

MOVING-WATER EQUILIBRIA PRESERVING NONSTAGGERED CENTRAL SCHEME FOR OPEN CHANNEL FLOWS

Zhen Li¹, jian dong², YiMing Luo¹, Min Liu¹, and Ding Fang Li¹

¹Wuhan University

²National University of Defense Technology College of Liberal Arts and Sciences

March 30, 2022

Abstract

In this paper, we investigate a well-balanced and positive-preserving non-staggered central scheme, which has second-order accuracy on both time and spatial scales, for open channel flows with variable channel width and non-flat bottom. We perform piecewise linear reconstructions of the conserved variables and energy as well as discretize the source term using the property that the energy remains constant, so that the complex source term and the flux can be precisely balanced so as to maintain the steady state. The scheme also ensures that the cross-sectional wet area is positive by introducing a draining time-step technique. Numerical experiments demonstrate that the scheme is capable of accurately maintaining both the still steady-state solutions and the moving steady-state solutions, simultaneously. Moreover, the scheme has the ability to accurately capture small perturbations in the moving steady-state solution and avoid generating spurious oscillations. It is also capable of showing that the scheme is positive-preserving and robust in solving the dam-break problem.

Hosted file

modified version.pdf available at <https://authorea.com/users/467963/articles/561842-moving-water-equilibria-preserving-nonstaggered-central-scheme-for-open-channel-flows>