• 10.5812/IRANJRADIOL.99140

Deep Learning Approach for Left Atrium Segmentation

Shakiba Moradi[1]; Mostafa Ghelich Oghli[2, *]; Azin Alizadehasl[3]; Ali Shabanzadeh[2]

[1]*Sharif University of Technology, Tehran, Iran*

[2]*Intelligent Imaging Technology Research Center, Med Fanavarn Plus Co., Karaj, Iran*

[3]*Rajaie Cardiovascular Medical and Research Center, Iran University of Medical Science, Tehran, Iran*

**Corresponding author: Intelligent Imaging Technology Research Center, Med Fanavarn Plus Co., Karaj, Iran. Email: m.g31_mesu@yahoo.com*

Abstract

Background: Cardiovascular disease is one of the most common causes of death in the world. Cardiovascular risk is often assessed by analyzing parameters extracted from image data taken from different parts of the heart. Transthoracic echocardiography is a non-invasive imaging modality that is usually the first step of diagnosis procedure. Extracting more information from epical and parasternal views can lead the doctor to early diagnosis. The examination analysis, although has a valuable role, relies on the operator experience. To have a more standard analysis, it is important to reduce the variability of the examination analysis. Automatic image analysis, which is very helpful in this context, can be implemented in image segmentation, parameter measurement, and even diagnosis levels. Left atrial measurements (mostly the atrial volume) are strong predictors of cardiac events. Elevated atrial pressure or increased flow can lead to atrial enlargement. There is evidence that patients with high left atrial volume are at risk of ischemic stroke, heart failure, and atrial fibrillation.

Objectives: The purpose of this paper was to conduct automatic segmentation of left atrium in four-chamber view images to make measurements reliable and independent from expert experience. Generally, most methods of automatic segmentation are based on image processing algorithms that are sometimes too complicated and less accurate. Deep learning models have been widely used in different computer vision areas. These models are mathematically simple and are proven to have better accuracy in computer vision problems. Accordingly, we used one of the famous neural network structures named Unet for left atrium segmentation in 2D echocardiography. Comparing the trained network's results with the ground truth segmentations made by experts, we showed that neural networks were strong choices for automation.

Methods: The dataset used in this research was the public echocardiography image dataset published in CAMUS (Cardiac Acquisitions for Multi-structure Ultrasound Segmentation) Challenge. The data included four-chamber view end-systole and end-diastole frames from 450 patients. Unet is a kind of pyramidal network with encoding and decoding paths. The encoder or contraction path was used to capture the context and features in the image. The second path was the symmetric expanding or decoder path that was used to enable precise localization. The whole task of the network was to classify each pixel in the image to the background or left atrium classes. The loss function in the learning procedure was defined as the Dice coefficient, which depicted the ratio of the number of pixels that were correctly classified. For comparing the method with experts, five-fold cross-validation was used. Each time, 10% of the dataset was used as a test set and 90% as a train set. In the training step, the network learned the train set annotations and in the testing procedure, the performance of the trained network was evaluated based on its predictions on the test set. Dice coefficient, Hausdorff distance, and mean absolute distance (MAD) were used to evaluate the accuracy of the method in echocardiography images.

Results: The calculated metrics were dice coefficient of 91.17%, Hausdorff distance of 3.31, and MAD of 0.71 for the train set and dice coefficient of 88.14%, Hausdorff distance of 4.75, and MAD of 1.67 for the test set.

Conclusion: We showed that using Unet architecture in four-chamber view echocardiography images for bordering left atrium can be a powerful alternative to remove the variability between different experts. Evaluation metrics analysis proved that we can rely on the method predictions and have a more accurate shape of the left atrium for further analysis and measurements such as volume and other features measurement.

• 10.5812/IRANJRADIOL.99142

Skin Lesion Diagnosis Using Ensemble Deep Learning Models

Mehdi Yousefzadeh[1, 2]; Parsa Esfahanian[1, *]; Saeid Rahmani[1]; Hossein Motahari[2]; Dara Rahmati[1, 3]; Saeid Gorgin[1, 4]

[1] *School of Computer Science, Institute for Research in Fundamental Sciences, Tehran, Iran*

[2] *Faculty of Physics, Shahid Beheshti University, Tehran, Iran*