HIGH- RESOLUTION MATHEMATICAL MODEL FOR SIMULATING 2D DAM-BREAK FLOOD WAVES

LIU YULING[1] and WEI WENLI[2]

[1] Lecturer, Institute of Water Conservancy and Hydraulic Engineering,
Xi'an University of Technology, 710048 Xi'an, Shanxi, China
(Tel: +86-29-82313848, Fax: +86-29-83230217, e-mail: liuyuling@xaut.edu.cn)
[2] Professor, Institute of Water Conservancy and Hydraulic Engineering,
Xi'an University of Technology, 710048 Xi'an, Shanxi, China
(Tel: +86-29-82313848, Fax: +86-29-83230217, e-mail: weiwenli@xaut.edu.cn)

Mathematically, the dam-break problem is commonly described by the shallow water equations (also named the Saint Venant equations for the 1D case). One feature of hyperbolic equations of this type is the formation of bores (i.e., the rapidly varying discontinuous flow). It is an important basis for validating the numerical method whether the scheme can capture the dam-break bore waves accurately or not. Many researchers have done much work to solve such a problem. Therefore, several finite difference schemes that handle discontinuities effectively were used to compute open-channel flows, such as the approximate Riemann solver (Glaister 1988), the modified Lax-Friedrich scheme (Nujic 1995). In recent studies, the finite-volume method based on a high-resolution scheme, such as the Godunov method, approximate Riemann solver, etc. (Mingham and Causon 1998), was used to a natural channel. During the last decade another type of shock-capturing scheme, the so-called total variation-diminishing (TVD) scheme, which was proposed by Harten (1983) and developed Yee (1987) and others, was applied widely in gas dynamics.The main advantage of this TVD scheme is that it has second-order accuracy, is oscillation-free across discontinuities, and does not require additional artificial viscosity. So it was introduced to solve hydrodynamics for free-surface flows, in particular, for recent complex dam-break flows. Delis and Skeels (1998) made a comparison with several different TVD schemes (i.e., symmetric, upwind, TVD-MacCormack, and MUSCL scheme) to predict 1D dam-break flows.

The technique is able to simulate satisfactory discontinuous flows such as those associated with the dam break problem or real hydrodynamic flows. However, the TVD schemes with different limiters have different features. Some are more dissipative and some are more compressive (Yang and Przekwas 1992; Jeng and Payne 1995). Based on the above research results, this paper is concerned with a High- Resolution mathematical model for 2D shallow water equations; and the 2D shallow water equations were split into two systems of equations in x and y directions by using the Strang type operator splitting method; and were solved with the one-dimensional upwind total variation diminishing (TVD) schemes and finite volume method (FVM). And this model is used to predict the flood evolution process caused by the instantaneous partial dam-break, and the simulating results are analyzed qualitatively. The analysis indicates that this model is fairly effective for simulating dam-break flood waves.

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