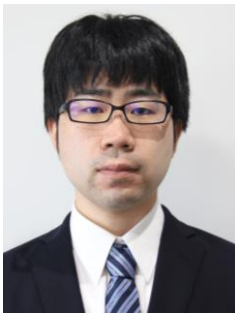

Development of Optimum Design System for Conceptual Design Support

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Research Outline

1. Development of topology optimization methods for convenience and efficiency

In recent years, the trend toward weight reduction has been driven by the Sustainable Development Goals (SDGs) and carbon neutrality. In addition, the safety of many products in the automotive and other industries is becoming more and more important every year. Because of the trade-off between weight reduction and safety, the burden on developers and designers to design lighter and safer products has increased, requiring a vast amount of knowledge and experience.

In our laboratory, we are working on the use of optimum design systems in the conceptual design phase of the design process to reduce the burden on developers and designers and to enable the rapid development of better products. Especially, we focus on topology optimization.

Topology optimization is a method of expressing a structure that achieves a desired objective (strength, mass, etc.) based on information such as design domain and loading conditions by means of a distribution of materials. Currently, we are working to develop a method that is both convenient by reducing the number of arbitrary parameters required for optimization and efficient by obtaining similar results in a small number of iterations. In this document, the stiffness maximization problem is solved as an example, in which the amount of material used is set and the amount of displacement is minimized.

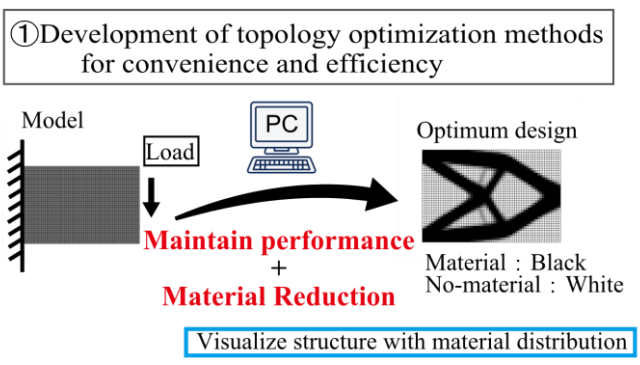

Figure 1 Image of Topology optimization

2. Research on using optimization results to support product development

The topology optimization described in Theme 1 is a simulation in which the theory is constructed using mathematical and engineering knowledge. Therefore, it is necessary to separately examine whether it is feasible to manufacture the product and whether it meets safety standards. In our laboratory, we are also conducting research to evaluate the results obtained from the optimum design by actually fabricating the topology using a 3D printer. This research strengthens the connection between simulation and experiment and makes optimal design available to a wider range of people.

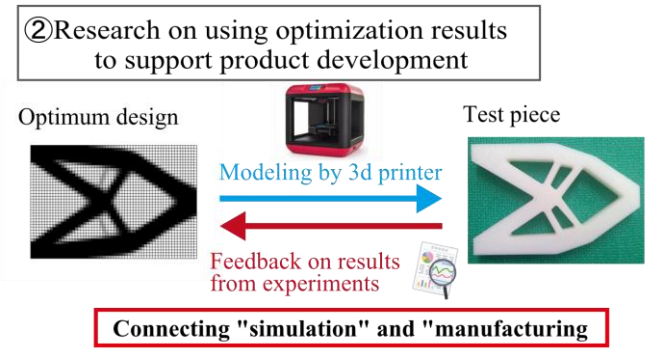

Figure 2 Simulation and manufacturing

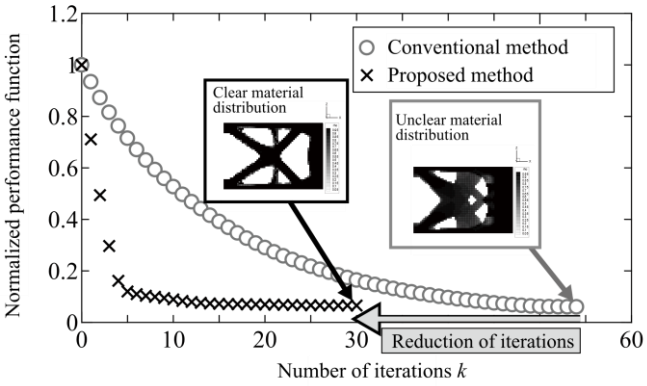

Figure 3 History of performance function in topology optimization for dynamic oscillation problem