Automated Breast Cancer Detection and Interface Development

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INTRODUCTION

We hope to use infrared imaging as a complementary method to mammography to detect breast cancer. We developed a system to both acquire and analyze infrared images. Promising results have been obtained and confirmed by processing a set of real and artificial images. The system is now ready for evaluation with clinical data.

IMAGE ACQUISITION

Figure 1. A breast thermogram captured using the N2 Imager

The camera used for this study was the N2 Imager loaned by the Army Night Vision Laboratory. It has a 480 x 640 array of detecting elements (17-micrometer pixels). Both the spatial resolution (1-2 mm at distance of 3 ft.) and the thermal resolution (20 mK/count) are sufficient for thermogram analysis based on prior work. For this work, images were taken of volunteers such as the one shown above.

Figure 2. Test image with warm region emulated on right breast.

We emulated cancerous regions by adding Gaussian noise to test images in which the mean variation in temperature matched expected temperature increases from the presence of a tumor.

SEGMENTATION

Figure 3. Going clockwise from top left: a) Image after manual segmentation, filtering, and edge detection b) Morphological operators used to identify longest boundaries c) Breast boundaries identified

Segmentation of the breast region from the rest of the image began with a rough manual selection of a rectangular region. Then, median filtering and Canny edge detection were performed. However, this method highlighted too many boundaries so morphological operators were used to detect only the longest connected edges. We completed our segmentation by selecting the lowest of these breast boundaries.

WARM REGION DETECTION

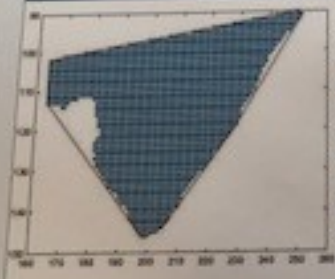

Figure 4. A red convex hull surrounds the identified warm region.

Upon segmentation, a ROI was selected using the largest connected warm region. A convex hull was drawn around these points. Several parameters were extracted including the centroid, the orientation, and the area. To the left is the warm region identified when applied to the test image. Underlying vascularity within the emulated tumorous region lends to its shape.

ASYMMETRY ANALYSIS

Figure 5. ROI and the corresponding region on the other breast are shown within red ellipses.

Given the parameters selected in the previous section, a corresponding region is identified on the opposite breast using the nipples as reference points. Several characteristics of the two regions are contrasted to classify whether a subject ha cancer.

FUTURE WORK

We plan to employ our analysis interface of which is shown ab setting fairly soon. We are cu automate segmentation furth