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BIOMIMETIC TOPOLOGY OPTIMIZATION WITH MULTIPLE LOAD CASES

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Abstract: Michał Nowak, Chair of Virtual Engineering, Poznan University of Technology, Poland Jan Sokołowski, Institut Elie Cartan, Laboratoire de Mathématiques Université Henri Poincaré, France Antoni Żochowski, Systems Research Institute of the Polish Academy of Sciences, Poland Biomimetic topology optimization with multiple load cases The trabecular bone adapts its form to mechanical loads and is able to form structures that are both lightweight but very stiff. In this sense, it is a problem (for the Nature or living entities) similar to the structural optimization, especially the topology optimization. The presented structural topology optimization method is based on the trabecular bone remodeling phenomenon. The developed biomimetic topology optimization method [1] do not need a volume constraint. Instead of imposing volume constraint shapes are parameterized by the assumed strain energy density on the structural surface. Using this approach also the problem of compliance optimization for multiple load cases can be efficiently solved. The results obtained from the multiple load cases analysis are different than those for only one case. Due to unique features of the presented biomimetic optimization method it is possible to find the solution, the stiffest structural configuration directly for the multiple load cases problem. The stiffest design is obtained by adding or removal material on the structural surface in the virtual space. The assumed value of the strain energy density on the part of the boundary subjected to modification is related to the material properties. The results of the 3D structural topology optimization for multiple load cases using the biomimetic approach will be presented.

Reference

[1] Nowak M., Sokołowski J., Żochowski A., Justification of a certain algorithm for shape optimization in 3D elasticity, Structural and Multidisciplinary Optimization DOI 10.1007/s00158-017-1780-7, February 2018, Volume 57, Issue 2, pp. 721–734, 2018