**Smoother studies applied to a multiscale formulation coupled with a high-order method**

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The modeling and simulation of multiphase flows in heterogeneous and anisotropic media are a major challenge in petroleum reservoir engineering. However, they are essential tools for reservoir engineering since it is possible to predict the performance of the hydrocarbon reservoir under various operational strategies with them.

Thus, there are several studies in the literature aimed at analyzing methods and techniques that can contribute to this end. Some of the areas still little explored, in the engineering of reservoirs, are the use of high-order and multiscale methods to solve the problem of multiphase flow. In this paper, the Multiscale Restricted Smoothed Basis (MsRSB) method coupled with a non-orthodox MultiPoint Flux Approximation with a Diamond stencil (MPFA-D) was used to solve the pressure problem (elliptical) and the high resolution Correction Procedure via Reconstruction (CPR) method for the discretization of the saturation equation (hyperbolic). A hierarchical Multidimensional Limiting Strategy (MLP) was used in the reconstruction stage in order to suppress numerical oscillations (under and over shoots) close to shocks that are typical in high-order schemes and to hand high precision in smooth regions of the solution. To properly couple the MsRSB method with the CPR formulation, it is necessary to obtain an adequate velocity reconstruction through the control volumes of the mesh. For this, the velocity field must present a certain degree of accuracy that, in some cases, is not handed by MsRSB, so that the high order method returns satisfactory results. In the pressure solver, some smoothers have been implemented to remove the high frequency components of the error and the residual, while maintaining the low frequency components. Thus, the aim of this paper is to analyze the behavior and efficiency of these smoothers applied to the elliptical problem in order to determine the one that produces the velocity field with the best accuracy to efficiently perform the coupling between pressure and saturation solvers.

**Keywords:** Smoother, High-order, CPR, MsRSB.