

Zoom up tsunami analysis on urban areas by three analyses stages using hierarchical domain decomposition in explicit MPS method

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Ishinomaki city was severely damaged by the tsunami of the Great East Japan Earthquake two years ago. Our target is to simulate impact by the tsunami run-up with many floating objects on a seacoast and an urban area of Ishinomaki. Zoom up analysis by three analyses stages is adopted to solve a large area from an epicenter to an urban area.

In the first stage, the 2-dimensional viscous shallow water analysis is solved in the area of 667km×525km from the epicenter to the seacoast. In this analysis, the 2D mesh of 125m element size is used. In the second and third stages, the 3-dimensional tsunami run-up analyses are solved for the seacoast area of 10.5km×10km and the urban area of 660m×810m, respectively, using the parallel explicit MPS (Moving Particle Simulation) method. In the second stage, 130 million particles of diameter 2m are used. In the third stage, 400 millions particles of diameter 0.3m are used and 431 floating objects flow in the urban area. In this research, the weak coupled problem by interplay between rigid bodies and fluid is solved for the flow of the floating objects.

For solving these tsunami run-up analyses, a new distributed memory parallel algorithm of the explicit MPS method has been developed. An analysis region of this method is divided for a distributed memory parallel computation using ParMETIS. These analyses have been carried out on the supercomputer FX10 of the University of Tokyo and the CX400 of Kyushu University.