A posteriori Finite-Volume local subcell correction of high-order Discontinuous Galerkin formulations for the nonlinear shallow-water equations

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In this oral presentation we will talk about a new Discontinuous Galerkin (DG) discrete formulation for the non-linear Shallow-Water equations (NSW), that preserve positive water height and deals with spurious oscillations, by mean of a selective *a posteriori* local subcell correction (*a posteriori* LSC), that relies on the expression of DG schemes as a finite-volume-like scheme on a subgrid, using reconstructed fluxes, inspiring from Vilar [2]. This new approach allows to combine the excellent robustness properties of the Finite-Volume (FV) lowest-order method and the high-order accuracy of the DG method. For any order of polynomial approximation, the resulting algorithm is shown to : (1) accurately handle strong shocks with no robustness issues ; (2) ensure the preservation of the water height positivity at the subcell level ; (3) preserve the class of motionless steady states (well-balancing) at the subcell level ; (4) retain the very high accurate subcel resolution of DG schemes.
These assets are numerically illustrated through an extensive set of test-cases, with a particular emphasize put on the use of very-high order polynomial approximations on coarse grids. For more details, we refer the reader to [1].

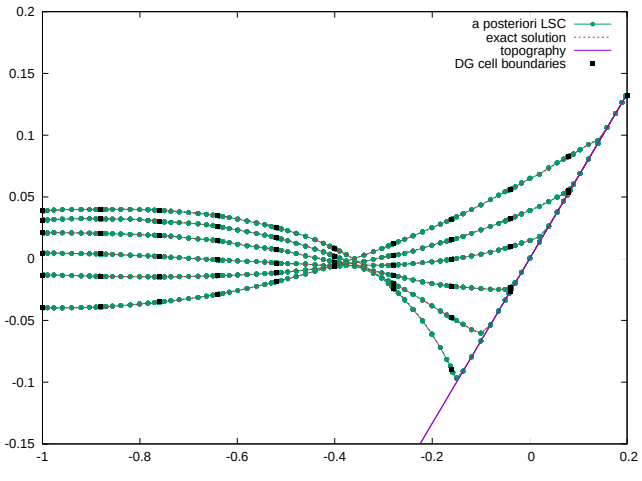

FIGURE 1 – 9th order Carrier and Greenspan transient, over 10 cells mesh for different values of time between 14.5 periods and 15 periods : profile of water elevation

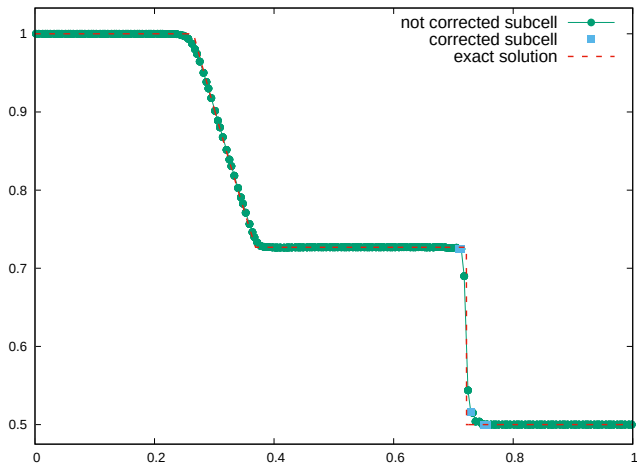

FIGURE 2 – 4th order dam break solution, over 50 cells mesh and up to stopping time t=0.075 : profile of water elevation

[1] A. Haidar, F. Marche, F.Vilar. *A posteriori finite-volume local subcell correction of high-order discontinuous galerkin formulations for the nonlinear shallow-water equations.* J. Comput. Phys., 2021. Article submitted.

[2] F. Vilar. *A posteriori correction of high-order discontinuous galerkin scheme through subcell finite volume formulation and flux reconstruction.* J. Comput. Phys., **387**, 245–279, 2019.

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