A posteriori cures of inherent numerical issues generated by high accurate schemes

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Solving a system of PDEs with a high accurate numerical scheme is usually well achieved if the solution is extremely regular. Unfortunately, in the case of an hyperbolic system of in presence of source terms or steep gradients, this assumption is often violated. Then "high accuracy" (for smooth solutions) often leads to "high troubles" close to irregular ones, generation of Gibbs phenomena, oscillations, lacks of admissibility, NaN (Not-a-Number) and ultimately code crash.

Therefore most high accurate numerical methods (FV, DG, FD, FE...) add some sort of artificial dissipation to avoid those phenomena. Then the tricky questions to answer are: where? and how much?

In this talk we will propose a solution for FV and DG based on an 'a posteriori' check of the solution and a recomputation with more dissipative schemes up to the validity of the numerical solution. The technique is based on three ingredients: a robust and trustable (parachute) scheme, an ordered cascade of numerical schemes to test successively and a Detection procedure to (in)validate a candidate numerical solution.

In this talk we will review the general idea and present several contexts of use by different groups of researchers.