Snakes Versus ConnectPixels: Segmentation of IR Images for Breast Cancer Detection
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Objective

Develop and compare the accuracy of two methods of automated segmentation used to isolate the breast region of the patients’ infrared images; increasing the accuracy of automated segmentation is important because it limits the area for tumor search, thereby increasing efficiency and reducing false positives.

Introduction

The overall study utilizes infrared (IR) imaging of breasts for tumor detection as an adjunct to mammography. This specific study aims to create a method of segmenting the breast regions to allow for an efficient registration and crop of all images with minimal manual input. Increasing the precision and efficiency of segmentation is necessary for cluster analysis.

Methods and Results

Three volunteers were analyzed using MATLAB. This study compares two pixel connection methods, connectPixels and snakes, to determine which one more closely approximated the natural outline of the breast.

There were difficulties in segmenting subjects with smaller, circular shaped breasts in previous studies [1]. To remedy this, the visible image was segmented and registered to the IR image, to be compared to the manual truth of the IR image. Success was calculated for each method with the Jaccard Similarity Index (JSI), using manual segmentation as truth.

Snakes

The snakes algorithm is a common image analysis technique for segmentation [2]. Snakes is an active contour that fits a curve based on the internal forces of the curve and the external forces of the image data. These forces either promote or restrain deformation of an energy-minimizing polynomial approximation line towards object contours, picking out an object outline from within the noisy 2D image [3].

Methods and Results (Cont.)

ConnectPixels

A combination of Canny, ellipse, and Laplacian of Gaussian (LoG) edge detections, and detection of the warmest five percent of pixels produced pixels that were weighted using a point system. These output pixels that passed the point system were labeled as edge pixels.

Discussion and Conclusion

For direct segmentation of the IR images, snakes was a closer match to truth than connectPixels. connectPixels required less manual input than snakes, but connectPixels had difficulty processing images of smaller breasts, and especially volunteer images. For visible image segmentation, the same trend followed, but the JSI values were lower overall. This could be due to issues with registration between visible and IR images.

Future Research

Future studies will involve automating segmentation further by reducing manual input. The connectPixels method will be developed further to be more accommodating of different breast sizes and ultimately, developed to be a more uniform cropping method. Furthermore, these results rely on the visible images of only four volunteers; using more visible images will increase the significance of the results.

References