ABSTRACT

Level-set Based Topology Optimization Using Adaptive Remeshing Technique

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Level-set based topology optimization method is widely used for its clear boundary expression than element based SIMP method in topology optimization method. However, the conventional level-set method cannot consider precise structural boundary in optimization process and guarantee the accuracy of analysis since it is Eulerian method due to use a fixed mesh which has simple and fast features for initial configuration. To consider precise structural boundary, in general, designer can mesh densely about design domain, however, degrees of freedom and computing time for design increase drastically. For this reason, many remeshing techniques such as adaptive remeshing method and extended finite element method(XFEM) considering the level-set boundary without entirely dense meshing have been researched for accuracy of analysis representatively.

The adaptive remeshing technique can guarantee qualities of elements and do not depend on initial mesh compare to XFEM, however, many elements around the level-set boundary can be generated and computing time increase sharply. Otherwise, a research to compare the two remeshing techniques about electromagnetic problem which is very sensitive about structural boundary has not been performed.

In this thesis, design optimization using level-set based topology optimization method applied adaptive remeshing technique which can prevent distortions of elements and consider precise structural boundary are performed. In optimization process, the boundary elements are determined using signs of the level-set functions as design variable and the remeshing is performed after tracking the level-set boundary using boundary points. To control the accuracy of analysis and computing time, the resolution parameter which can control the number of boundary points and prevent the generating of many elements around the level-set boundary is introduced, and first-order triangular element and quadrilateral element are applied to the remeshing technique for expandability.

To verify the effectiveness of the proposed method, it is applied to various structural problem and electromagnetic problem which is very sensitive about structural boundary, and compared with fixed mesh and widely used XFEM.