A study of local mass conservation in 3D flood simulator

Yotaro Minamite[1], Seizo Tanaka[2] and Daigoro Isobe[3]

[1] Graduate School of Systems and Information Engineering, University of Tsukuba
Tennodai 1-1-1, Tsukuba-shi, Ibaraki 305-8573, JAPAN
s1920941@s.tsukuba.ac.jp

[2] Environmental Civil Engineering, Hiroshima Institute of Technology
Saeki-ku Miyake 2-1-1, Hiroshima-shi, Hiroshima 731-5143, JAPAN
s.tanaka.iz@cc.it-hiroshima.ac.jp

[3] Division of Engineering Mechanics and Energy, University of Tsukuba
Tennodai 1-1-1 , Tsukuba-shi, Ibaraki 305-8573, JAPAN
isobe@kz.tsukuba.ac.jp

In recent extreme weather condtions, the intensity and frequency of typhoons, hurricanes and torrential rains have increased and they have caused extensive damage to infrastructures in many parts of the world. In water disasters such as flood, storm surge and tsunami, evaluating the hydrodynamic forces acting on countermeasures and buildings is important to predict the damage caused by flood waters. In order to evaluate the fluid force accurately, it is necessary to consider water front motion as accurately as possible. In numerical simulation of water disaster, the interface capturing method such as VOF method have been used for free surface flows because this method can easily treat the water front motion. However, this method is weak when imposing the kinematic condition on the interface and mass conservation since the position of the interface is expressed indirectly by using a function. To overcome this problem, higher mass conservation method had been required to accurately evaluate the inundation area.

In the previous study [1], a numerical code based on Discontinuous Galerkin (DG) method was developed to improve the mass conservation in two-dimensional problems. DG method guarantees mass conservation on an element-by-element basis by using different interpolation functions for each element.

In this presentation, we have extended the method for three-dimensional problems. In order to examine the numerical accuracy and mass conservation of solutions in advection equations, we took up the three-dimensional one-way advection problem and the three-dimensional dam-break problem to examine its effectiveness in free surface flow problems.

References

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