BREAST BIOMECHANICAL MODELING FOR COMPRESSION OPTIMIZATION IN DIGITAL BREAST TOMOSYNTHESIS

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Mammography is a specific type of breast imaging that uses low-dose X-rays to detect cancer in early stage. During the exam, the women breast is compressed between two plates until a nearly uniform breast thickness is obtained. This technique improves image quality and reduces dose but can also be the source of discomfort and sometime pain for the patient. Therefore, alternative techniques allowing reduced breast compression is of potential interest.

The aim of this work is to develop a 3D biomechanical Finite Element (FE) breast model in order to analyze various breast compression strategies and their impact on image quality and radiation dose.

Previously developed biomechanical breast models use a simplified breast anatomy by modeling adipose and fibro-glandular tissues only [1]. However, breast reconstruction surgery has proven the importance of suspensory ligaments and breast fasciae on breast mechanics [2]. We are therefore considering using a more realistic breast anatomy by including skin, muscles and suspensory ligaments. A particular attention is granted also to the computation of the residual stress in the model due to gravity and to boundary conditions (thorax anatomy, patient position inside MRI machine).

A physical correct modeling of the breast requires the knowledge of the stress-free breast configuration. Here, this undeformed shape is computed using the prediction-correction iterative scheme proposed by [3]. The unloading procedure uses the breast configuration in prone and supine position in order to find a unique displacement vector field induced by gravitational forces. .

Finally, the model is evaluated by comparing the estimated breast deformations under gravity load with the experimental ones measured in three body positions: prone, supine and oblique supine.

References:

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