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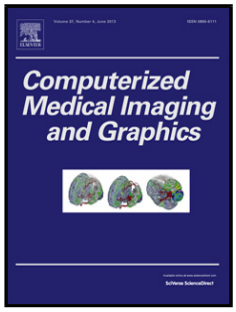

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ACCEPTED MANUSCRIPT

Combined Radiogrammetry and Texture Analysis for Early Diagnosis of Osteoporosis Using Indian and Swiss data

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Abstract

Osteoporosis is a bone disorder characterized by bone loss and decreased bone strength. The most widely used technique for detection of osteoporosis is the measurement of Bone Mineral Density (BMD) using Dual Energy X-ray Absorptiometry (DXA). But DXA scans are expensive and not widely available in low income economies. In this paper, we propose a low cost pre-screening tool for the detection of low bone mass, using cortical radiogrammetry of third metacarpal bone and trabecular texture analysis of distal radius from hand and wrist radiographs. An automatic segmentation algorithm to automatically locate and segment the third metacarpal bone and distal radius Region of Interest (ROI) is proposed. Cortical measurements such as Combined Cortical Thickness (CCT), Cortical Area (CA), Percent Cortical Area (PCA) and Barnett Nordin Index (BNI) were taken from the shaft of third metacarpal bone. Texture analysis of trabecular network at the distal radius was performed using features obtained from histogram, Gray Level Co-occurrence Matrix (GLCM) and Morphological Gradient Method (MGM). The significant cortical and texture features were selected using independent sample t-test and used to train classifiers to classify healthy subjects and people with low bone mass. The proposed pre-screening tool was validated on two ethnic groups, Indian sample population and Swiss sample population. Data of 134 subjects from Indian sample population and 65 subjects from Swiss sample population were analysed. The proposed automatic segmentation approach shows a detection accuracy of 86% in detecting the third metacarpal bone shaft and 90% in accurately locating the distal radius ROI. Comparison of the automatic radiogrammetry to the ground truth provided by experts show a mean absolute error of 0.04 mm for cortical width of healthy group, 0.12 mm for cortical width of low bone mass group, 0.22 mm for medullary width of healthy group, and 0.26 mm for medullary width of low bone mass group. Independent sample t-test was used to select the most discriminant features,

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