

Real-time breast deformation using non-linear tissue properties

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Abstract: Localization of target structures in open surgical breast procedures mostly rely on localization wires that give coarse orientation hints together with a set of radiological images to convey the extent and location. Patient positioning, however, is different for image acquisition and surgery. We propose to simulate the breast deformation between these positions to track and visualize the target position. To date no sufficiently fast and accurate methods have been proposed for that purpose, which is caused by the computational expensiveness caused by the non-linear behavior of the material. In contrast, the FEM-based simulation framework employed in our work allows for an online update of material attributes, in particular the per-element elastic modulus, which affects the reaction to forces. Fast breast deformation simulation is thereby for the first time amenable to improve accuracy and confidence of breast surgeons compared to the de-facto standard techniques for localization of target structures.