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Shape optimization for minimizing the KS function of von Mises stress using shape derivative of domain integral type

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Abstract

In structural design, it is important to determine the optimal shape that maximizes strength for a given material. When the strength criterion of the material is given by the von Mises stress, the maximization of the strength is achieved by minimizing the maximum value of the von Mises stress. However, it is difficult to use directly the maximum value of the von Mises stress as an objective function, because we cannot evaluate the derivative of the objective function. One way to avoid this problem is to use the Kreisselmeir-Steinhauser (KS) function of the von Mises stress as an objective function. In the previous studies of our research group, the formula of the shape derivative of the KS function of boundary integral type has been used.

In the present paper, a new formula of the shape derivative of the KS function of domain integral type is derived theoretically based on the general formulae of shape derivatives of functionals. The shape derivative is evaluated with the solutions of the main problem and the adjoint problem. To solve the shape optimization problem to minimize the KS function, we use an iterative algorithm based on the H1 gradient method.

We developed a computer program to solve the shape optimization problem using the algorithm and implemented it in commercial finite element analysis software. Numerical example will be shown in the WCSMO-11.