LESION SEGMENTATION OF DYNAMIC CONTRAST ENHANCED BREAST MRI USING MEAN SHIFT METHOD

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Breast Magnetic Resonance Imaging (MRI) is the most sensitive imaging modality for diagnosing primary and recurrent breast cancer, and previous studies demonstrate that breast MRI outperforms other screening modalities for the women at high risk of developing breast cancer. Breast MRI has also evolved as a useful tool in staging of breast cancer; previous studies indicate that breast MRI is more accurate than mammography and ultrasound in estimating tumor size. Thus, breast MRI has promise for improving breast cancer management. Traditional manual interpretation of DCE breast MRI is time-consuming and tedious and can lead to oversight error due to the large size of its four-dimensional data sets (three spatial dimensions plus time). Manual interpretation of lesion morphological features and size is also subject to inter- and intra-observer variability. To facilitate the use of this advanced imaging modality for improving breast cancer care, there is a need to develop an image analysis system to help interpret the breast MR images in a more accurate, efficient, and consistent way. To achieve this goal, it is vital to develop an efficient lesion segmentation method to segment out the lesion from the surrounding tissues.

The lesion segmentation step is crucial because it will lead to accurate lesion localization and size measurement for staging purposes, and delineation of lesion morphological/margin features for classification. In order to eliminate the impact of motion distortion on segmentation performance, we propose to segment the lesion from the surrounding tissues on the first post-contrast image, which also provides the strongest contrast between lesion and non-lesion tissues. This practice is consistent with the American College of Radiology's guidelines that have been published for radiologists to suggest lesion measurement be performed on the first post-contrast image. Rather than attempting to automate the detection step, we assume the Region of Interest (ROI) has already been detected by the human reader. In order to successfully delineate the tissue heterogeneity in the ROI, it is desirable to design an algorithm that can partition the ROI into multiple (more than two if necesary) homogeneous sub-regions.

Very often, segmentation on the basis of image intensity alone lacks spatial coherency. Ideally, spatial information of the image should be incorporated into segmentation scheme. Therefore the mean shift method is applied to the joint spatial-intensity domain in our study. The experimental segmentation results demonstrate that anatomically plausible segmented tissues which are further confirmed by their corresponding kinetic time intensity curves. The proposed method is advantageous in that it is efficient, flexible, and robust.