Topology optimization method based on isoparametric element

***H.X.Wang[1], J. Liu[1,2], †G.L. Wen[1]**

1. State Key Laboratory of Advanced Design and Manufacturing for Vehicle Body, Hunan University, Changsha 410082, Peoples Republic of China
2. Centre for Innovative Structures and Materials, School of Civil, Environmental and Chemical Engineering, RMIT University, GPO Box 2476, Melbourne 3001, Australia

*Presenting author: wanghx@hnu.edu.cn

†Corresponding author: glwen@hnu.edu.cn

Abstract

The main contribution of this work is to overcome the drawback that optimal geometries obtained from traditional topology optimization methods often have unsmooth edges, and therefore are incompatible with traditional manufacturing methods. Finite element-based topology optimization method is used, where we transform the regular square element into the irregular isoparametric element via the movement of the node. The node of each element is endowed with its density and coordinate, based on which a regulation is proposed to move the node to make the element deformed. The stiffness matrix of the isoparametric element is constructed by using Gauss integration. A density-update criterion is further introduced to satisfy the volume constraint by considering the volume change of various isoparametric elements. Several numerical examples are tested to demonstrate the effectiveness of the proposed method. The proposed method could make the layouts be fabricated conveniently and accurately by linking it with the 3D design software, i.e., CAD.

Keywords: Topology optimization; manufacture; isoparametric element; CAD; density-update criterion.