Development of Solid-Gas-Liquid 3-phase Calculation System Coupling CADMAS-SURF/3D and DEM

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Abstract:

There are many problems related to destructive phenomena such as failure of structures on land, impacts of drifting objects etc. caused by giant tsunami on coastlines in recent years, which are difficult to clarify by only analyzing simple fluid phenomena. And such phenomena are characterized by extremely strong non-linearitythe impact on structures of breaking waves and other fluids in surge statethus difficult to analytically unravel.
On the other hand, computers have advanced remarkably, so in recent years, there have been many researches on multi-phase flow calculation by the coupling method, based on calculation methods typified by the particle method (for example, Goto et al., 2008 and Ikari et al. 2009). At the same time, Arikawa and Yamano (2008a) developed a single-phase numerical wave tank based on the VOF method, and confirmed that it is a highly robust system, even in large-scale calculations. And they also showed that structural deformation calculations can be done based on a model coupled with FEM (Arikawa et al., 2009). But when using FEM analysis, it is difficult to calculate after failure, and the mixing of air in breaking waves and surges can become an important element. So this research expanded the numerical wave tank to a gas-liquid 2-phase model, and also, a system coupled with the distinct element method was developed, with the goal set as building a calculation method which can be applied to various failure phenomena caused by fluid bodies.
The results confirmed that there was less numeric noise than with a single-phase model, and that it can calculate the breaking wave pressure with high precision. Next, a system coupled with the distinct element method was developed. Although qualitative, it conformed with an experiment with large-scale wall failure, confirming the appropriateness of the solid-gas-liquid 3-phase model.