

**Semi-implicit fully exactly well-balanced schemes for shallow flows****Authors:**

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**Abstract:**

This study focuses on the development of semi-implicit schemes for one-dimensional shallow flows, with a primary emphasis on preserving all steady states, rather than just water-at-rest ones. Drawing inspiration from prior research (see [1] and [2]), the authors employ splitting and relaxation techniques to avoid the nonlinearities associated with pressure terms. The proposed methodologies exhibit better performance compared to conventional explicit schemes, particularly in the low Froude regime, characterized by celerity larger than the fluid velocity. This advantage minimizes the necessity for many iterations over large time intervals. The performance of the scheme is further demonstrated through different numerical simulations.

**References:**

- [1] C. Caballero-Cárdenas, M. J. Castro, T. Morales de Luna, and M. L. Muñoz-Ruiz, “Implicit and implicit-explicit Lagrange-Projection finite volume schemes exactly well balanced for 1d shallow water system”, *Applied Mathematics and Computation*, 443, 2023, p. 127784, <https://doi.org/https://doi.org/10.1016/j.amc.2022.127784>.
- [2] C. Caballero-Cárdenas, M. J. Castro, C. Chalons, T. Morales de Luna, and M. L. Muñoz-Ruiz, “A semi-implicit fully exactly well-balanced relaxation scheme for shallow water system”, *SIAM Journal on Scientific Computing*, submitted, 2023.