# Metric-based adaptive mesh refinement and flux error in CFD problems IX International Conference on Adaptive Modeling and Simulation – AD-MOS 2021

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## ABSTRACT

The present conference paper discusses a new adaptive mesh refinement (AMR) method implemented in our in-house open-source solver Basilisk [2]. The solver uses a cell-centered volume of fluid (VOF) approach [5] for the numerical résolution on isotropic octree/quadtree meshes. The current AMR method is meant to improve the accuracy of resolution namely when dealing with multi-scale problems with or w/o singularities or multi-phase flows [4].

The novel AMR approach uses a metric-based error estimation of the linear interpolation error for some field [1] and a flux error involving the model equation without the use of a dual problem. This metric-based approach has been compared with the wavelet-based AMR implemented in Basilisk [3].

In order to assess the efficiency of our new AMR approach, we test the performance of the method for the reaction-diffusion equation. In particular, we use a multi-scale problem with known solution composed of a high amplitude and high frequency oscillation and several low amplitude and low frequency oscillations (Figure 1). This problem, while simple, is shown to be a challenging test case to evaluate the performance of AMR methods.

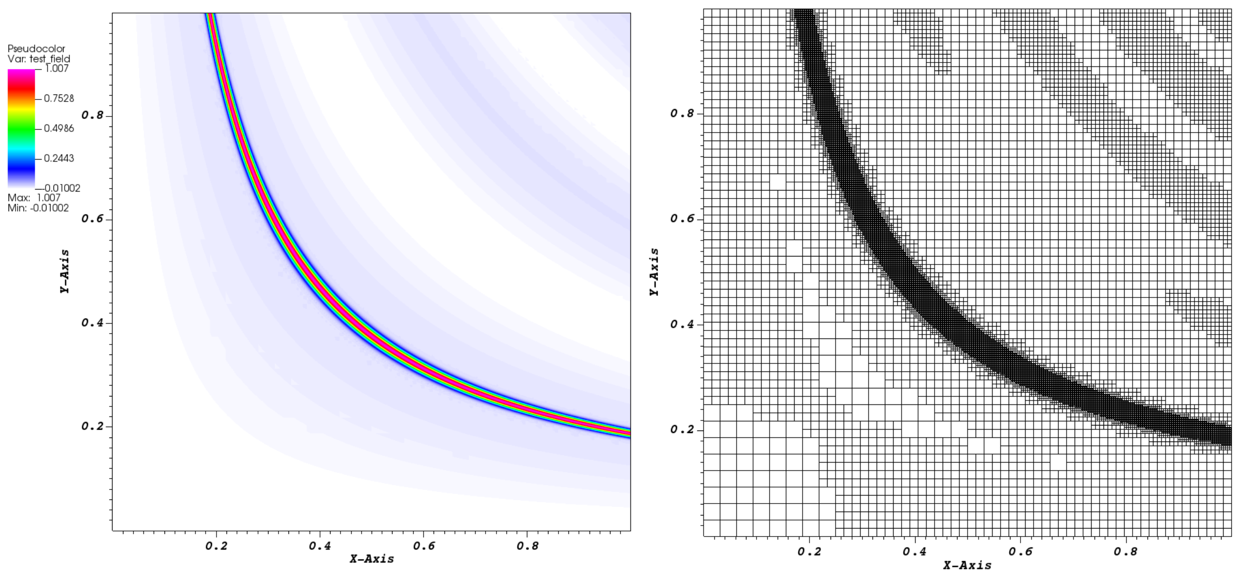


*Figure 1 : (Left) : Solution field. (Right) AMR mesh obtained for the multi-scale function*

The grid obtained is able to capture the different scales present in the problem. Comparing the global error convergence in $L^1$ norm versus the square root of the number of cells (Figure 2), we clearly see that the native wavelet-based AMR method is not able to reduce the error with respect to a cartesian grid. Remarkably, the new proposed method significantly reduces the error introduced in the solution for a given number of grid cells getting close to the optimal performance expected for a quadtree grid.

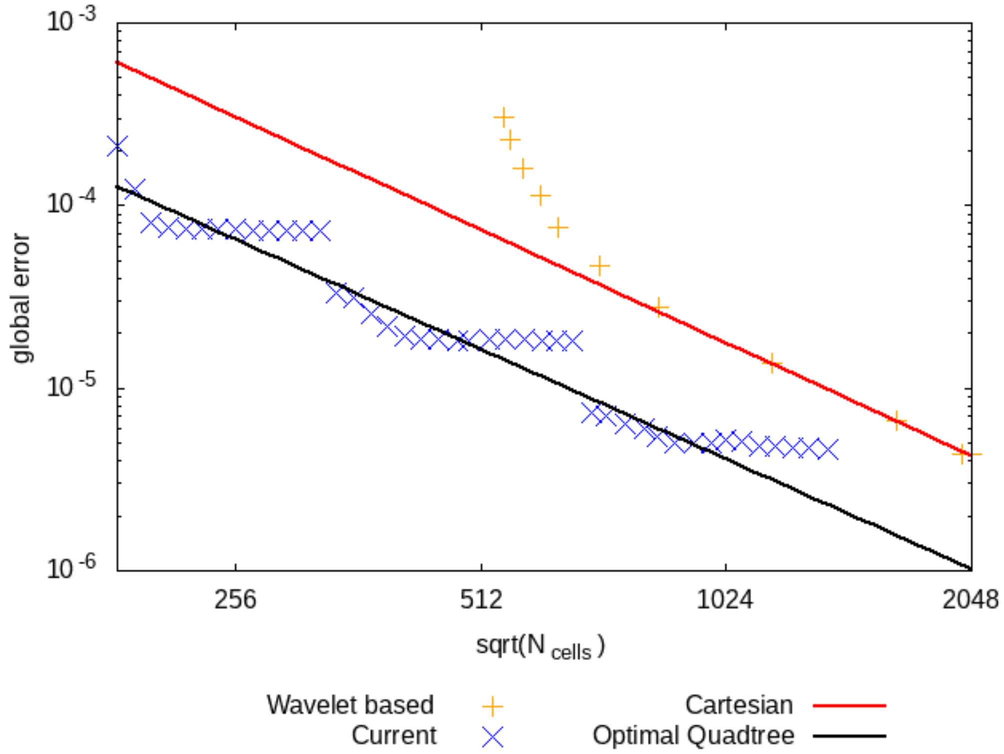


*Figure 2 : Comparison of error convergence for two AMR methods for a specific reaction-diffusion equation.*

The adaptation of the current approach to standard incompressible Euler and Navier-Stokes flow solver is currently under study.

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