LEVEL SET IMMERSED BOUNDARY METHOD FOR THE SOLUTION OF SHALLOW WATER FLOW

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The simulation of complex problems arising in hydrology and/or hydrodynamics requires the detailed description of the geometry of the domain and hence a good mesh in order to obtain reliable results. In such situations the construction of unstructured meshes can be very expensive from the computational point of view. This is particularly true in the following situations: 1) presence of moving boundaries requiring remeshing strategy; 2) a doption of a mesh adaption procedure; 3) uncertainty in the data requiring multiple realizations in order to quantify the uncertainty in the results. In this paper, we propose a Cartesian ghost-cell method for the solution of hyperbolic system. The description of the immersed boundary is obtained using a level set approach. On the immersed boundary suitable boundary conditions are enforced: particular attention has been devoted to the development of correct boundary conditions for the moving boundary case. The imposition of the boundary condition give rise to a linear system of equations whose unknowns are the values of the physical variables in the centers of the ghost-cells. In order to reduce the computational cost associated with the solution of this system a suitable preconditioning strategy can be adopted (for example Multigrid). Another key point in the advocated method is the interpolation procedure used to enforce the boundary conditions on t he immersed boundary: in particular enlarging the stencil higher order method can be easily developed. The proposed method can also used to devise a 1D-2D or 2D-3D coupling strategy: some examples are a 1D representation of a river inside a 2D domain or a 2D representation of a fault into a 3D porous media. The method is applied to solution of the shallow water equation and some preliminary numerical results are presented in order to asses the eectiveness of the algorithm.