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論　文　要　旨
Thesis Abstract

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主論文題名　（Title）**Topology Optimization for Nonlinear Material Structures based on Proportional Technique**

内容の要旨　（Abstract）

Topology optimization is a preliminary process for the structural design to acquire an optimal layout based on each boundary condition. Moreover, the topology optimization is the most complex on the design process due to the optimal layout acquires from an unknown initial design. In automotive manufacturers, a nonlinear design is important for the safety of occupants to increase a deformation while keeping the transmitted load, such as a crashworthiness design. So, this research proposed the methodology and algorithm for topology optimization under material nonlinearities. Solid Isotropic Material with Penalization (SIMP) approach was employed for the optimization algorithm to determine the optimal layout. Element densities of design variables were updated based on a proportional algorithm, which is a non-sensitivity method for finding a suitable value of the element density in each iteration. The new proportional algorithm was introduced and formulated for updating the element densities by concerning the criteria of fully stressed design for topology optimization. The proportional topology optimization for nonlinear material behavior was first verified for investigating the performance of this algorithm by comparing it with the optimal layout on the gradient method. The optimal layout on the proportional technique showed significantly effective for the nonlinear optimization procedure.

Next, a characteristic of bilinear elastoplastic material was concerned for optimizing with the static load was applied. The objective of the optimization problem is to maximize the internal energy of the structure subjected to the maximum limit of the von mises stresses to avoid failure behavior. The results from the geometrical nonlinear structure were completely different when concerned with only elasticity structure. Besides, cyclic loading was applied to the structure for topology optimization under the material characteristic of isotropic and kinematic hardening. In this case, an unloading behavior was considered during the nonlinear

optimization process to acquire the optimal layout. A common weight filtering factor cannot clearly obtain a final layout from topology design when the unloading behavior was concerned. Finally, a new weight filtering factor was introduced to acquire a clear layout from nonlinear topology design without the effect of unloading behavior and possesses all requirements for optimization constraint.

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