High-Performance Tsunami Wave Propagation Modeling

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Abstract. Strongest earthquake of December 26, 2004 generated catastrophic tsunami in Indian Ocean. This shows that, in spite of recent technology progress, population at coastal zone is not protected against tsunami hazard. Here, we address the problem of tsunami risks mitigation. Note that prediction of tsunami wave parameters at certain locations should be made as early as possible to provide enough time for evacuation. Modern computational technologies can accurately calculate tsunami wave propagation over the deep ocean provided that initial displacement (perturbation of the sea bed at tsunami source) is known. Modern deep ocean tsunameters provide direct measurement of the passing tsunami wave in real time, which help to estimate initial displacement parameters right after the tsunami wave is recorded at one of the deep ocean buoys. Therefore, fast tsunami propagation code that can calculate tsunami evolution from estimated model source becomes critical for timely evacuation decision for many coastal communities in case of a strong tsunami. Numerical simulation of tsunami wave is very important task for risk evaluation, assessment and mitigation. Here we discuss a part of MOST (Method of Splitting Tsunami) software package, which has been accepted by the USA National Ocean and Atmosphere Administration as the basic tool to calculate tsunami wave propagation and evaluation of inundation parameters. Our main objectives are speed up the sequential program, and adaptation of this program for shared memory systems (OpenMP) and CELL architecture. Optimization of the existing parallel and sequential code for the task of tsunami wave propagation modeling as well as an adaptation of this code for systems based on CELL BE processors (e.g. SONY PlayStation3) is discussed. The paper also covers approaches and techniques for programs optimization and adaptations, and obtained results.

Keywords: Tsunami Wave Propagation Modeling, Method of Splitting Tsunami, Fine-grain Parallel Algorithms, OpenMP Paradigm, Cell BE Architecture.

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