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# Wavelet-based multifractal analysis of dynamic infrared thermograms and X-ray mammograms to assist in early breast cancer diagnosis

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Breast cancer is the most common type of cancer among women and despite recent advances in the medical field, there are still some inherent limitations in the currently used screening techniques. The radiological interpretation of X-ray mammograms often leads to over-diagnosis and, as a consequence, to unnecessary traumatic and painful biopsies. First we use the 1D Wavelet Transform Modulus Maxima (WTMM) method to reveal changes in skin temperature dynamics of women breasts with and without malignant tumor. We show that the statistics of temperature temporal fluctuations about the cardiogenic and vasomotor perfusion oscillations do not change across time-scales for cancerous breasts as the signature of homogeneous monofractal fluctuations. This contrasts with the continuous change of temperature fluctuation statistics observed for healthy breasts as the hallmark of complex multifractal scaling. When using the 2D WTMM method to analyze the roughness fluctuations of X-ray mammograms, we reveal some drastic loss of roughness spatial correlations that likely results from some deep architectural change in the microenvironment of a breast tumor. This local breast disorganisation may deeply affect heat transfer and related thermomechanics in the breast tissue and in turn explain the loss of multifractal complexity of temperature temporal fluctuations previously observed in mammary glands with malignant tumor. These promising findings could lead to the future use of combined wavelet-based multifractal processing of dynamic IR thermograms and X-ray mammograms to help identifying women with high risk of breast cancer prior to more traumatic examinations. Besides potential clinical impact, these results shed a new light on physiological changes that may precede anatomical alterations in breast cancer development.