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Large scale Tsunami simulation by a particle method and its 3D visualization

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INTRODUCTION

A couple of years have passed since the great east Japan earthquake, and new tsunami disaster prevention and mitigation methods are promoted actively toward the next millennium Tsunami. Numerical prediction of the fluid impact force acted on structures including bridges, private houses and buildings during tsunami is strongly desired for generating the new regulation of tsunami disaster prevention. In this study, the numerical prediction of tsunami inundate area is conducted by a stabilized ISPH[1], and 3D visualization technique is adapted to output our particle simulation results for the tsunami disaster mitigation and prevention.

GEOMETRICAL MODELING FOR TUSNAMI ANALYSIS

A multi-resolution geometrical modeling is performed for a highly resolved geometrical map for tsunami run-up simulation. As a first step, Digital Elevation Map (DEM) with 5m structure grid information is utilized for a low resolution geometrical modeling. The DEM doesn’t include the information of structures including sea-walls, houses and building. The deficient information of the geometry has recovered by aerial survey data as points with 1m resolution.

TSUNAMI ANALYSIS WITH REAL GEOMETRY AND 3D VISUALIZATION

Tsunami run-up behavior is simulated with the real geometrical map generated from a multi-resolution aerial survey data. The tsunami is inputted on the right boundary edge in our model shown in Fig.1, and the input of tsunami is assumed from the investigation of Tohoku earthquake. The height is 3m, and its velocity is 10m/s. The constant tsunami is given during our tsunami simulation for 3 minutes in the real time. Fig 4 shows the snapshot of tsunami simulation after 1m50s and 2m25s. In the figures, contour color indicates the velocity magnitude in the horizontal direction of the figure. These run-up behaviors show a good agreement with the damage investigation results.

The computation was mainly carried out using the facilities at Research Institute for Information Technology at Kyushu University. It spends about 3days for the 3minutes behaviors.

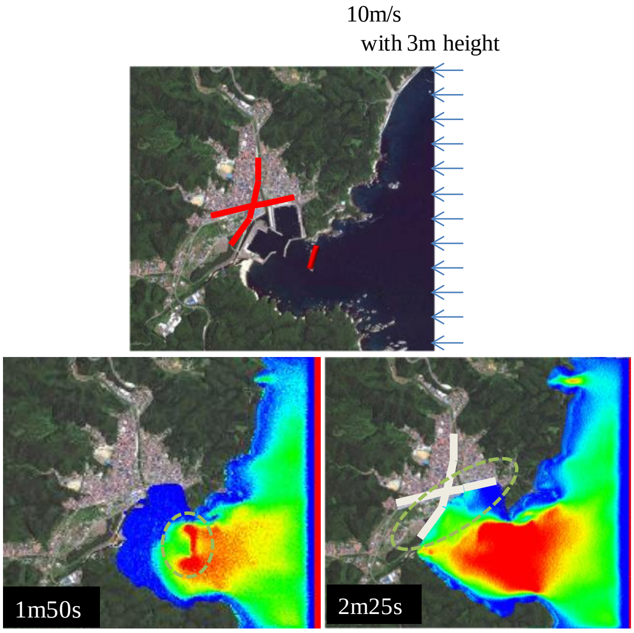

Fig.1. Tsunami run-up simulation at Taro

For tsunami mitigation, 3D vilsualization is useful to show our result to citizen. Fig2 shows one of the samples of 3D vilsualization.

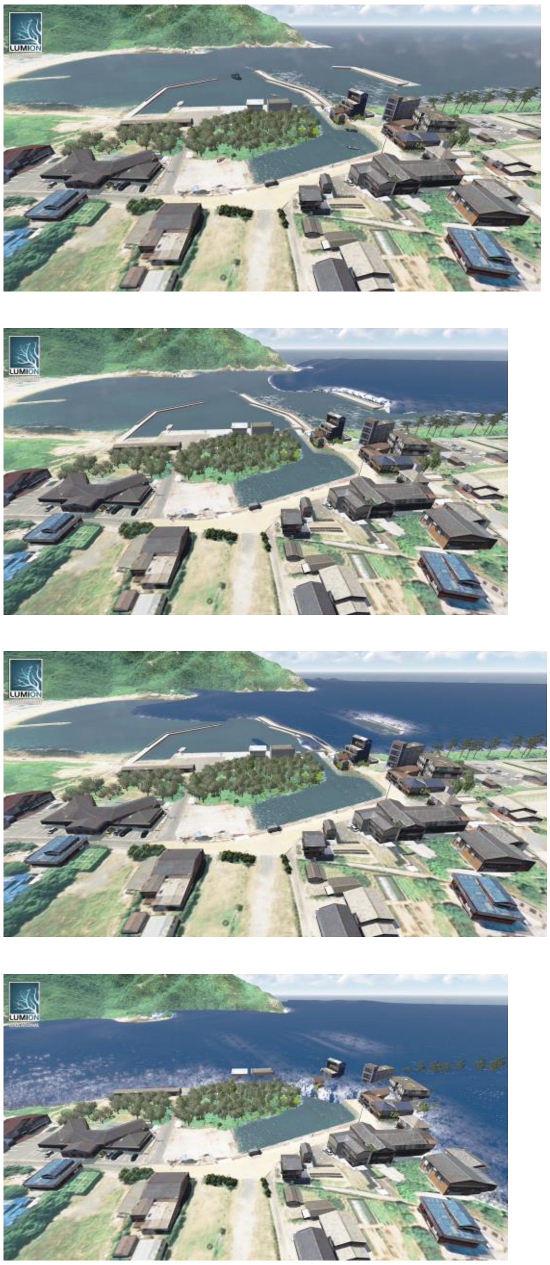

Fig.2 Simulation based CG for tsunami mitigation

CONCLUSION

A stabilized ISPH is adapted for the 3D tsunami run-up simulation with a real geography. We have developed a SPH analysis tools with semi-automatic geometrical modeling for particle type simulation. The tool can easily generate the particle data from numerical maps through the 3D CAD format.

In our future work, we are going to simulate coastal structures which receive impulsive fluid load due to Tsunami or storm wave. Therefore, the global tsunami run-up simulation should be reasonably connected to a local zooming analysis with structures.

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