Med Image Comput Comput Assist Interv. 2008;11(Pt 2):798-805.

Dynamic thermal modeling of the normal and tumorous breast under elastic deformation.

Website: http://www.ncbi.nlm.nih.gov/pubmed/18982678

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Abstract

To quantify the complex relationships between (1) the temperature, and temperature differences, on the surface of the breast as recorded byinfrared thermal imaging and (2) the underlying physiological and pathological factors, we have developed a dynamic finite element method for comprehensive modeling of both the thermal and elastic properties of normal and tumorous breast tissues. In the steady state, the gravity-induced deformation is found to cause markedly asymmetric surface temperatures even though all thermal-elastic properties are symmetrical. In the dynamic state, the time course of breast thermal imaging in cold-stress and thermal-recovery procedures is found to be useful in characterizing the origins of the thermal contrast on the breast surface. The tumor-induced thermal contrast has slower temporal behavior than the deformation-induced thermal contrast on the breast surface, which may lead to improvements in breast-tumor diagnosis.

PMID:

18982678

[PubMed - indexed for MEDLINE]