

Robust Segmentation of Salient Features in Automatic Breast Ultrasound (ABUS) Images

Authors : Lamees Nasser, Yago Diez, Robert Martí, Joan Martí, Ibrahim Sadek

Abstract : Automated 3D breast ultrasound (ABUS) screening is a novel modality in medical imaging because of its common characteristics shared with other ultrasound modalities in addition to the three orthogonal planes (i.e., axial, sagittal, and coronal) that are useful in analysis of tumors. In the literature, few automatic approaches exist for typical tasks such as segmentation or registration. In this work, we deal with two problems concerning ABUS images: nipple and rib detection. Nipple and ribs are the most visible and salient features in ABUS images. Determining the nipple position plays a key role in some applications for example evaluation of registration results or lesion follow-up. We present a nipple detection algorithm based on color and shape of the nipple, besides an automatic approach to detect the ribs. In point of fact, rib detection is considered as one of the main stages in chest wall segmentation. This approach consists of four steps. First, images are normalized in order to minimize the intensity variability for a given set of regions within the same image or a set of images. Second, the normalized images are smoothed by using anisotropic diffusion filter. Next, the ribs are detected in each slice by analyzing the eigenvalues of the 3D Hessian matrix. Finally, a breast mask and a probability map of regions detected as ribs are used to remove false positives (FP). Qualitative and quantitative evaluation obtained from a total of 22 cases is performed. For all cases, the average and standard deviation of the root mean square error (RMSE) between manually annotated points placed on the rib surface and detected points on rib borders are 15.1188 mm and 14.7184 mm respectively.

Keywords : Automated 3D Breast Ultrasound, Eigenvalues of Hessian matrix, Nipple detection, Rib detection

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