Microwave Breast Imaging

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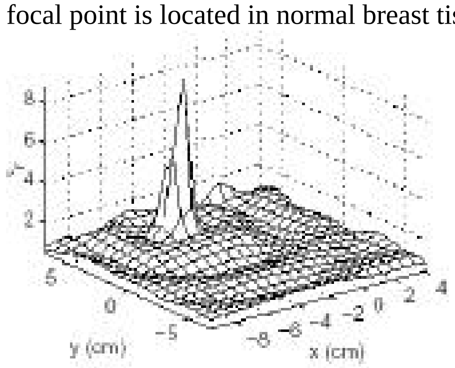
The American Cancer Society recommends that women age forty and over should get annual mammograms, because early detection coupled with prompt and appropriate treatment saves lives. Breast Cancer is the most popular form of cancer in women in the United States. New scientific evidence proves that more lives will be saved if women in their forties get mammograms every year. A mammogram is an x-ray examination of the breast. It is used to detect and diagnose breast disease in women who have no breast complaints and in women who have breast symptoms. Mammograms are safe and effective. The only states without mandated mammography coverage in private health plans are Utah and Wyoming. Some states do not conform to ACS early detection guidelines and some are more "generous" than ACS recommends. Rhode Island specifically states in legislative language that mammography should be covered according to American Cancer Society early detection guidelines.

Reading mammograms is challenging though. A mammogram is like a fingerprint; the appearance of the breast on a mammogram varies a great deal from woman to woman. Some breast cancers may produce changes in the mammogram that are difficult to notice. Because of the difficulties in reading mammograms an alternate imaging technique is being developed.

Microwave Breast Images are images of the electrical properties in the breast. The electrical properties of breast tissue are similar to fat, while the electrical properties of malignant tumors are similar to muscle. Benign tumors are also expected to be different from malignant ones. The contrast in the properties of normal and malignant breast tissue is thought to be significant, so tumors appear very different from normal breast tissue in images. Microwave imaging has the potential to provide both tumor detection and an indication of whether a tumor is malignant or benign.

From a health perspective, microwaves are attractive because they have less energy than x-rays. The breast is illuminated with a pulse of microwaves by an antenna, and reflections from the breast are recorded at the same antenna. The antenna is moved to a set of locations, and data collection is repeated at each antenna. Normal breast tissue is reasonably translucent at the frequencies of interest, so only a small amount of the pulse is reflected from normal tissue. When the pulse encounters a tumor, a much larger reflection occurs. The focusing algorithm used to form the image takes advantage of this much larger reflection. First, the distance from each antenna to a focal point in the breast is computed. The part of the signal recorded at each antenna that corresponds to this distance is selected, and all signals are added together. The focal point is scanned through the breast to form the image. When the focal point is located at a tumor, the reflections from the tumor add together and create a much larger response than when the focal point is located in normal breast tissue.



The problem with Creating microwave images involves solving an extremely complicated problem. This has only recently become feasible with increases in computer power. We are investigating an alternative approach to breast tumor detection with microwave imaging that avoids difficult image reconstruction algorithms. This method is called confocal microwave imaging.