Smoothed particle hydrodynamics method for fluid-structure interaction analysis - elastic-plastic analysis of structure -

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ABSTRACT

Particle methods are recently applied to fluid dynamics analyses for predictions of damage under natural disasters. The methods have advantage more than the traditional methods that are the mesh based methods. The fluid-structure interaction analyses can be also calculated by the particle method. In fluid structural interaction analyses, if the structures are subjected to the large deformation, the stress may exceed the yield stress in the structures. The elastic-plastic effects have to be taken into account for the large deformation of the structure under the natural disasters or the large scaled earthquakes. The computational elastic-plastic procedures for the finite element method and other method etc. are proposed by several researchers. The procedures are both implicit method with iteration and explicit one without iteration. The smoothed particle hydrodynamics (SPH) method [1][2][3] 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 elastic-plastic calculation of the SPH method is performed for uniaxial tensile test and the dynamic press process.

In the present study, the computational elastic-plastic procedure for structural analysis which is appropriate to the SPH method is used for structural analysis. The Marcal method [4] which is explicit method for elastic-plastic algorithm are adopted to the SPH method in the present study. The method is expected to shorten the computational time with the SPH method of the elastic-plastic problems. This method for the SPH method is evaluated on computational precision. It is successful to apply the Macarl method to the SPH method because the sufficient precisions of elastic-plastic problems are obtained. The Macarl method can be applied to fluid-structure interaction analysis of the SPH method.

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