11th. World Congress on Computational Mechanics (WCCM XI)
5th. European Conference on Computational Mechanics (ECCM V)
6th. European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

# 2D HIGH-ORDER REMAPPING USING MOOD PARADIGMS

**R. Loubère[1], M. Kuchařík[2] and Steven Diot[3]**

[1] Institut de Mathématiques de Toulouse, CNRS, Université de Toulouse, France (raphael.loubere@math.univ-toulouse.fr)
[2] Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Czech Republic (kucharik@newton.fjfi.cvut.cz)
[3] Los Alamos National Laboratory, Fluid Dynamics and Solid Mechanics (T-3), Los Alamos, NM, U.S.A (diot@lanl.gov)

**Key words:** *high-order remapping; MOOD paradigm; shock hydrodynamics; ALE methods; .*

In this work we will show how to adapt the MOOD paradigms (Multidimensional Optimal Order Detection) from [1, 2, 3] to build a genuinely very high-order remapping method.

MOOD method is based on two tools: (i) a high-order piece-wise polynomial reconstruction operator, say from degree 1 to 5, and (ii) a Detection criteria (positivity, maximum principle, physical admissibility, etc.) to state if a numerical solution is eligible.
This new remapping method works on general polygonal/polyhedral grids. First, the remap uses unlimited polynomial reconstruction of current fluid quantities. Second, a sweep over cells does detect which ones are acceptable according to the set of criteria from (ii) and which ones are to be recomputed with a lower order polynomial. Then invalid cells are recomputed with a lower degree polynomial (as well as their direct neighbors). Next, they are further checked for eligibility and so on.

In the worst case all cells are updated with a first-order (piece-wise constant) robust and stable scheme. Very often, the high-order polynomials can be used in most cells. Specific smoothness detectors as in [1, 2, 3] are employed to distinguish between numerical smooth and non-smooth extrema. One key point of the MOOD method is the set of detection criteria which almost entirely defines which properties should fulfill a good numerical solution. As such, this drives the method to find such an approaching numerical solution.

We will present 1D and 2D numerical examples to show the features of our high-order remapping scheme. The effective high-order of accuracy will be assessed on smooth problems (up to sixth order of accuracy). Comparison to classical remapping methods on non smooth problems will also be presented. Possibly hydrodynamics examples in a Lagrange + Remap context will be presented.

## REFERENCES

[1] S. Clain and S. Diot and R. Loubère. “A high-order finite volume method for hyperbolic systems: Multi-dimensional Optimal Order Detection (MOOD).” *J. Comput. Phys.*, 230(10), pp. 4028–4050, 10 2011.

[2] S. Diot and S. Clain and R. Loubère. “Improved detection criteria for the multi-dimensional optimal order detection (MOOD) on unstructured meshes with very high-order polynomials.” *Computer and Fluids*, 64, pp. 43–63, 2012.

[3] R. Loubère and S. Clain and S. Diot. “The MOOD method in the three-dimensional case: Very- high-order finite volume method for hyperbolic systems.” *Int. J. Numer. Meth. Fluid*, 2013, accepted.