Development of Tsunami Wave Propagation Analysis Method for Damage Estimation of Structure

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ABSTRACT

Tsunami hazard is connected with significant loss of human life, destruction of coastal infrastructures. The protection system for tsunami disaster like seawalls, breakwaters and evacuation buildings must have sufficient performance to be proof against the tsunami impacts. Numerical simulation is a powerful tool used to estimate the risk of damage, that it can evaluate the dynamic wave impact forces. Wave propagation analysis requires the high-resolution mesh near the structure with large domain. High-resolution mesh requires significant amount of memory and computational time. The development of multi-core/CPU parallel computer with fast network in recent years has dramatically being realizing the large-scale simulations.

In this paper, we report large-scale parallel computation for damage estimation of structure by tsunami wave force. Tsunami wave propagation is simulated by solving the three dimensional Navier-Sokes equation with free surface. The interface capturing method based on the volume of fluid (VOF, [1]) approach is used to simulate free surface flow. In this approach, the Navier-Stokes equation is solved over a fixed finite element mesh. An interface color function serves as a marker identifying the two fluids. A stabilized finite element formulation with the streamline upwind/Petrov-Galerkin method and pressure stabilizing/Petrov-Galerkin method [2],[3] is used to discretize the Navier-Stokes equation. These stabilization terms provide stability and accuracy in solution. The OpenMP and MPI hybrid parallelization is used to reduce the computational time and to distribute the memory usage for large-scale problem.

REFERENCES

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