JSPS A3 FORESIGHT PROGRAM
GSIS Homogenization and Numerical Analysis
International Summer School
July 31–August 9, 2015

MULTISCALE TOPOLOGY OPTIMIZATION APPLYING A HOMOGENIZATION METHOD

J. Kato[1], D. Yachi[1], S. Nishizawa[1], K. Terada[2]

[1]Department of Civil Engineering, Tohoku University,
Aramaki, Aza-Aoba 6-6-06, Aoba, Sendai 980-8579, Japan,
jkato@civil.tohoku.ac.jp
[2]International Research Institute of Disaster Science, Tohoku University,
Aza-Aoba 468-1, Aramaki, Aoba-ku, Sendai 980-0845, Japan

Key words: *Topology Optimization, Decoupling Multi-Scale Analysis, Hyperelasticity, Microstructures, Homogenization.*

The present study proposes topology optimization for both micro- and macro- structures of composites to maximize the end compliance of the macro-structure, applying a decoupling multiscale analysis [1]. In general, the mechanical behavior of composite materials mainly depends on the geometric properties of the micro-structure such as material distribution, shape or size of constituents. In other words, designing micro-structure is an effectual way to improve the macroscopic structural performance. For linear elastic problems, a previous study [2] introduces the basic concept of the present approach and shows successful results for maximizing the stiffness of macro-structures. The present study tries to extend it to nonlinear structural problems considering hyperelastic behavior, not only for microstructure but also macrostructure simultaneously in 3D. A gradient-based optimization strategy is applied for optimization. It is verified from a series of numerical examples that the proposed method has great potential especially for advanced material designs.

REFERENCES

[1] K. Terada, J. Kato, N. Hirayama, M. Inugai, K. Yamamoto, A method of two-scale analysis with micro-macro decoupling scheme: application to hyperelastic composite materials, Comput. Mech. (2013), 52: 1199-1219, DOI 10.1007/s00466-013-0872-5.

[2] J. Kato, D. Yachi, K. Terada, T. Kyoya, Topology optimization of micro-structure for composites applying a decoupling multi-scale analysis, Struct. Multidisc. Optim. (2014), 49: 595-608, DOI: 10.1007/s00158-013-0994-6.