Abstract

Objectives: Cardiac Image Segmentation field have a lot of difficulties when we take the big changes in sequences of images that are of different types. In image sequences, Segmentation of objects which are not fixed is more challenging. To handle such situations, use of Improved Genetic Algorithm for Image Segmentation of Cardiac images is presented. Methods: We propose an algorithm based on Improved Genetic Algorithm, for segmentation of medical image sequences, which uses K-mean clustering. For clustering in the feature space, we used feature vector of two-dimension. Findings: In our paper, for Cardiac Image Segmentation, we are presenting a state of art review of various methods and techniques. Various sequences of Cardiac image have been Registered, and then for segmentation process, single image is used. Novelty/ Improvement: Satisfactory results have been given by the experiments done on Cardiac images.

Keywords: Cardiac Image Segmentation, Clustering, Genetic Algorithm, Image Segmentation

1. Introduction

Heart diseases are the most common reason for death in India and this is the reason why researchers carrying out the study of cardiac medical imaging and considering it as the rigorous topic of their research. Diagnosis and treatment of Heart disease follows the cardiac imaging that consist echo-graphy, coronary angiography, computerized tomography, and cardiac MRI. It is difficult and lengthy process if Segmentation of cardiac image is done manually. In methods like automated cardiac medical segmentation a lot of research scope is available.

In this paper we consider the problem of image segmentation as optimization problems. For solving the optimization problems in medical image segmentation, generally, genetic algorithm and genetic programming are used. Another consideration in medical image analysis is very important which includes the reduction in the computation time of gas, which is also a time consuming process. This paper presented various methods those are based on artificial neural networks for medical image segmentation. Categorization of networks was done into two categories: feedback and feed-forward networks. For classification and function approximation these are effective.

1.1 Genetic Algorithm

In the 1960s, Evolutionary computing was first introduced by I. Rechenberg. His idea was then taken forward by other researchers. Genetic algorithms were invented by John Holland and he later developed it with his students and colleagues. He wrote the first book on genetic algorithms “Adaption in Natural and Artificial Systems” which was published in 1975.
of traits, if the offspring inherit traits from their parents, and if the environment cannot support all members of a growing population, then those members of the population will die out which are with less-adaptive traits, and then those members who are with more-adaptive traits will thrive. Because of this, evolution of species will be resulted. Natural selection will not always result in development of a new species.

To begin algorithm populations are taken. Then a new population will be formed using individuals which are selected from one population. They are selected according to their value of fitness function – as the probability of their reproduction is more if they are comparatively more appropriate than others. After selection, evolution process is carried out.

Mohanta presents a review on applications of Genetic Algorithm for image segmentation. In image segmentation, genetic algorithms are also used for solving parameter selection problem because so many factors need to be characterized.

The genetic algorithm is a copy of machine learning which derives its manners from a simile of the processes of evolution in nature. With a set of solutions also known as population, algorithm is started. Some popular traits of Genetic Algorithms are:

- Both variables, continuous or discrete optimized efficiently by genetic algorithm
- At the same time we can process a large number of variables.
- Variables can be optimized by it with highly complex cost surfaces.
- Instead of a single solution, it gives group of optimum solutions. So, at the same time, different optimization can be obtained.

Pluempiwiwiyawej et al. In his paper discussed a scheme for automatic image segmentation named as novel stochastic active contour scheme that is formed to deal with difficulties.

Galic et al. present a Spatio–temporal segmentation technique based on K-mean clustering. Paper presents that, in the feature space, for clustering, two-dimensional feature vector has been used. In this paper, three features are used for segmentation. The image brightness is the applying feature, which discloses the structure of interest in the image.

Kirisli et al. present an algorithm for whole heart segmentation, which is new automatic segmentation algorithm and also presents a segmentation of cardiac chambers from CTA datasets.

Mahaptra, in a graph cut framework, uses information from prior shape to achieve image segmentation. Original data is used for experiment and in comparison of other competing methods give superior performance.

According to paper, non-synthetic SPECT segmentation and other modalities 4D images are discussed by the author. On SPECT image sequences, the accuracy of segmentation of image is calculated.

The paper presented a specific segmentation difficulties associated to medical image segmentation problems. The author categorizes segmentation of cardiac images into different classes with a main emphasis on the level of external information up to which it is required and for constrain segmentation how it is used.

The paper discussed the problems in segmentation of cardiac images and to initialize the meta-morph models they proposed an automatic image segmentation method. A hierarchy also presented in paper of global and local deformations. Another problem of medical image segmentation using Genetic Algorithm is the computation time.

Soesanti presented an Image segmentation method for Brain MRI images known as optimized fuzzy logic method. In their paper, they applied the modified FCM clustering algorithm. The important aim presented here is to use this method on normal Magnetic Resonance Imaging brain images with tumor and after that examine the portion of tumor from segmented images.

### 2. The Proposed Algorithm

A set of unlabeled points, can be clustered appropriately, in N-dimension into K clusters by using the searching capability of Gas. In our proposed scheme, we are using the same idea on image data. We have taken an m x n size color image and every pixel has Red, Green and Blue components. A sequence of K cluster centers is represented by each chromosome as a solution. Population is initialized in various rounds randomly.

In the first step of fitness computation the clustering of pixel dataset is done according to nearest respective cluster centers such that each pixel \( x_i \) of color image is assigned to cluster with cluster center \( z_j \) for \( j = 1, 2, ..., K \) by the following equations:

\[
\begin{align*}
\text{if} & \quad ||x_i - z_j|| < ||x_i - z_l||, \\
i & = 1, 2, ..., m \times n, l = 1,2,...,K, \text{and } p \neq j.
\end{align*}
\]
In second step new cluster centres are obtained by calculating the mean of each pixel of the related clusters. The new cluster centre $Z_i$ for the cluster $C_i$ is given by

$$Z_i(r, g, b) = \frac{1}{n_i} \sum_{x_j \in C_i} X_j(r, g, b), \quad i = 1, 2, \ldots, K$$

Now the fitness function is computed by calculating Euclidean distance between the pixels and their respective cluster by using following equations

$$M = \sum_{i=1}^{K} M_i$$

$$M_i = \sum_{(x_j, r, g, b) \in C_i} \sqrt{[(x_j - z_i) \cdot (r,g,b)]^2}$$

Over the cluster set, the segmentation of input Cardiac image is done having fitness value greater than all others.

### 3. Results

In experiment 1 shown in Figure 2 distinct image sequences of Cardiac image has been registered first and then for segmentation process only single image is used while Figure 3 shows segmentation results from MRI image. The image taken as input and the output segmented image are shown.

### 4. Conclusion

In our paper we have presented so many review methods for Cardiac Image Segmentation. After review of various methods and techniques this becomes clear now that there are so many methods with enhanced Specificity, Sensitivity and Accuracy are available by using which we can segment the Cardiac image. It is also clear that a promising future is there for Medical imaging as the universal segmentation problem. Our aim is to enhance this approach for classification of disease. Here an algorithm is proposed for Cardiac medical images segmentation based on Improved Genetic Algorithm. Results obtained from experiments on Cardiac images are satisfactory.

### 5. References

1. Estrada FJ, Jepson AD. Benchmarking image segmentation algorithms. International Journal of Computer Vision. 2009 May 28; 85:167–81. Crossref
2. Farmer ME, Shugars DS. Application of genetic algorithms for wrapper-based image segmentation and classification. IEEE Congress on Evolutionary Computation; 2006 Jul. p. 1300–7.
3. Halder A, Pathak N. An evolutionary dynamic clustering based color image segmentation. International Journal of Image Processing. 2011; 4(6).
4. Khashandarag AS, Mirnia M, Sakhavati A. A new method for medical image clustering using genetic algorithm. International Journal of Computer Science. 2013 Jan; 10(1).
5. Pluempiwiiriwaej C, Moura JMF, Wu Y-JL, Ho C. STACS: New active contour scheme for cardiac MR image segmentation. IEEE Transactions on Medical Imaging. 2005 May; 24(5).
6. Galic S, Loncaric S. Cardiac image segmentation using spatio-temporal clustering. Proceeding SPIE 4322, Medical Imaging 2001: Image Processing; 2001 Jul 3. Crossref
7. Kirisli HA, Schaap M, Klein S, Neefjes LA, Weustink AC, Van Walsum T, Niessen WJ. Fully automatic cardiac segmentation from 3D CTA data: a multi-atlas based approach. Proceedings SPIE 7623, Medical Imaging 2010: Image Processing. 2010 Mar 12; 7623.
8. Mahapatra D. Cardiac image segmentation from cine cardiac MRI using graph cuts and shape priors. Society for Imaging Informatics in Medicine. 2013. Crossref
9. Montagnat J, Delingette H. 4D deformable models with temporal constraints: application to 4D cardiac image segmentation. Medical Image Analysis. 2005; 9(2005):87–100. Crossref
10. Petitjean C, Dacher J-N. A review of segmentation methods in short axis cardiac MR images. Medical Image Analysis. 2011. Crossref
11. Metaxas D, Chen T, Huang X, Axel L. Cardiac segmentation from MRI-tagged and CT images. 8th WSEAS International Conference on Computers, Special Session on Imaging and Image Processing of Dynamic Processes in biology and medicine; 2004.
12. Khashandarag AS, Mirnia M, Sakhavati A. A new method for medical image clustering using genetic algorithm. International Journal of Computer Science. 2013 Jan; 10(1).
13. Moghaddam MJ, Soltonian-Zadeh H. Medical image segmentation using artificial neural networks. Image Analysis Lab., Radiology Department, Henry Ford Health System, Detroit, Iran Michigan, USA; 2011 Apr.
14. Maulik U. Medical image segmentation using genetic algorithms. IEEE Transactions on Information Technology in Biomedicine. 2009 Mar; 13(2).
15. Soesanti I, Susanto A, Widodo TS, Tjokronagoro M. Optimized fuzzy logic application for MRI brain images segmentation. 2011 Oct; 3(5).
16. Sukassini MP, Velmurugan T. A survey on the analysis of segmentation techniques in mammogram images. Indian Journal of Science and Technology. 2015 Sep; 8(22). Crossref
17. Naveen A, Velmurugan T. Identification of calcification in MRI brain images by k-means algorithm. Indian Journal of Science and Technology. 2015 Nov; 8(29). Crossref