

Breast Cancer Thermography: A Literature Review

Aleksandra Desansky and Professor Murray Loew
Department of Biomedical Engineering

School of Science & Applied Science
The University of Western Australia

Introduction

- Abnormal thermograms (Figure 1.1) are a marker for breast cancer development. Each person has a temperature distribution unique to them which changes in event of high focal, metabolic activity caused by cancer cells.



Figure 1.1 – Normal breast thermogram (left) and abnormal (right) thermogram. <http://www.uprightmideerfield.com/thermogram.php>

2/3 of all biopsies arising from thermography are negative

In an adjunct to other imaging modalities, breast thermography can detect 95% of breast cancer [Jones, 1979]

Drawback: high rate of false positives

It is reported that the results of thermography can be correct 8-10% before mammography can detect breast mass and that the error in thermography is that it is 'too right' - Ng et al. 2001

Objectives

- To provide a critical overview of the work that has been done in the area of thermal imaging and breast cancer detection between 1979 and 2015
- Summarize what was done with breast thermography to guide and stimulate others interested in the field
- Bring attention to absence of standard scientific rigor in thermal imaging and interpretation

Author and Study Size	Hardware/Software	Reported Detection/ Diagnostic Performance
Qi and Heald, 2001, not clinical	Inframetrics 500M camera with a 05K sensitivity	mean, variance, skewness, kurtosis, correlation, entropy, joint entropy
Kapoor et al., 2010, not specified	IRAD40 long range thermal imager having a spectral response of 8µ to 14µ	Not reported
De Oliveira et al., 2013, 328	FLIR Thermo CAM 585	Not reported
Jakubowski, 2008, 80	Not specified	Not reported
E. Y. K. Ng and E. C. Kee, 2008, 82	The thermal imager used was Avio TVS-2000 MMS ST (Tokyo, Japan)	100% sensitivity, 70.9% specificity
Paritsky et al., 2003, 875	Not specified	99% sensitivity, 18% specificity
Sujatha, Ramakrishnan, 2014, 20	a FLIR ThermoCam 545 camera	Variance, contrast, entropy, energy
Snyder et al., 1979, 315	Thermophyl M 201	Not reported
Gonzalez, 2007, not specified	State-of-the-art infrared imager	Not reported

Table 2.1 – Sample of 9 studies reviewed

Methods

- Total 40 papers analyzed, sorted by segmentation (12), classification systems (4), system evaluation (12), and data collection enhancement (4), review (6)
- Evaluated the evolution of sensitivity, specificity, researchers' analysis of results



Figure 2.1 – Proportion of Studies Conducted

Results/Discussion

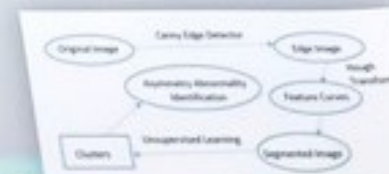


Figure 3.1 – Typical study results [Qi et al., 2001]

- Little documentation on ways to reliably acquire and interpret thermal images; deficient in standardization

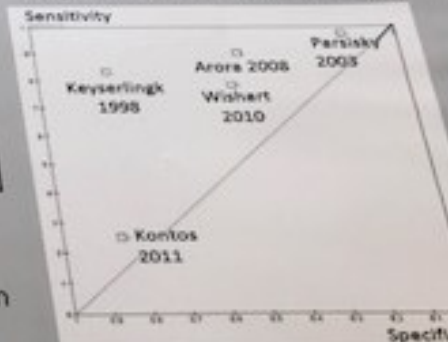


Figure 3.2 – ROC space of Sensitivity and Specificity in studies [Fitzgerald et al., 2011]

Future Work

- Further research on validity of thermography as a breast diagnosis tool and standardization of how the results of ideas are presented
- Automate approach from