A METHOD OF PHYSICAL FRACTIONAL STEPS FOR NUMERICAL SOLUTION OF UNSTEADY 2-D OPEN CHANNEL FLOWS

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There are two key problems in the numerical solution of unsteady two-dimensional flows. One is how to deal with the complicated shape of natural river boundaries; and the other is how to solve the water governing equations (Wei Wen-Li, 2001). The two key problems have been well solved in this paper. The complicated shape of natural river boundaries are represented accurately in the finite-difference formulation by the use of numerically generated boundary-fitted coordinate system (Thompson, J.F., 1980). This procedure eliminates the shape of the boundaries as a complicating factor and allows the flows about arbitrary boundaries to be treated essentially as easily as that about simple boundaries. All computations can be done on a rectangular transformed field with a square mesh regardless of the shape or configuration of boundaries in the physical field. Therefore the technique of boundary-fitted coordinate system is used to overcome the difficulties resulting from the complicated shape of natural river boundaries. The water governing equations have been well solved by the method of physical fractional steps (Wei Wen-Li, 1998; Wei Wen-Li, 2001). The basic idea of this method is that according to the behavior of each differential operator, the water governing equations can be separated into three parts. The first is a convective problem; the second is a diffusive problem; and the third is a source term. The advantage of this method is that in the convective-diffusion equation a more reasonable scheme for the convective and diffusive operator is adopted respectively. In the convective problem, since the equations are hyperbolic, the use of the method of characteristics will reduce numerical viscosity and liquidate spurious oscillations. Therefore, we use the method of characteristics for the convective problem calculation; and in the diffusive problem, since the equations are elliptic, ADI method is effective for the diffusive problem calculation. The technique of moving boundary is used to deal with the riverbed exposed to water surface due to unsteady flows. By using this method, the computed results are in good agreement with the experimental data for a steady flow.

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