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# Shape Optimization of Dynamic Structural Member in Isogeometric Analysis

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We establish computational schemes for shape optimization of structural member in Isogeometric analysis (IGA). The target structure is a dynamic three-point bending analysis of a hat member. In conventional finite element analysis, drastic shape change and arriving at the true optimal shape is extensively difficult. In this study, by searching optimal shape utilizing IGA data characteristics, compatibility with digital data and convergence to the optimum solution is investigated.

Figure 1 indicates shape deformation in finite element method (FEM). Although FEM is conventional computational strategy for computational aided engineering (CAE), angular shape is introduced by moving node. From this, we can see that treatment of drastic shape deformation is extremely difficult. On the other hand, by using IGA, we can use large shape change with smooth computational surface. Figure 2 is shape deformation in IGA. The shape deformation in IGA can be divided into two kinds of procedures. This first procedure is moving of control point as shown in Figure 2 (a). In this first approach, a curvature of structural surface is changes by moving control points. The second procedure is changing of weight of control point. In this second approach in Figure 2 (b), we can change structural shape by adjusting weight without moving of control points.

Figure 3 shows symmetric computational model of hat member to validate presented optimization procures in IGA. A indenter is impacted with initial velocity. Figure 4 demonstrates cross-sectional initial shape (black line) and optimum shape (red line). We can attain uneven optimum cross-sectional shape on top, bottom and side surfaces, observe smooth cross-sectional shape using IGA. Figure 5 compares relationship between force and stroke in initial and optimum shapes of hat member. In this graph, the force of optimum shape indicates higher than case of the initial shape. In addition, we succeed in reduction the weight of hat member.

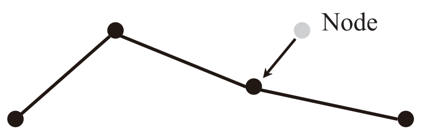
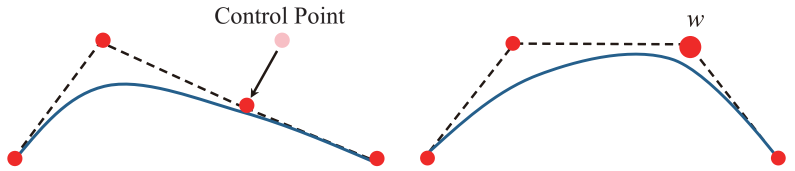



Fig.1 Shape deformation in FEM




(a) Moving control point (b) Changing weight of control point

Fig.2 Shape deformation in IGA

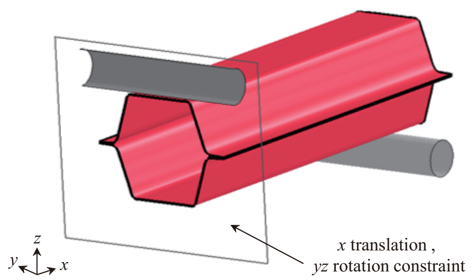



Fig.3 Computational model of hat member

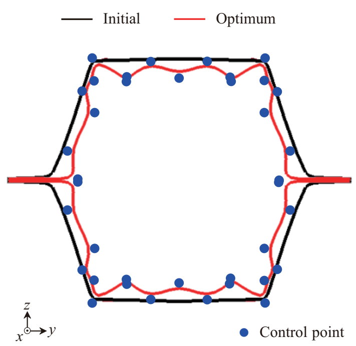



Fig.4 Optimum cross section

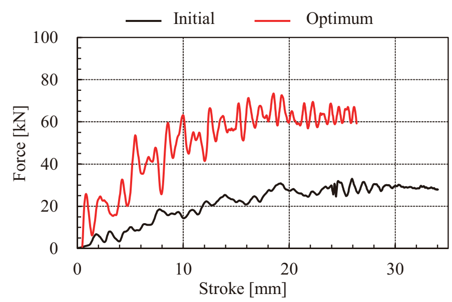



Fig.5 Force-stroke curves