finite difference WENO (AFD-WENO) scheme which was slower to catch on. We explain why that scheme was slower to catch on – it is because all ingredients that are needed to make a production code out of AFD-WENO were not available at that time. Besides, the scheme was not easy to understand at the time of its initial presentation. We demystify the AFD-WENO algorithm in this talk.

In this talk we explain why the AFD-WENO scheme, nevertheless, had several significant advantages, if it could be developed into an automated algorithm for production codes. This talk is devoted to developing AFD-WENO into a simple algorithm that is easily explained to others and also easily implemented in production codes. To reach that goal, we had to make several algorithmic innovations which we explain here.

The original FD-WENO schemes were also only viable for conservation laws. But the field has moved on and it is very normal for scientists and engineers to discover hyperbolic PDE systems that have non-conservative products, often with stiff source terms. To accommodate such PDE systems, we present the first of its kind AFD-WENO scheme that can retain strict conservation when the PDE is conservative, and yet, accommodate non-conservative products. This vastly expands the class of PDEs that can be treated with AFD-WENO schemes. Several examples are demonstrated in this talk.

The Department of Applied and Computational
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