THE UNIVERSITY OF MAINE

School of Computing and Information Science

Ph.D. Dissertation Defense
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A Longitudinal Study of Mammograms Utilizing the Automated Wavelet Transform Modulus Maxima Method

Abstract: Breast cancer is a disease which predominatly affects women. About 1 in 8 women are diagnosed with breast cancer during her lifetime. Early detection is key to increasing the survival rate of breast cancer patients, since the longer the tumor goes undetected, the more deadly it can become. The modern approach for diagnosing breast cancer relies on a combination of self-breast exams and mammography to detect the formation of tumors. However, this approach only accounts for tumors which are either detectable by touch or are large enough to be observed during a screening mammogram. For some individuals, by the time a tumor is detected, it has already progressed to a deadly stage. Unlike previous research, this paper focuses on the predetection of tumorous tissue. This novel approach sets out to examine changes in the breast microenvironment instead of locating and identifying tumors. We hypothesized that changes in the breast tissue would be detected by analying a set of time-series digital mammograms corresponding to 26 longitudinal cancer cases. By automating the Wavelet Transform Modulus Maxima (WTMM) method, a mathematical formalism that we used to perform a multifractal analysis, we calculated changes in breast tissue fluctuations across mammograms. The AWTMM allowed us to see with greater detail the changes in mammogram tissue, specifically concerning breast density. The results suggest that signs of malignancy can be observed before standard radiological procedures.