

Smoothed particle hydrodynamics method for fluid-structure interaction analysis

- Fluid analysis and elastic-plastic structural analysis-

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ABSTRACT

Particle methods are recently developed to the applications of the fluid dynamics and the fluid structure interaction. The smoothed particle hydrodynamics (SPH) method [1] and the moving particle semi-implicit (MPS) [2] method are recently applied to fluid dynamics analyses for predictions of damage under natural disasters such as Tsunami.

A lot of offshore floating structures are proposed for wind power generation. The analysis for stabilization of floating structure such as offshore wind power plant on the ocean also needs to calculate the fluid structure interaction. It is sometimes difficult for the mesh based method such as FEM and so on to simulate failure phenomena and fracture phenomena such as impact problems. SPH methods can calculate complicated fluid-structure interaction problems.

In fluid-structure interaction analyses, if the structures are subjected to the large deformation, the stress may exceed the yield stress in the structures the offshore floating structures. The smoothed particle hydrodynamics (SPH) method is usually calculated by explicit procedure. The elastic-plastic treatment during deformation for the explicit calculation procedure, that is suitable to the SPH method, is applied to the SPH in the present paper.

The Marcal method [3] which is explicit method for elastic-plastic algorithm is applied to the SPH method in the present study. The method is able to calculate the elastic-plastic problem without the iteration. It is successful to apply the Marcal method to the SPH method because the sufficient precisions of elastic-plastic problems are obtained. And the fluid dynamics analysis is also performed by the SPH method including artificial viscosity to stabilize pressure of the fluid.

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