# Integrated Predictive Simulation for Earthquake and Tsunami Disaster (3) Combined Simulation System for Ground Motion/Structure Oscillation

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For contributing to the reduction of earthquake and tsunami disaster, our research project develops an integrated computer simulation system to reproduce and predict the chain of earthquake-related multi-scale and multi-physics processes, namely tectonic stress accumulation due to relative plate motion, earthquake generation, seismic wave and tsunami propagation, and the artificial structure oscillation (Research Director: Mitsuhiro MATSU'URA, Project Name: Integrated Predictive Simulation System for Earthquake and Tsunami Disaster in High Performance Computing for Multi-scale and Multi-physics Phenomena of CREST (Core Research for Evolutional Science and Technology) in JST (Japan Science and Technology Agency) Basic Research Programs). To develop this system, we organized 4 research groups: 1) Predictive Simulation System for Earthquake Generation group, 2) Integrated Simulation System for Ground Motion and Tsunami group, 3) Combined Simulation System for Ground Motion/Structure Oscillation group and 4) Development of a Platform for Combined Simulation group. In this presentation, we demonstrate two kinds of subsystems which are developed by Combined Simulation System for Ground Motion/Structure Oscillation group to conduct the artificial structure oscillation evaluation including seismic response analyses of urban structures and the floating roof of an oil storage tank. (a) Subsystem for seismic response evaluation of urban structures Realistic simulation of possible earthquakes is crucial for producing a rational counter plan against earthquake disasters. This subsystem presents such a simulation method, which uses a computer-based high-resolution strong ground motion simulator and a Virtual Reality city constructed from GIS/CAD data. This system is an integrated computer system that is intended to simulate all phases of earthquakes numerically: earthquake hazards, earthquake disasters, and human and social actions against earthquake disasters. An efficient combination of GIS/CAD data and numerical simulation tools for each phenomenon on this computer system can achieve integrated earthquake simulation. This presentation presents the methodology of reconstruction of a Virtual Reality city and the prototype of this system. An example

of a Virtual Reality city model is reconstructed and some earthquake disaster simulations are undertaken to examine the performance of this system. (b) Subsystem for seismic response evaluation of fluid-structure coupling system Even the malfunction of the important structures such as oil storage tanks severely damages socioeconomic activity. To predict the seismic response of oil storage tanks with high accuracy, we develop a fluid-structure coupling code based on the tightly coupling method, and conducted dynamic response analyses for oil storage tanks with a free surface enforced by observed seismic waves. Various modeling methods for a tank and a floating roof are applied, and their effects on the responses are investigated.