Symmetrical Analysis for Thermographic Breast Cancer Detection
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Breast Cancer, in its early stages, is characterized by a significant increase of vascularity in the affected region, prompting blood flow and skin temperatures to increase accordingly. Prior research has indicated not only that the surface temperature of the skin is altered in the presence of a tumor, but also that the natural cooling of the skin over time does not occur at the same rate when a tumor is present. Skin temperature can be measured with a thermal camera, which is passive, fast, and non-contact, thus prompting the use of thermographic image analysis as a novel method for detecting and classifying breast cancer. By performing an assortment of image analysis procedures on these thermographic images, this research aims to develop an algorithm that identifies breast cancer development in patients to assist in physician diagnosis.

The initial goal of this study was to confirm the theoretical conclusion that tumor-affected tissue was significantly warmer than unaffected tissue in a clinical setting, which was achieved by imaging patients from the GW MFA Breast Cancer clinic over a period of 15 minutes each. Our findings indicate that in this 15-minute window, the tumorous tissue stays warmer and cools more slowly than normal, non-tumorous tissue. With this knowledge, we have developed a cluster isolation algorithm, which uses patient and volunteer (cancer-free) images and isolates pixel clusters that have high clinical significance (high correlation with cancer development). Initially, the algorithm clusters the warmest pixels based on iterative thresholding and a Density Based Spatial Clustering Algorithm (DBSCAN). Then, clusters are removed if they are deemed to be clinically unimportant based on three distinct factors: If the cluster crosses the midline, if the cluster has another cluster in a reflected position about the midline, and if the cluster lies on the bottom border of the breast. Only the clusters that pass all three isolation mechanisms are deemed clinically important.

The results from our first iteration of algorithm development indicate high validity when isolated clusters are compared with the known tumor locations (obtained from the GW MFA Clinic). As additional data are gathered, this algorithm will be adjusted appropriately to produce results with increased accuracy. The goal of this project is to provide patients and clinicians a complementary resource for early detection of breast cancer.