Advanced integrated technique in breast cancer thermography. 2008

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Abstract

Thermography is a passive and non-contact imaging technique used extensively in the medical arena, but in relation to breast care, it has not been accepted as being on a par with mammography. This paper proposes the analysis of thermograms with the use of artificial neural networks (ANN) and bio-statistical methods, including regression and receiver operating characteristics (ROC). It is desired that through these approaches, highly accurate diagnosis using thermography techniques can be achieved. The suggested method is a multi-pronged approach comprising of linear regression, radial basis function network (RBFN) and ROC analysis. It is a novel, integrative and powerful technique that can be used to analyse large amounts of complicated measured data such as temperature values extracted from abnormal and healthy breast thermograms. The use of regression allows the correlation between the variables and the actual health status of the subject, which is decided by other traditional means such as the gold standard of mammography for breast cancer detection. This is important as it helps to select the appropriate variables to be used as inputs for building the neural network. RBFN is next trained to produce the desired outcome that is either positive or negative. When this is done, the RBFN possess the ability to predict the outcome when there are new input variables. The advantages of using RBFN include fast training of superior classification and decision-making abilities as compared to other networks such as backpropagation. Lastly, ROC is applied to evaluate the sensitivity, specificity and accuracy of the outcome for the RBFN test files. The proposed technique has an accuracy rate of 80.95%, with 100% sensitivity and 70.6% specificity in identifying breast cancer. The results are promising as compared to clinical examination by experienced radiologists, which has an accuracy rate of approximately 60-70%. To sum up, technological advances in the field of infrared thermography over the last 20 years warrant a re-evaluation of the use of high-resolution digital thermographic camera systems in the diagnosis and management of breast cancer. Thermography seeks to identify the presence of a tumour by the elevated temperature associated with increase blood flow and cellular activity. Of particular interest would be investigation in younger women and men, for whom mammography is either unsuitable or of limited effectiveness. The paper evaluated the high-definition digital infrared thermographic technology and knowledge base; and supports the development of future diagnostic and therapeutic services in breast cancer imaging. Through the use of integrative ANN and bio-statistical methods, advances are made in thermography application with regard to achieving a higher level of consistency. For breast cancer care, it has become possible to use thermography as a powerful adjunct and biomarker tool, together with mammography for diagnosis purposes.