LEFT VENTRICLE ENDOCARDIUM SEGMENTATION FROM ULTRASOUND IMAGES USING PDAF WITH CANNY EDGE DETECTION

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ABSTRACT

To characterize heart functionality automatic segmentation of the Left Ventricle endocardium from ultrasound (US) images is a essential step. There are several advantages involved in solving this problem in echocardiography. To access cardiac function of the heart in ultrasound images segmentation of the left ventricle (LV) is an important task. This paper presents a methodology for the segmentation of the LV in three-dimensional echo cardiographic images based on the probabilistic data association filter with canny edge detection. The proposed methodology begins with user input and it comprises the following feature hierarchical approaches such as edge detection in the vicinity of the surface, edge grouping to obtain potential LV surface patches, patch filtering using a shape- PDAF framework (high-level features) and Canny edge detection. This method provides good performance accuracy than the state-of-the-art segmentation methodologies

Keywords: PDAF, LV, Canny edge detection

INTRODUCTION

The endocardium is the innermost layer of tissue that lines the chambers of the heart. Its cells are embryologically and biologically similar to the endothelial cells that line blood vessels. The endocardium also provides protection to the valves and heart chambers. One of the crucial step to characterize heart functionality (e.g. ejection fraction) is automatic segmentation of the Left Ventricle endocardium from a ultrasound images. In a clinical setup, there are several advantages involved in solving this problem in echocardiography. This includes the increase of patient throughput and the reduction of inter-user variability in the LV delineation procedure. Although other imaging techniques, such as MRI and CT, provide images with better spatial resolution, echocardiography is still one of the most preferred modalities due to its temporal resolution, versatility and low cost [1]. However, automatic segmentation in echocardiography is not a simple task since it raises several challenges. First, the US images may contain more than one anatomical structure, meaning that it is necessary to correctly identify the region of interest (i.e. initialization procedure). Second, the borders of those structures may not always be present and they are often difficult to locate due to misleading edges and background noise. This problem is particularly accentuated in echocardiographic images, characterized by low signal-to-noise ratio, weak echoes, scattering, echo dropouts and presence of speckle (i.e., cluttered background and outliers).

This paper presents a methodology for the segmentation of the LV in three-dimensional echo cardiographic images based on the probabilistic data association filter with canny edge detection. The proposed methodology begins with user input and it comprises the following feature hierarchical approaches such as edge detection in the vicinity of the surface, edge grouping to obtain potential LV surface patches, patch filtering using a shape- PDAF framework (high-level features) and Canny edge detection. This method provides good performance accuracy than the state-of-the-art segmentation methodologies

RELATED WORKS

There are several works are done in literature for automatic segmentation of left ventricle endocardium. T. McInerney and A. Hammoude [2, 3] have proposed one of the most promising approaches to the segmentation in echocardiographic images which is called as deformable models. However, they still face two major issues. First, the initialization has a significant influence in the segmentation. This means that different initializations may provide different final shape estimates, introducing user-dependent bias. An automatic initialization solves this problem by guaranteeing that, for a specific volume, the final segmentations are consistent. Second, the presence of clutter hampers the accuracy of the segmentations. Blake et al. [5] the sequential state estimation framework has proved useful in a wide range of applications. The main idea is to use the Kalman filter, combining state predictions and image measurements, to track B-spline contours deformed by linear transformations lying in a shape space (model subspace). Xulei Yang et al [10] have proposed the segmentation method which is based on the random walk (RW) algorithm, which requires user-selected background and foreground seeds. In this paper, the seeds are initialized automatically. The first image frame of a short-axis slice is first partitioned into different regions using the fuzzy clustering algorithm, and the LV region is identified using a heuristic method. Two circular region of interests (ROIs) are then defined based on the estimated centre of the partitioned Left Ventricle region, which are used as the RW seeds initialization to segment the LV of the first image frame. The Left Ventricle segmentation from echo cardiographic images is one of such examples that uses the above framework. For instance, in [6,7], the proposed segmentation is performed in a sequential state-estimation where the extended Kalmam filter is used to recursively update global pose and local shape parameters. In the same spirit [8] the state estimation is combined with an active shape model with the predefined deformation modes. This approach is also applied in [9] in the context of 2D echocardiography. Prashant Bansod et al [11] have proposed fully automatic method for obtaining an initial estimate of endocardial border in short axis echo cardiographic videos at two different levels of left ventricle (LV). The geometry of the acoustic window along with circular Hough transform and image statistics is used to robustly identify the region of interest, which encloses left ventricle, irrespective of image quality and level of left ventricle at which image was acquired.

PROPOSED METHOD

This section describes a methodology that is able to deal with both the initialization and the segmentation of left ventricle. Fig. 1 illustrates an overview of proposed approach. It includes three main blocks: Initialization of the parameters 2) the extraction of the image features such as low level, mid level and high level features points based on their reliability; and 3) segmentation of the surface towards the Left Ventricle border.

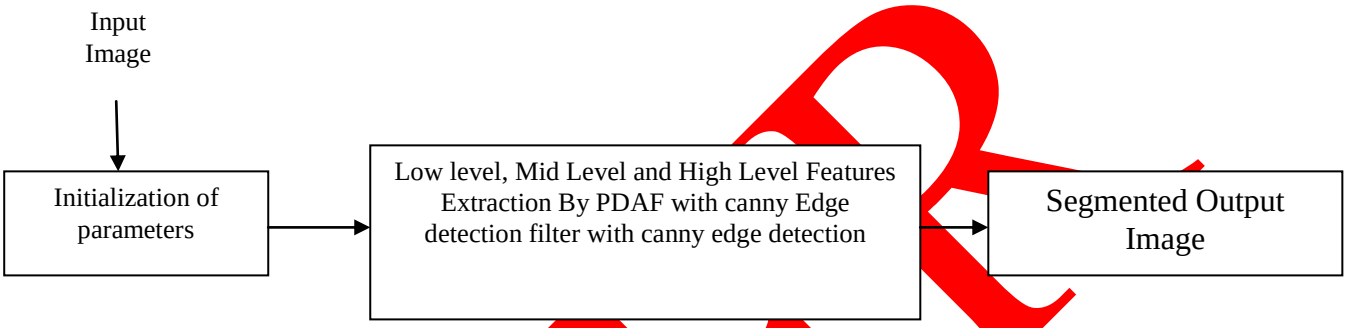

Fig 1 Block Diagram

A. Initialization

Here the initialization requires a user input and it does not need user intervention. It take automatic segmentation of left ventricle border. It has three steps such as identifying the location of the LV center in each plane of the image, computing the left ventricular features and creating the surface model using the information obtained from step 1 & 2.

B. Feature Extraction

This section addresses how feature detection can be performed under noisy images. The proposed feature extraction block includes three steps that aim to produce more reliable Left Ventricle boundary points. The first step consists of the detection of 3D edge points in the vicinity of the surface model, which we denote as low-level features. The second step introduces the notion of mid-level features, which are surface patches formed by grouping low-level features. These patches correspond to edge surface portions that describe the boundary of some structure in the volume. The final step of the feature extraction block consists in estimating the LV boundary based on the detected patches. Since undesired patches (outliers and not belonging to the LV) may be detected, we use a robust shape estimation approach that is able to deal with outliers

C. Canny Edge Detection

The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images. Canny edge detection is a technique to extract useful structural information from different vision objects and dramatically reduce the amount of data to be processed. It has been widely applied in various computer vision systems. Canny has found that the requirements for the application of edge detection on diverse vision systems are relatively similar. Thus, an edge detection solution to address these requirements can be implemented in a wide range of situations. The general criteria for edge detection includes:

1. Detection of edge with low error rate, which means that the detection should accurately catch as many edges shown in the image as possible
2. The edge point detected from the operator should accurately localize on the center of the edge.
3. a given edge in the image should only be marked once, and where possible, image noise should not create false edges.

RESULTS AND DISCUSSION

This section presents a result of the proposed left ventricle segmentation. First the input image is given after that the input image is preprocessed and the features of that input images such as low level, mid level and high level features are extracted. And also canny edge detection is used to improve the segmentation of left ventricle endocardium.

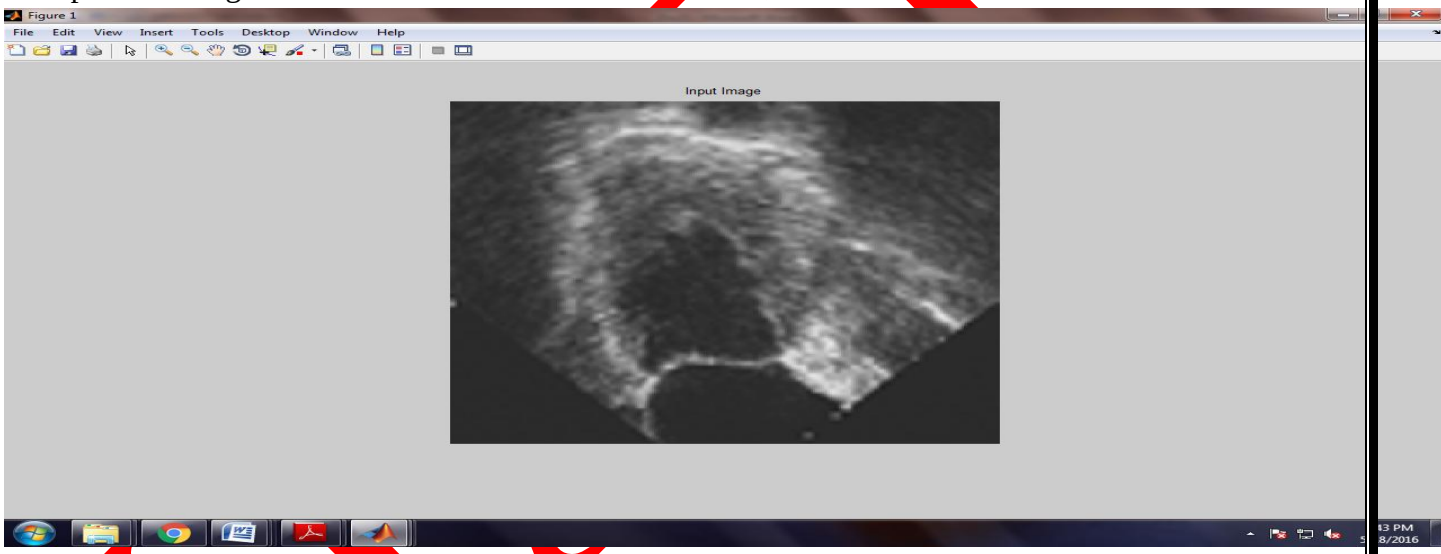

Fig 2 Input Image

Fig 2 shows the input image. The input image is further preprocessed and from the preprocessed image feature values are extracted using probabilistic data association filter method.

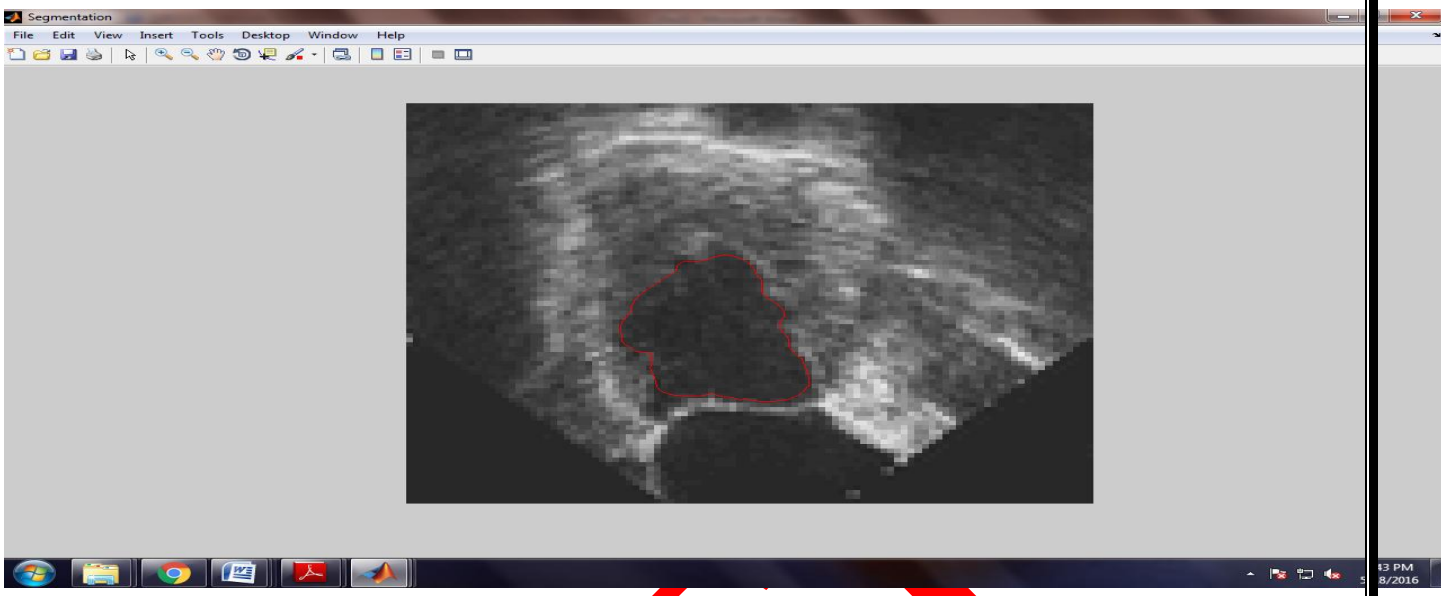

Fig 3 Segmented image

Fig 3 shows that the segmented image. Here the edge of the left ventricle is segmented by calculating the edge features such as low level, mid level and high level features based on probabilistic based data association filter with canny edge detection method.

CONCLUSION

This paper presents a segmentation system to segment the Left Ventricle endocardium. The methodology is based on the use of a probabilistic data association filter with canny edge detection to improve the detection of the ventricle boundary. This segmentation system was coupled with an automatic initialization method to produce a fully automatic segmentation procedure that achieved competitive results when compared to a semi-automatic initialization. The results show that the proposed system performs well compared with state-of-the-art works.

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