

BREAST MODELING IN THE CONTEXT OF COMPUTER ASSISTED MEDICAL INTERVENTIONS: CHALLENGES AND BOTTLENECKS

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1. Introduction

This work addresses the design of breast biomechanical models in the context of computer assisted medical interventions. Since the last 20 years, many models have been proposed by research labs around the world, for various medical applications, including preoperative planning, diagnosis and clinical biopsy, mammography, image-guided surgery, surgical training or image registration [1-4]. If we target such a breast model to be integrated into a medical device, a digital twin of the patient breast has to be developed with a model that needs to accurately reflect the patient morphology as well as the specific constitutive parameters of each soft tissue implemented in the model (skin, gland, fascias, muscle, ligaments).

2. Materials and Methods

During her PhD, Ana Mira has designed a breast 3D Finite Element (FE) model from MRI data of a volunteer [5]. This model included specific anatomical structures such as skin, adipose and glandular tissues, muscle, suspensory ligaments and pectoral fascias (figure 1). Hyper-elasticity was modeled using Neo-Hookean constitutive material while the stress-free breast geometry was estimated using tissues deformations measurements from MR images collected in prone and supine configurations.

3. Results and discussion

One of the challenges when designing such an FE model is to estimate the patient-specific constitutive parameters from *in vivo* measurements. This has been proposed from local tissue suction with a VLASTIC non-invasive device used on a cohort of 200 women [6]. In addition, MRI data from the same volunteer chosen to design the FE model were collected in a tilted supine position. Breast

shapes in such a position were used to propose optimal constitutive parameters with equivalent stiffness of adipose/fibrogladular tissue that were surprisingly found to be very low (300 Pa). Another challenge is the design of the patient-specific FE model in a short time delay, compatible with the clinical constraints.

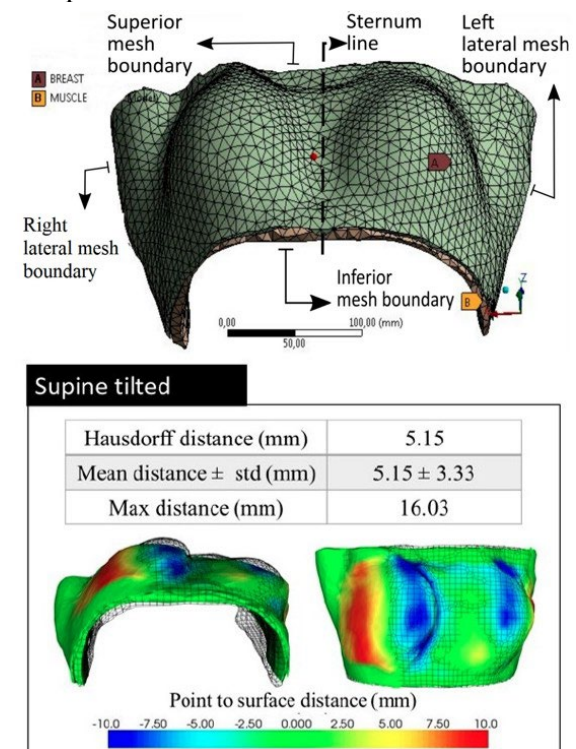


Figure 1: Breast FE model fitted onto MRI data [5].

4. References

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