Title: Saving computational costs with efficient iterative ADER methods: p-adaptivity, accuracy results and structure preserving limiters

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Abstract: Hyperbolic solvers with arbitrarily high order of accuracy are widely used in scientific simulations, but they often come with a high computational cost. In this study, we introduce a modification to the ADER (Arbitrary DERivative) and Deferred Correction (DeC) methods that can save up to half of the computational cost, without sacrificing accuracy. By iteratively increasing the degree of solution reconstruction, our modification provides a natural framework for introducing p-adaptivity in the method, allowing users to adjust the accuracy level according to their goals, cell by cell. Additionally, our approach enables the preservation of solution properties such as positivity, local maximum principle or entropy inequalities, with a very efficient *a posteriori* limiter.

We demonstrate the effectiveness of our method through results applied on ADER-DG and ADER-FV, using the Discrete Optimally increasing Order Method (DOOM) limiter to preserve positivity of density and pressure for compressible Euler and Navier-Stokes equations. Our approach offers a significant computational advantage compared to classical ADER methods, with minimal impact on the accuracy achieved.

References:

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