

# Abstract

The characterization of the mechanical behavior of soft living tissues is a big challenge in Biomechanics. The difficulty arises from both the access to the tissues and the needed manipulation in order to know their physical properties. Currently, the biomechanical characterization of organs is mainly performed by testing *ex-vivo* tissue samples or by means of indentation tests. In the first case, the obtained behavior does not represent the real response of the organ. In the second case, it is only a representation of the mechanical response of the indented areas. The purpose of the research reported in this thesis is the development of a methodology for the *in-vivo* characterization of the biomechanical behavior of two different organs: the breast and the cornea. The proposed methodology allows the *in-vivo* characterization of their biomechanical behavior using medical images.

The research reported in this thesis describes a new approach for the *in-vivo* characterization of the biomechanical behavior of the breast and the cornea based on the estimation of the elastic constants of their constitutive models. This estimation is performed using an iterative search algorithm which optimizes these parameters. The search is based on the iterative variation of the elastic constants of the model in order to increase the similarity between a simulated deformation of the organ and the real one. The similarity is measured by means of a volumetric similarity function which combines overlap-based coefficients and distance-based coefficients.

In the case of the breast, the methodology is based on the simulation of the compression of the breast during an MRI-guided biopsy. The validation was performed using breast software phantoms. Nevertheless, this methodology can be easily transferred into its use with real breasts. In the case of the cornea, the methodology is based on the simulation of the deformation of the human corneas due to non-contact tonometry.