The 18th International Conference on Finite Elements in Flow Problems (FEF2015)
16-18 March 2015, Taipei, Taiwan

Development of a 2D-3D hybrid tsunami numerical model based on stabilized finite element method

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Key Words: *Tsunami Numerical Model, 2D-3D Hybrid, Stabilized Finite Element Method.*

Tsunami disasters have caused serious destruction to the coastal areas in the past decades. It is an effective way to know the tsunami behaviour by numerical simulation. Considering the traditional 2D models which are based on the hydrostatic approximation may be limited to get the detail information around structures and the heavy computational burden of 3D models, computing the wave propagation by 2D and the area around structures by 3D is an efficient and economical way.

This study presents a 2D-3D hybrid numerical model that couples the 2D Boussinesq equation and the 3D Navier-Stokes equation by a stabilized finite element method [1]. The Eulerian approach using fixed grid is applied to the moving boundary technique for describing tsunami run-up of the 2D analysis. The advection eqution is applied to solving the interface function between air and water, as well as the interface-capturing approach based on VOF method [2] is applied to the 3D analysis. For the discretization in space, the equal order interpolation is applied, while the Crank-Nicolson method is applied to the discretization in time. The present method is applied to several benchmark examples to show the validity and efficiency of the method.

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