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Meshfree method with restricting bubble radius for nodal relocation method

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The element free Galarkin (EFG) method is appropriate for adaptive methods to be able to add and to move nodes easily. The adaptive methods of the FEM can be classified into the h-adaptive, the p-adaptive and the r-adaptive method. The h-adaptive is the method by which number of the nodes increase on mesh refinement. The p-adaptive is the method which makes increase its order of the shape function. The r-adaptive is the method which moves nodes at which the error is close to higher precision. The proposed adaptive method is the method which are combined by the h-adaptive and the r-adaptive. The relocation of nodes with related to the error are performed in this method. Therefore, It is necessary to estimate the error of numerical solutions of the EFG method for the adaptive analyses to evaluate the accuracy of them. Both adding nodes and moving nodes which have the radius of the domain of influence for a potential function used to the physically based simulation. It is called the bubble system which are applied to the EFG method [1]. The nodes of the bubble system have the bubble radius of the potential function. The equilibrium state under the each inter-nodes force of the potential function becomes to the relocated nodes allocation.

The relative error is estimated by the difference of the energy norm of the nodes and the projected energy norm of nodes. The nodes are added to the area where the relative error exceeds the threshold value. The bubble radius for the potential function is given by associating with the relative error.

When nodes are usually added near the stress concentrated region, they sometimes make change the node distribution finer than that of the surrounding area. These gaps of the nodal density which are produced by the adding nodes lead results to lower accuracy one. To move the nodes after adding nodes is needed to improve the accuracy of the solutions. The nodes have to be moved at appropriate locations after adding nodes to take higher accuracy solutions. The nodal relocation method is applied to smooth the distribution of nodes in domain and boundary of an analysis model.

The nodal relocation method in which nodes are automatically relocated using physical internodes forces called bubble meshing for FEM is applied to the adaptive analysis after additional nodes are generated. The physical internodes force is given as the bubble radius which is associated with the calculated posteriori error. The calculations of the EFG method are repeated again after the posteriori error estimation.

It is successful to apply this method to infinite plate with a hole which is the stress concentration problem. The numerical results are better than those of only adding nodes.

Some concentrations of nodes are observed in the previous analysis. The concentrations of nodes are tried to be canceled by restriction of changing bubble radius. In the present paper, the adaptive EFG method with improved nodal relocation with restriction of changing the radius for crack problems which has the stress singularity is applied to calculate the J-integral around the crack-tip.

REFERENCES

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