Unified treatment of some different fabrication-cost functions in truss topology optimization

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Abstract

In truss topology optimization based on the ground structure approach, recent work has proposed including the fabrication cost of a truss in the problem formulation and assumed this cost to be proportional to either the number of members or the number of nodes (connections). A major difficulty in considering such a cost function in truss topology optimization is that the number of nonzero entries of a vector is not a differentiable function, and hence we cannot apply a gradient-based optimization method in a direct manner. As a remedy, Asadpoure *et al.* [1] proposed to use a regularized Heaviside function. Also, Kanno and Fujita [2] proposed to use an alternating direction method of multipliers (ADMM).

In this paper, we introduce the ℓ_p-norm constraint on the vector of degrees of nodes to handle some different fabrication-cost functions in a unified manner. The presented formulation includes the cost functions proportional to the number of members [1] and the number of nodes [2, 3] as two particular cases. Another interesting, and more realistic, case is that the cost of a node is assumed to increase dramatically as the degree of a node increases.

We incorporate the presented constraint in a straightforward manner into a *mixed-integer second-order cone programming* (MISOCP) formulation for truss topology optimization considering the self-weight load [4]. We present numerical examples to illustrate how the difference in the fabrication-cost function affects optimal truss designs.

References

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