A Meshless Numerical Model with Flux Limiter for Two-dimensional Shallow Water Equations

***Po-Wei Li[1], and †Chia-Ming Fan[1]**

[1]Department of Harbor and River Engineering & Computation and Simulation Center, National Taiwan Ocean University, Keelung 20224, Taiwan

*Presenting author: 10152028@ntou.edu.tw
†Corresponding author: cmfan@ntou.edu.tw

Abstract

In this study, we presented a meshless numerical scheme with flux limiter to accurately solve the two–dimensional shallow water equations. The shallow water equations are a set of hyperbolic partial differential equations and had various applications in ocean and hydraulic engineering. The proposed numerical scheme is a combination of the generalized finite difference method (GFDM), the split-coefficient matrix methods, the second-order Runge-Kutta method and the flux limiter technique. To adopt the split-coefficient matrix methods can transform the shallow water equations to the characteristic form, which can obviously indicate the information of wave characteristics. Then, the GFDM, a newly-developed meshless method, and the second-order Runge-Kutta method are applied for spatial and temporal discretizations of the equations. In the GFDM, the spatial derivatives at each node can be expressed as linear combinations of function values of nearby nodes with different weighting coefficients. In order to cooperate with the split-coefficient matrix to capture the wave transmission, a new shape of star is defined in this work. In addition, the flux limiter technique, which can reduce small wiggles near discontinuities, is used to stabilize the proposed numerical model. Numerical results and comparisons of several examples are provided to demonstrate the applicability of the proposed meshless scheme. Besides, the numerical results are compared with other numerical solutions and experimental data to validate the accuracy and the consistency of the proposed meshless numerical scheme.

Keywords: Meshless numerical scheme, Shallow water equations, Generalized finite difference method, Split-coefficient matrix method, Runge-Kutta method.