Synthesis of Compliant Micro-actuators for Mechanical Straining of Biological Tissues

Prabhat Kumar*, Ole Sigmund

Department of Mechanical Engineering Technical University of Denmark, Kongens Lyngby, Denmark
*e-mail: pkumar@mek.dtu.dk

ABSTRACT

We present a synthesis approach based on topology optimization for design of compliant micro-actuators for mechanical straining of biological tissues. The designed micro-mechanisms are supposed to provide induced static- and dynamic strains/stresses necessary for growing and studying live tissue. The optimized mechanisms are to be fabricated via a multi-material 50% (v/v) PEGDA (MW700) stereolithography process with high precision 3D printing.

An objective based on least-square error with respect to target strains/stresses is conceptualized and minimized with the given set of constraints and the appropriate tissue environment. The target uniaxial strain in the tissue is considered up to 20%. Both, linear and nonlinear mechanical deformation settings are considered within the optimization and their respective optimized designs and deformation behaviors are compared.

Keywords: Compliant micro-actuators, Topology optimization, 3D printing, Biological tissue