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Large Scale Simulation for Tsunami Waves Using the 3D parallel VOF method

***Taiki Fumuro[1], Seizo Tanaka[2] and Kazuo Kashiyama[3]**

[1] Department of Civil and Environmental Engineering,
Chuo University, Kasuga 1-13-27, Bunkyo-ku, Tokyo, Japan
fumuro@civil.chuo-u.ac.jp
[2] Earthquake Research Institute,
The University of Tokyo, Yoyogi 1-1-1, Bunkyo-ku, Tokyo, Japan
stanaka@eri.u-tokyo.ac.jp
[3] Department of Civil and Environmental Engineering,
Chuo University, Kasuga 1-13-27, Bunkyo-ku, Tokyo, Japan
kaz@civil.chuo-u.ac.jp

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The shallow water equation and Boussinesq equation are well used for the tsunami propagation and run-up analysis. However, in order to predict the damage of structures, the three-dimensional simulation based on Navier-Stokes equation is required. In case of the three-dimensional Navier-Stokes equation, the simulation becomes a quite large scale simulation and it is essential to use the parallel computing techniques. The finite element method is suitable to investigate the damage of structures, since the finite element method can treat the arbitrary shapes of structures.

This paper presents a large scale tsunami wave simulation method based on the 3D parallel VOF method. The three-dimensional Navier-Stokes equation and continuity equation are employed as the governing equation. The interface-capturing approach based on VOF method [1] is employed because the method is robust in the applicability. The stabilized finite element method [2] based on unstructured grid is employed for the spatial discretization. The full implicit scheme based on Crank-Nicolson method is used for the temporal discretization. In order to handle the large scale tsunami simulations, a parallel computing method using MPI is employed. The present method is applied to the real world tsunami simulation caused by the Great East Japan Earthquake.

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