Simplified approach of topology optimization

for improving structural strength

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ABSTRACT

The present study deals with topology optimization for improving structural strength of the products by additive manufacturing. One of the common and important design problems may be to develop the optimal design method considering nonlinear and complex structural response such as buckling or elastoplastic behavior. The number of research related to this problem is gradually increasing, however, these approaches request the complicated sensitivity analysis and also high computational costs to achieve optimal results. This is the reason why the optimal design methods based on linear structural analysis are still the central among optimization methods. However, optimal layouts based on linear analysis tend to show vulnerable response, for example, loading capacity suddenly drops when design conditions uncertainly changed.

From this background, we propose a simplified approach of topology optimization to increase structural strength for a severe loading condition with much lower computational cost than optimizations based on nonlinear analysis. Finally, we discuss the setting of the optimization problem improving the structural strength and demonstrate the accuracy and performance of the proposed method by a series of numerical examples.

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