How to obtain diverse and efficient structural designs through topological optimization

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Abstract

Shape and topology optimization techniques are widely used to maximize the performance or minimize the weight of a structure through optimally distributing its material within a prescribed design domain. However, existing optimization techniques usually produce a single optimal solution for a given problem. In architectural design, it is highly desirable to obtain multiple design options which not only possess high structural performance but have distinctly different shapes and forms. Here we present simple and effective strategies for achieving such diverse and competitive structural designs. These strategies have been successfully applied in the computational morphogenesis of various structures of practical relevance and importance. The results demonstrate that the developed methodology is capable of providing the designer with structurally efficient and topologically different solutions. The structural performance of alternative designs is only slightly lower than that of the optimal design. This approach holds great potential for practical applications in architecture and engineering. These strategies are applicable to commonly used topology optimization techniques, although examples shown in this study are based on the bi-directional evolutionary structural optimization (BESO) technique [1].

References

[1] X. Huang, Y.M. Xie, *Evolutionary Topology Optimization of Continuum Structures Methods and Applications*, John Wiley & Sons, 2010