

Apply It.

The math behind...

Breast Cancer Detection Research



Technical terms used:

Inverse scattering, microwave tomography, algorithms, breast cancer detection

Uses and applications:

Microwave tomography can provide a cheaper and less risky alternative to X-ray mammography.

How it works:

Microwave tomography detects cancers by measuring inhomogeneities in the electrical conductivity of breast tissue. An array of low-power microwaves are transmitted into the breast from different positions and the resulting scattered signals are collected by antennas surrounding it. The malignant-to-normal tissue contrast arises because cancerous cells have higher water content, and are hence stronger scatterers than normal tissue.

The electrical properties measured by microwaves are sensitive to physiological parameters such as water content, temperature and vascularization. In addition, they can give an estimate of mammographic breast density, which is a crucial factor in evaluating a patient's risk of breast cancer. The distribution of these electrical parameters in space is used to reconstruct the image of the breast with the help of carefully designed algorithms.

There is room for improvement in the mathematical method that currently exists for image reconstruction in microwave tomography. The problem to be solved is an inverse scattering problem. At microwave frequencies, the inverse problem is difficult to solve accurately because it is highly nonlinear. In addition, it is an ill-posed problem, which means that it does not have a solution in the strict sense, the solutions are not usually unique, and may not depend continuously on the data.

Interesting fact:

The 5-year survival rate for all women diagnosed with breast cancer is 89 percent. *

**Currently, X-ray mammography is the best method to detect breast cancer early when it is easier to treat and before it is big enough to feel or cause symptoms. Having regular mammograms can lower the risk of dying from breast cancer.*

Resources:

1. American Cancer Society, Breast Cancer Facts & Figures 2009-2010 http://ww5.komen.org/uploadedFiles/Content_Binaries/806-316a.pdf
2. Centers for Disease Control and Prevention - http://www.cdc.gov/cancer/breast/basic_info/screening.htm
3. A Visualization Method for Breast Cancer Detection Using Microwaves F. Delbary, M. Brignone, G. Bozza, R. Aramini, and M. Piana, SIAM J. Appl. Math. 70, 2509 (2010), DOI:10.1137/090774720

