

Bias restrictions for the MRE nonlinear inversion problem

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Deducing constitutive mechanical parameters based on magnetic resonance imaging motion data represents the last stage of magnetic resonance elastography. A various set of strategies are developed to adapt to the tissue and associated parameters. The quantitative identification nonlinear inversion (NLI) problem incorporates a finite element discretization of the governing constitutive equations as an optimization minimization problem. A prominent reconstruction method oriented towards three-dimensional time-harmonic viscoelastic MRE is the subzone approach [1]. Minimization is performed on small overlapping domains allowing faster computations while applying local and global criterions. Optimal constitutive parameters are obtained through gradient methods considering the forward adjoint problem and a weighted data match term least square term [2]. This approach suffers from experimental and numerical bias due to noisy kinematical inputs and geometric imprecision. In addition to these errors, the NLI algorithm becomes highly sensitive to reconstruction parameters such as spatial resolution and initial conditions.

Stability and reliability of this adjoint method is highly depending of the displacement boundary conditions (u-BC) application. We introduce a novel formulation of the adjoint forward problem that does not depends to the u-BC anymore [3]. To validate this coupled approach, we developed a linear viscoelastic incompressible heterogeneous numerical finite element model. Visual and statistical comparison results from reconstructed constitutive moduli using the non-coupled and coupled approach depending on measurement level of noise are presented. We demonstrate that the coupled approach is an efficient strategy for noise-corrupted data identification and a promising tool for quantitative estimations accuracy. Numerical multiparametric incomes and *in-vivo* MRE applications will be discussed.

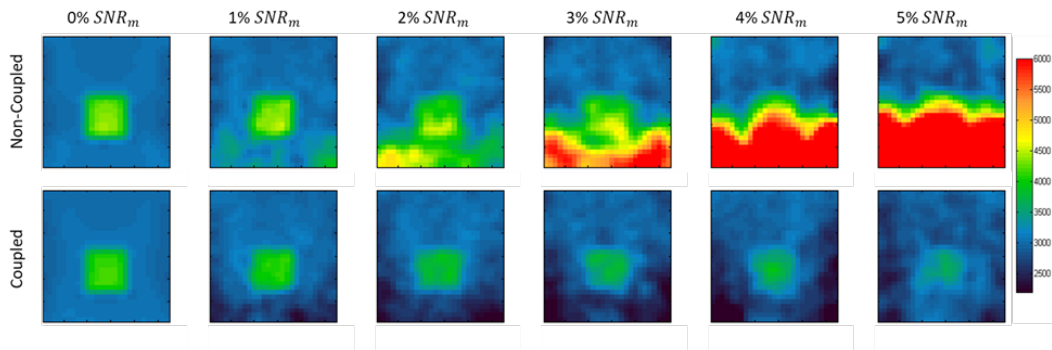


Fig. 1: Impact of noise level comparison between non-coupled approach (top) and novel coupled approach (bottom) analysis based on the reconstructed shear modulus [Pa].

References

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