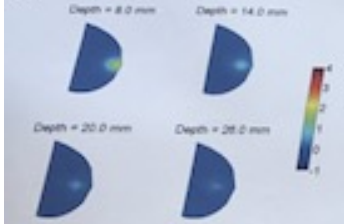
Surface thermal pattern analysis and its relationship with breast cancer: an infrared imaging approach

Shijian Fan, Mahsa Alborz, Murray H. Loew
The George Washington University, Department of Biomedical Engineering, Washington, D.C.

THE GEORGE WASHINGTON UNIVERSITY
WASHINGTON, DC

1. Introduction

Although the mammogram remains the gold standard for breast cancer screening and evaluation, the required radiation and need for physical compression motivate the search for complementary modalities. Previous theoretical and simulation studies in our lab have shown that certain relationships exist between the presence of a tumor and increased localized surface temperature. In this study, infrared images are used for thermal pattern analysis. Volunteer human subjects were imaged in a controlled environmental setting and a series of infrared images were obtained. Software was developed for quantitative analysis and visualization of the obtained images.



-induced temperature alteration with a size of 16 mm at several tumor depths.

rocessing of the infrared images

the inherent noise and defocusing, filtering and TV (Total Variation)-ing methods are used.

sing

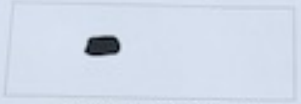
Image after denoising

3. Region-growing (RGW)-based detection methods

To delineate the region with the elevated temperature RGW was used. RGW uses an arbitrary seed point and subtracts the intensity value of the seed point from the adjacent pixels and adds the pixels to the growing region if they have an intensity difference less than or equal to a preset threshold. The threshold within the range 0.3 - 0.5.

1. Original Image

2. Image after denoising



3. Region-Growing result

4. Image with detected warm region

4. Corresponding region finding and comparing

The Hough-based circle finding method was used to find the reference points.

The reference points finding

The corresponding region finding

The Corresponding region

The spatial distribution of pixels with 1% highest values

The reference points were then used to build a relative coordinate system; the distances and angles corresponding to these two points were used to detect the corresponding region on the other breast.

The histogram of the corresponding region was generated, and enabled us to test the significance of the temperature difference of the warmer region in the reference image.

5. The Hessian Matrix-based vessel structure detection

To further show the distribution and influence of the surface vessels, we used a Hessian matrix-based vessel filtering algorithm to find the vessel-like structures within the images.

The result of vessel-like structure findi

6. Future work

For future research, images with p or negative diagnoses will be c with the collaboration of clinici analytical method will be devel evaluating the infrared image assessing the effectiveness of a based modality as an a mammograms.

References

1. L. Jiang, W. Zhan, and M. "Modeling static and dynami of the human breast under el deformation," *Phys. Med. B* 1, 2011, pp. 187-202.
2. Chan, Stanley H., et al. Lagrangian method for to restoration." *Image Proc Transactions on* 20.11