

**MAMMOGRAPHIC PHANTOM IMAGES USING RECEIVER
OPERATING CHARACTERISTIC ANALYSIS**

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MAMMOGRAPHIC PHANTOM IMAGE ANALYSIS FROM RECEIVER
OPERATING CHARACTERISTIC (ROC) CURVE

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*To my beloved mother,
sisters and brothers*

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ABSTRAK

Kanser payudara adalah sejenis kanser penyebab utama kematian wanita di seluruh dunia. Sebahagian imej mammografi digital mempunyai hingar dan kontras yang rendah. Teknik pemprosesan imej telah digunakan untuk meningkatkan kualiti imej. Tujuan penyelidikan ini adalah untuk melakukan analisis ciri operasi penerima (ROC) terhadap imej fantom mamografi yang dikenakan dua teknik peningkatan untuk menentusahkan sama ada teknik peningkatan itu meningkatkan kualiti imej. Imej mammografi digital ini ditingkatkan menggunakan teknik morfologi dan ubah bentuk gelombang kecil. Bagi teknik morfologi, imej dipertingkatkan menggunakan pembesaran untuk operasi morfologi dan penutupan morfologi. Bagi peningkatan ubah bentuk gelombang kecil, penuras *wavelet biorthogonal 2.8* dengan dua tahap penguraian ($L=2$) telah digunakan. Empat orang pemerhati menilai imej yang mengandungi nodul, gentian dan mikronodul. Prestasi pengesanan terhadap imej asal dan imej yang telah diproses melalui tersebut dinilai dengan lengkung ROC. Imej juga dinilai berdasarkan tahap kontras, ketajaman serta kualiti imej keseluruhan. Analisis ROC menunjukkan pengesanan terhadap mikronodul memberi luas di bawah lengkungan dan nilai sensitiviti yang lebih tinggi daripada pengesanan terhadap nodul dan gentian. Bagi penilaian keseluruhan kualiti imej menggunakan skala penilaian subjektif pemerhati pula, imej asal menunjukkan nilai min yang lebih tinggi daripada imej yang ditingkatkan.

ABSTRACT

Breast cancer is a form of cancer which is a leading cause of death among women worldwide. Some digital mammographic images are noisy and have low contrast. Image processing techniques have been used to improve the quality of images. The aim of this study is to perform receiver operating characteristic (ROC) analysis on mammographic phantom images subjected to two enhancement techniques in order to verify whether the enhancements improve the quality of the images. The digital mammographic images were enhanced using the morphological and wavelet transform techniques. For the morphological techniques, the images were enhanced using dilation for morphological operation and morphological closing. For wavelet transform enhancement, biorthogonal 2.8 wavelet filter with two levels of decomposition ($L=2$) was used. Four observers evaluated the images that contain fibres, nodules and micronodules. The detection performances of the original and enhanced images were evaluated using ROC curves. The images were also rated based on contrast visibility, sharpness and overall image quality. The ROC analysis showed that detection of micronodules gave higher area index of curves and sensitivity than the detection of nodules and fibrils in all image datasets. For evaluation of overall image quality using observers' subjective rating scale, original images have higher mean values than the enhanced images.