

Multi-material optimization for future products by additive manufacturing to minimize dynamic structural response

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ABSTRACT

Multi-material design is receiving a lot of attention in advanced structural designs and is promoted to satisfy various mechanical properties such as weight reduction, strength, ductility in industries. This trend has been enhanced by expecting to the future development of the Additive Manufacturing (AM) technologies [1], capable to use different kinds of materials into single mechanical products. With this circumstance, the present study proposes a multi-material topology optimization method to suppress vibration of a structure with dynamic load. The vibration control mechanism proposed in this research is to combine several materials with different properties of material, such as elastic modulus, density, and viscosity, and derives the damping effect of the entire structure by determining its optimum topology. In this context, we propose an interpolation method of element damping matrix based on SIMP method and conduct some numerical calculation examples to verify the proposed method. It is verified that the proposed method can simultaneously determine both the optimum layout of the entire structure and the optimum arrangement of materials to minimize the vibration such as dampers.

REFERENCES

- [1] Liu, J., Gaynor, A.T., Chen, S., Kang, Z., Suresh, K., Takezawa, A., Li, L., Kato, J., Tang, J., Wang, C.C.L., Cheng, L., Liang, X., To, A.C. Current and future trends in topology optimization for additive manufacturing *Struct. Multidisc. Opt.* (2018) **57**(6):2457–2483.