A Finite Volume Scheme Based on Matrix Sign and Devoted to non Homogeneous Systems

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This talk is devoted to the analysis, the application and the two-dimensional extension, of a new finite volumes scheme (SRNH) proposed recently for a class of non homogeneous systems. The stability analysis of the scheme, first in the scalar case then in the case of systems of conservation laws, leads to a new formulation of the scheme which is based on the sign of the Jacobian matrix of the system under study. For Shallow Water equation with slope source term, one shows formally that the scheme SRNHS preserves the exact C-property introduced in the context of equilibrium schemes, by Bermùdez and Vázquez. The 1D numerical results, in particular in the case of a dam break over a step, show how much the scheme is really efficient. For numerical solution of morphodynamic problems in one space dimension. The governing equations consist of two components, namely a hydraulic part described by the shallow water equations and a sediment part described by the Exner equation. Based on different formulations of the morphodynamic equations, we propose a family of three finite volume methods. The numerical fluxes are reconstructed using a modified Roe's scheme that incorporates, in its reconstruction, the sign of the Jacobian matrix in the morphodynamic system. A well-balanced discretization is used for the treatment of source terms. The method is well-balanced, non-oscillatory and suitable for both slow and rapid interactions between hydraulic flow and sediment transport. The obtained results for several morphodynamic problems are considered to be representative, and might be helpful for a fair rating of finite volume solution schemes, particularly in long time computations.

KEYWORDS : Finite volume method, SRNHS scheme, Shallow water equations, Source terms, Riemann Problems, Morphodynamic model, Sediment transport, well-balanced discretization.