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Inverse modeling of biological tissue using a parameter transformation method

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Characterizing biomechanical behavior of soft tissue is of great significance in understanding disease development. This usually requires solving inverse problem for a highly nonlinear biological system. However, the high nonlinearity easily induces slow convergence or non-convergence issues when solving the inverse nonlinear elasticity problem. To address this issue, a novel approach using elementary algebra techniques of parameter transformation to reduce the nonlinearity of the problem has been proposed[1]. This presentation will present the two parameter case and a generic extension to arbitrary number of parameters. In this presentation, the inverse problem is posed to be a nonlinear optimization problem where the estimated material parameters are obtained by minimizing the difference between the measured and computed strain or stress fields. The computed field is acquired by solving a forward problem at the current estimated material properties at every minimization iteration. To show the excellent performance of the proposed framework, we will compare the convergence rate of solving a number of inverse problems by the standard and proposed methods. Additionally, we will analyze and compare the convergence performance of solving inverse problem using a group of different parameter transformations. Overall, this new approach opens a new door to address the converge issue existing in many optimization-based inverse solvers.

REFERENCES

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