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INVERSE MODELLING FOR MATERIAL PARAMETERS IDENTIFICATION OF SOFT TISSUES

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Summary: Soft tissue material behaviour modelling has become a significant area of interest of numerous researchers in technical materials. In order to make prediction of the mentioned materials behaviour as accurate as possible, adequate material models must be used. Since soft tissues are nonlinear elastic materials that can undergo large deformations when subjected to loading, it is suitable to take into account application of hyperelastic material models. Some well-known models that are in wide use are Yeoh, Mooney-Rivlin, Odgen, neo-Hookean, Weronda-Vestmann, Humphrey, Arruda-Boyce, Gent and polynomial material models. Those models differ from each other by the number of constants which have to be identified as meaningful material parameters. Some material models even have few variants in order to capture more or less phenomena in material, which correspond to the number of parameters. Also, there are complex material models which are comprised from several components which originate from simpler models. In order to describe the behaviour of soft tissues as accurately as possible, it is not only crucial to select appropriate material model, but also the calibration of the chosen model must be performed. Excluding very simple material models, like those with one (for example, neo-Hookean or the first order Yeoh model, which are equivalent) or two (for example, Mooney and the second order Yeoh model) parameters, calibration of the models is not a trivial task and adequate optimization procedures, like evolutionary algorithms, need to be applied. It especially comes to expression when working with previously mentioned complex material models. This paper proposes solution for the mentioned calibration as an inverse modelling in the application of genetic algorithm with specially developed genetic operators. The algorithm has proved itself to be a suitable tool for automatization of the calibration process and also to be applicable within the scope of the widely available numerical computing environments. Effective genetic algorithm enables the achievement of appropriate values of material parameters for the chosen models and, consequently, the more accurate modelling of the behaviour of soft tissues.