Estimating the patient-specific relative stiffness between a hepatic lesion and the liver parenchyma

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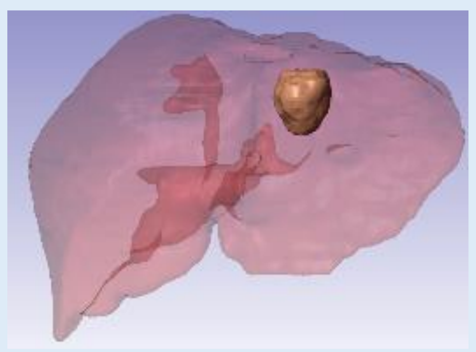
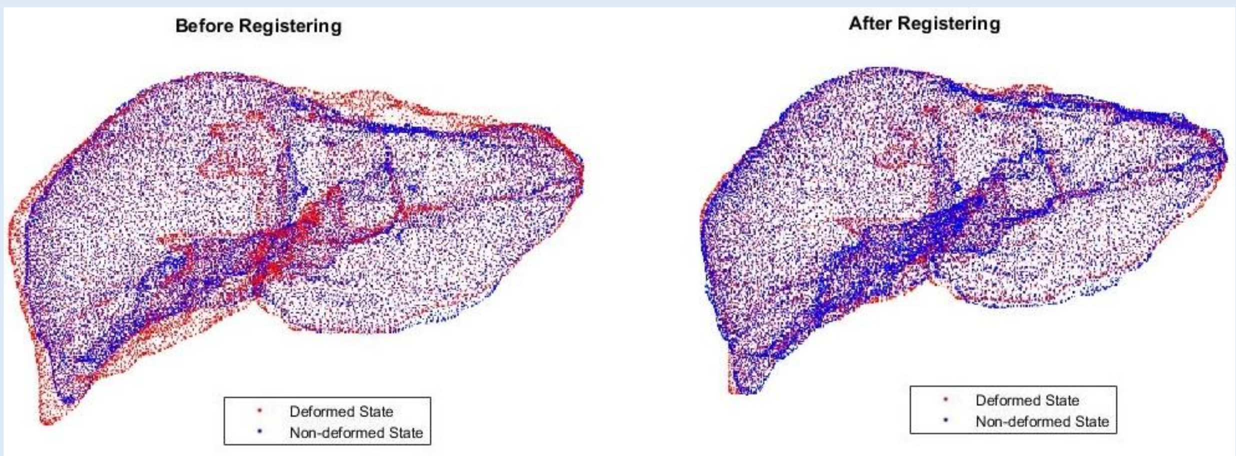
INTRODUCTION

A new non-invasive methodology for the estimation of the relative stiffness between the tumor tissue and the liver parenchyma for patient-specific and in vivo.



MATERIALS AND METHODOLOGY

Boundary conditions with Coherent Point Drift (CPD) algorithm:



Hyperelastic model (Ogden):

$$W_O = \sum_{i=1}^{N} \frac{\mu_i}{\alpha_i}(\bar{\lambda}_1^{\alpha_i} + \bar{\lambda}_2^{\alpha_i} + \bar{\lambda}_3^{\alpha_i} - 3) + \frac{K_O}{2}(J-1)^2$$

Elastic constants:

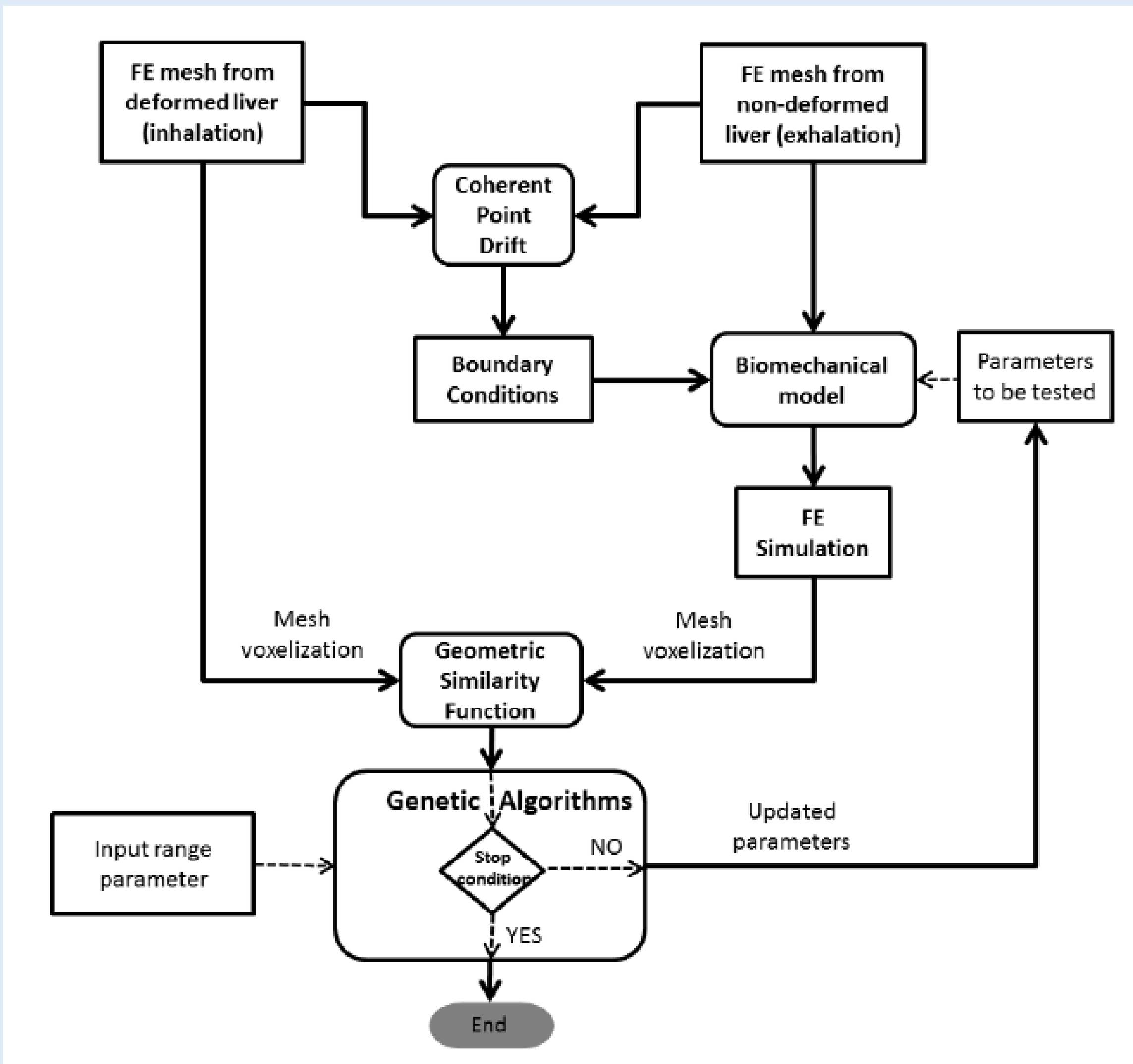
$\mu_L = 364{,}74$ Pa $\qquad \mu_T = k_{rel}\,\mu_L$

$\alpha_L = 16{,}19$ $\qquad \alpha_T = \alpha_L$

Cost function:

GSF = ln((1-JC)MHD)

Iterative Process with Genetic Algorithms:



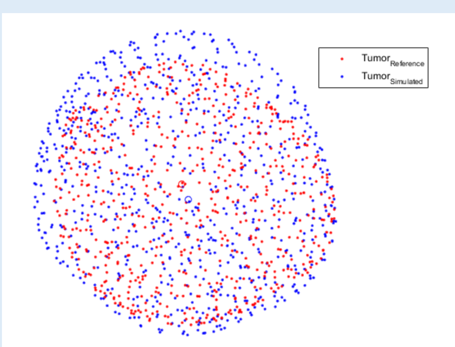
RESULTS

Optimal values of the relative stiffness between tumour and liver:

Sample	k_{rel}	JC	MHD (mm)	GSF
Test Sample 1	10.48	0.9995	0.58	-8.20
Actual Sample 1	12.72	0.89327	1.41	-1.89
Actual Sample 2	1.12	0.8465	1.19	-1.70

Distance of center of mass:

Sample	d_{CM} (mm)
Test Sample 1	0.02
Actual Sample 1	3.92
Actual Sample 2	6.30



CONCLUSIONS

The stiffness of the tumor has been proved to be a biomarker of the type of lesion.
The method could be used to model the behaviour of this hepatic tumor during medical interventions.

ACKNOWLEDGMENTS

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