EngOpt2018 - 6th International Conference on Engineering Optimization
Instituto Superior Técnico, Lisbon Portugal • 17-19 September, 2018
Editors: H.C. Rodrigues, J. Herskovits, C.M. Mota Soares, et al.

Abstract ID 1282

APPLICATION OF GLOBAL OPTIMIZATION METHODS IN MULTISCALE INVERSE PROBLEM SOLUTION

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Keywords: numerical homogenization,optimization,inverse problem,biomechanics,FEM

Abstract: The multiscale modelling of materials plays important role in engineering design and biomechanical analysis of tissues. The multiscale methods allow to take into account influence of microstructure of the macro model behaviour. The paper deals with multiscale modelling of hyperelastic biomechanical tissue. The tissue is modelled with use of numerical homogenization technique. The direct problems are solved with use of the Finite Element Method. The mechanical macro parameters of tissue can be obtained on the experimental way, but the properties of microscale sometimes must be determined using inverse problems. The author propose the formulation of the inverse problem as a optimization problem with objective function depended on macro level properties. The design variables describe material properties in micro level. The minimization of objective function leads to design variables values which should correspond with micro level material properties. The nonuniqueness of solutions of the inverse problems are well known problem. The optimization with use of global optimization evolutionary based algorithm is considered, the algorithm is used many times to empirically check the problems with nonuniqueness. The optimization algorithm is implemented in commercial FEM software. The full paper contain information about evolutionary algorithm, implementation of algorithm in FEM software, description of multiscale algorithm, the inverse problem formulation and tests. The material properties in microscale for models of brain tissue are considered as a numerical examples.

Acknowledgement. The research is partially financed from statutory subsidy of the Faculty of Mechanical Engineering of the Silesian University of Technology in 2018 and BK226/RMT4/2018