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Automatic Identification of Pectoral Muscle

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Abstract : Mammography is a worldwide image modality used to diagnose breast cancer, even in asymptomatic women. Due to its large availability, mammograms can be used to measure breast density and to predict cancer development. Women with increased mammographic density have a four- to sixfold increase in their risk of developing breast cancer. Therefore, studies have been made to accurately quantify mammographic breast density. In clinical routine, radiologists perform image evaluations through BIRADS (Breast Imaging Reporting and Data System) assessment. However, this method has inter and intraindividual variability. An automatic objective method to measure breast density could relieve radiologist's workload by providing a first aid opinion. However, pectoral muscle is a high density tissue, with similar characteristics of fibroglandular tissues. It is consequently hard to automatically quantify mammographic breast density. Therefore, a pre-processing is needed to segment the pectoral muscle which may erroneously be quantified as fibroglandular tissue. The aim of this work was to develop an automatic algorithm to segment and extract pectoral muscle in digital mammograms. The database consisted of thirty medio-lateral oblique incidence digital mammography from São Paulo Medical School. This study was developed with ethical approval from the authors' institutions and national review panels under protocol number 3720-2010. An algorithm was developed, in Matlab® platform, for the pre-processing of images. The algorithm uses image processing tools to automatically segment and extract the pectoral muscle of mammograms. Firstly, it was applied thresholding technique to remove non-biological information from image. Then, the Hough transform is applied, to find the limit of the pectoral muscle, followed by active contour method. Seed of active contour is applied in the limit of pectoral muscle found by Hough transform. An experienced radiologist also manually performed the pectoral muscle segmentation. Both methods, manual and automatic, were compared using the Jaccard index and Bland-Altman statistics. The comparison between manual and the developed automatic method presented a Jaccard similarity coefficient greater than 90% for all analyzed images, showing the efficiency and accuracy of segmentation of the proposed method. The Bland-Altman statistics compared both methods in relation to area (mm^2) of segmented pectoral muscle. The statistic showed data within the 95% confidence interval, enhancing the accuracy of segmentation compared to the manual method. Thus, the method proved to be accurate and robust, segmenting rapidly and freely from intra and inter-observer variability. It is concluded that the proposed method may be used reliably to segment pectoral muscle in digital mammography in clinical routine. The segmentation of the pectoral muscle is very important for further quantifications of fibroglandular tissue volume present in the breast.

Keywords : active contour, fibroglandular tissue, hough transform, pectoral muscle
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