

BOUNDARY CONDITION ENFORCEMENT IN STRESS ANALYSIS USING STRUCTURED MESH

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The authors have been researching for structural analysis methods in industrial design applications utilizing data of the new style CAD named V-CAD [1], which can handle volume data directly. As a part of our studies[2], we are developing the stress analysis system using the extended Finite Element Method (X-FEM) [3] with the voxel-type finite elements.

Structured data, such as voxel data, for modeling the analyzed domain simplifies the definition of the analysis model, because the location of the cell including the specified point can be searched easily by simple calculation related to the coordinates, since the information of element-connectivity, which should be described as input data in the conventional FEM, is not required. Moreover, the interpolation function enriched by the step function used in X-FEM analysis can simplify the definition of the boundaries having complex geometries. In the analyzed model for this method, however; the boundary surface does not always coincide with the element surface. Therefore, an appropriate method to enforce essential and natural boundary conditions is required.

In our study, various methods to enforce essential boundary conditions are examined for two and/or three dimensional elastostatic problems. They include the penalty function method, the Lagrange multiplier method in conjunction with the modified variational method, the multi-point constrains, *etc.*

References

- [1] Kase, K., Teshima, Y., Usami, S. H., Ohmori, C. Teodosiu, A. Makinouchi, Volume CAD, Volume Graphics (2003) (to be appeared).
- [2] Nagashima, T., Ishihara, Y., Niiyama, K., Makinouchi, A., Development of Stress Analysis System by X-FEM with Voxel-Type Mesh, Proceedings of the Fifth World Congress on Computational Mechanics (WCCM V), July 7-12, 2002, Vienna, Austria.
- [3] Sukumar, N., Moës, N., Moran, B., Belytschko, T., Extended finite element method for three-dimensional crack modeling, Int. j. numer. methods eng., 48 (2000), 1549-1570.