Abstract

The breast is the most distinctive organ of women's anatomy, and it is vital to support lactation. It is also an important organ in the social relations and affective life of women. For these reasons, the studies related to women's breasts have an undoubtable social importance, and this fact propitiates the collaboration of multidisciplinary research teams and synergy between medical and engineering knowledge and techniques.

The research conducted in the present thesis addresses the study and computerized simulations of breast biomechanics through the use of the finite element method. Given that the breast is a complex organ, this study focuses on breast mechanical aspects analyzed from two real clinical situations of two patients. The first analysis consists of the study of a breast affected by a tumor. A mammography is simulated, and the results of the simulation are compared with those obtained during the clinical practice. In the second analysis, an augmentation mammoplasty is simulated, describing the computer model of a patient before the intervention.

In this study, the role played by computer simulations in the prediction of clinical outcomes in both case studies is enforced. There are a vast number of studies concerning mammography simulations, but not in the field of augmentation mammoplasties. Moreover, there are still many computational aspects which need further analysis and research.

Female breasts are heterogeneous organs consisting of soft tissues that provide a complex mechanical response. In the present thesis, and with the aim of correctly performing the corresponding computer simulations, a hyperelastic formulation of the breast tissues is used, and the equations are implemented in non-linear finite element models. The subsequent and necessary validation of the simulations is done by comparing the simulation results with the clinical outcomes of the patients.