Characterization and Variation of Segmentation Methods by Euclidean Distant Model Using Optical Coherent Tomography Image

G Mohandass, R. Ananda Natarajan

Abstract— Optical coherence tomography (OCT) is non-invasive imaging, depth-resolved the biological tissue in examination by high resolution cross-sections of retinal morphology. Segmentation algorithms of threshold methods are an entity characterized to detect intra-retinal layers of Central serous chorioretinopathy (CSR) diseases in OCT images. The algorithm is characterized by comparing the statistical techniques such as Mean square error (MSE), Normalized cross correlation (NCC) and Maximum Difference (MD). The estimation of Variation is done by multidimensional analysis in evaluating the relation of the algorithm and characterizes using Euclidean distant model. This work implies the statistical survey with the taken sample segmentation methods, Interpretation of this relational by data analyst, report the particular set of data is more appropriate deciding with appreciate of segmentation methods.

Keywords— Segmentation, multidimensional analysis, Euclidean distant model

I. Introduction

THE Central Serous Retinopathy (CSR) effect the photoreceptor layer in the retinal pigment epithelial (RPE) cells of the retina lies above the choroid, Fig [1]. The RPE affect the macular region of the retina i.e., Centre of fovea. The RPE layer actually detaches to form a small cyst in the area of the macula. The cyst changes the shape of the retina, in result effect distorts vision.

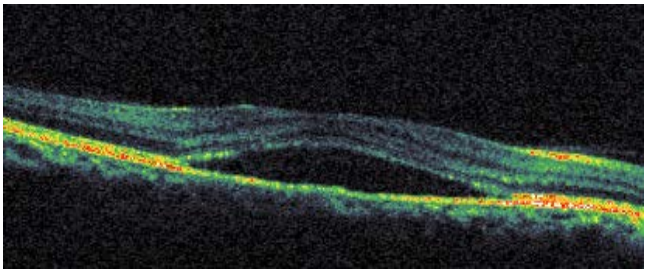

Fig. 1 Central Serous Retinopathy (CSR – OCT) - detached from RPE layer.

Image segmentation is the multiple segment process of partitioning a digital image. The objective of segmentation is to attain effective information and significant image analysis.

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Threshold techniques, which make decisions based on intensity levels of the objects and local pixel information. Here segmentation methods chosen on the categories of the threshold methods in four groups i.e., Clustering based threshold methods, Entropy-based threshold methods, locally adaptive threshold methods and threshold algorithms based on attribute similarity. Multidimensional Scaling [1] is statically based on the dimensional analysis of producing a visual display of the distances between pair of methods. MDS is similar to cluster analysis of similar/dissimilarity data; which relate the quality of research. Euclidean Distance model give the relation distant between the algorithms and similarity or dissimilarity.Here, statistical image processing is implemented with three parameter. Mean square error is to quantify the difference between values implied by an estimator and the true values of the quantity being estimated.

Normalized cross correlation (NCC) is measure of brightness in the image and template can vary due to lighting and exposure conditions, the images can be first normalized. This is typically done at every step by subtracting the mean and dividing by the deviation. Maximum difference between two elements gives the variation of larger and smaller element in numbers. Maximum difference between two elements gives the variation of larger and smaller element in numbers.

II. Methods

Based on the categories, segmentation methods are analysed with CSR-OCT image with the different segmentation algorithm. Adaptive Smooth filter is the standard deviation of those pixels to attain image sharpness based on the new calculation by surrounding valid pixels. Filter techniques are applied before segmentation process.

Categorize the threshold techniques [2] [3] are given as:

(i) Clustering based thresholding methods - Kittler, Lloyd, Otsu, Riddler and Yanni.
(ii) Locally adaptive thresholding methods - Niblack, Palumbo and Sauvola.
(iii) Thresholding Algorithms Based on attribute similarity - Tsai Segmented Method.
(iv) Entropy based thresholding methods - Kapur

Based on the categories, mostly known and basic segmentation methods are selected for this quality analysis process.Riddler [4] Segmentation method was one of the first iterative schemes based on two-class Gaussian mixture

models. At iteration , a new threshold is established using the average of the foreground and background class means. Otsu [5] Segmentation method suggested minimizing the weighted sum of within-class variances of the foreground and background pixels to establish an optimum threshold.

Kapur [6] Segmented image is by entropic threshold, the sum of the two class entropies is a maximum the image is said to be optimally threshold. Lloyd [7] segmentation is minimum error threshold which can be characterized by a mixture distribution of foreground and background pixels with equal variance of Gaussian density functions and the threshold that minimizes the total misclassification error. Tsai [8] Segmentation threshold method is based on attribute of similarity measure between the original image and the binarized version of the image. Kittler [9] Segmentation works on approximating the histogram as a bimodal distribution with probability density functions and finds the cut-off point so as to segment the image into either foreground or background. Niblack [10] is Local threshold method adapts the threshold based on the calculation of the local mean and standard deviation over a window size so as to suppress noise. Palumbo [11] segmentation method is locally adaptive threshold methods where threshold values have been suggested. Yanni [12] Segmentation threshold value is distinct two peaks values of gray level are identifiable with the summation of probability mass functions (pmf) with mid values as limits. Sauvola [13] Segmentation method claims to improve on the Niblack method especially for stained.Statistical Image Data analysis is done by Multidimensional scaling (MDS) to evaluate similarity or dissimilarity data which is located close together. Inter-point distances is measuring of values, variety of distance is weighted Euclidean distance model. By the OCT-CSR image, output is compared with original image and distorted images with statistical techniques. Based on the comparison, Multidimensional values are obained for MSE, NCC and MD.

Mean Squared Error (MSE) is the average squared difference between a reference image and a distorted image. It is computed pixel-by-pixel by adding up the squared differences of all the pixels and dividing by the total pixel count. The use of cross-correlation for template matching is motivated by the distance measure (squared Euclidean distance) Maximum Difference (MD) is standard rating scales where, the maximum absolute difference of the images. Maximum difference gives indicate the best and worst scaling by produces a rank between the items tested plus a metric distance between the items. The ranks are established at individual methods, they can vary greatly across respondents.

III. Results

The output of varies segmentation methods are given below in the fig. [2] - [12]. This output of image segmentation methods is obtained by Matlab and VSG tool. The Multidimensional data are given in graphic representation in fig. [13][15][17].

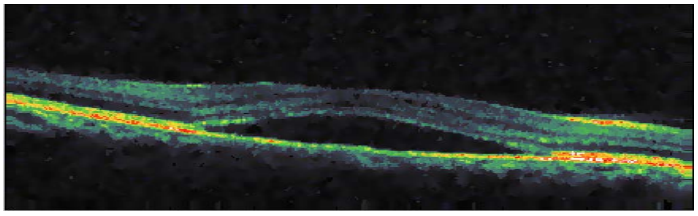

Fig. 2 Adaptive Smooth Filter

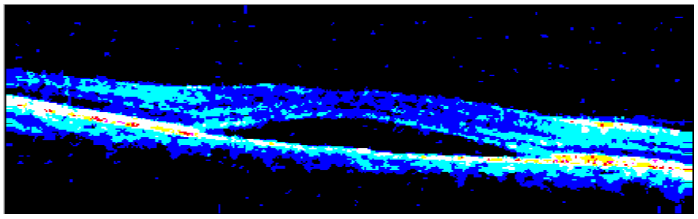

Fig. 3 Kapur Segmentation

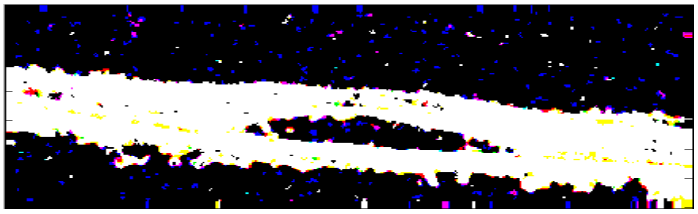

Fig. 4 Kittler Segmentation

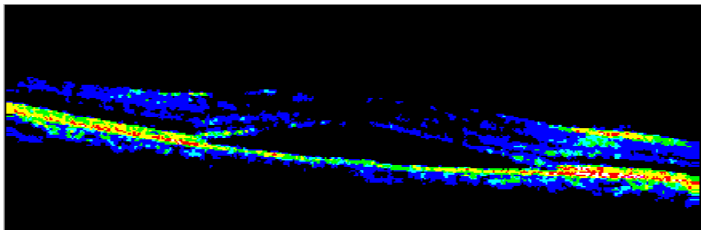

Fig. 5 Lloyd Segmentation

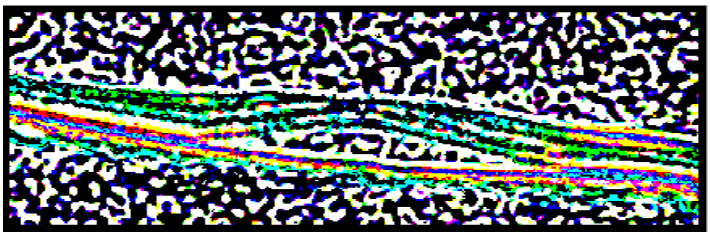

Fig. 6 Niblack Segmentation

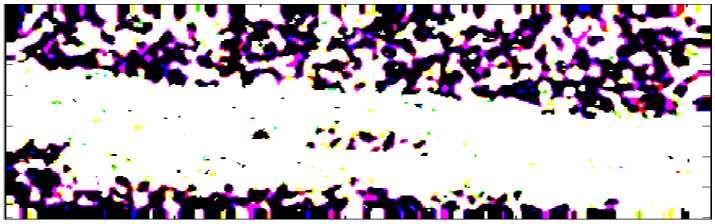

Fig. 7 Otsu Segmentation

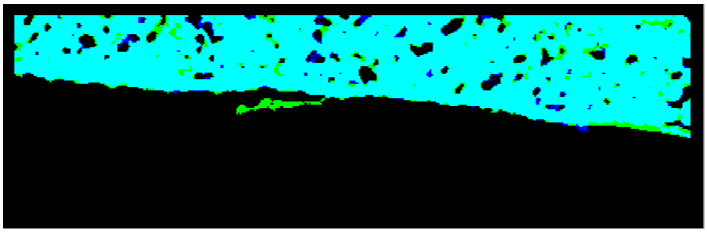

Fig. 8 Palumbo Segmentation

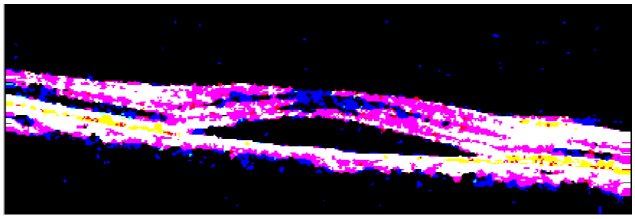

Fig. 9 Riddler Segmentation

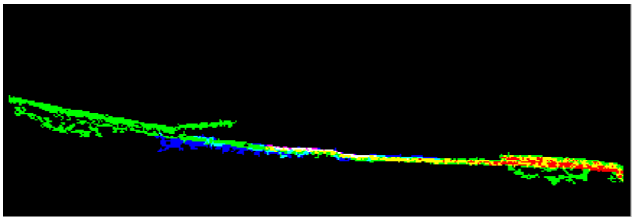

Fig. 10 Sauvola Segmentation

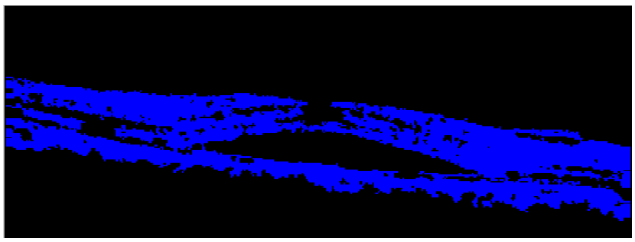

Fig. 11 Tsai Segmentation

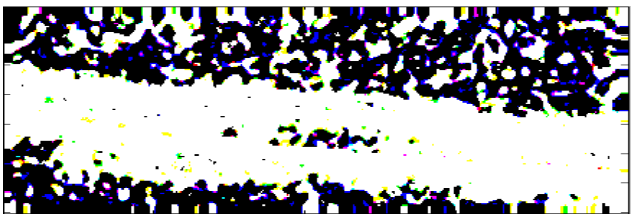

Fig. 12 Yanni Segmentation

In graph, x - axis and y - axis represent name of segmentation methods. The range in graph is the values obtained by statistical techniques, respectively. The corresponding result of Euclidean distant model by MDS is given in the Fig. [3][5][7]. Dimension 1 and Dimension 2 represent the multidimensional values of MDS, equal diagonal values, corresponding to x - axis and y - axis .An Otsu segmentation method is peak value of MSE techniques.

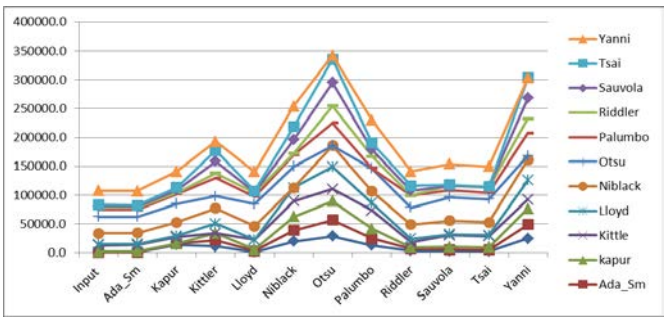

Fig. 13 Multidimensional values- graph for Mean Square Error (MSE)

The Euclidean distant model, the result is cluster analysis to identify segments with similar/Dissimilar responses.

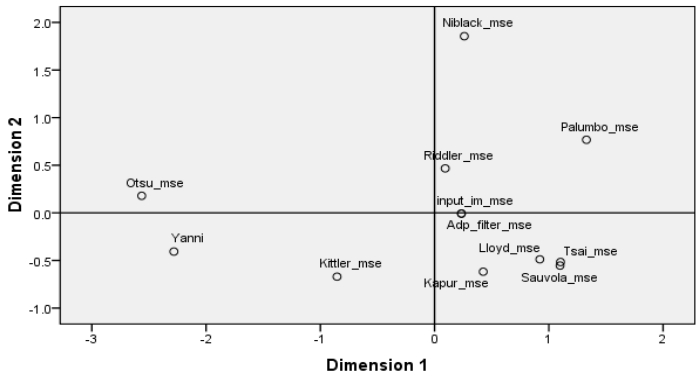

Fig. 14 Mean Square Error (MSE) Euclidean Distant Model

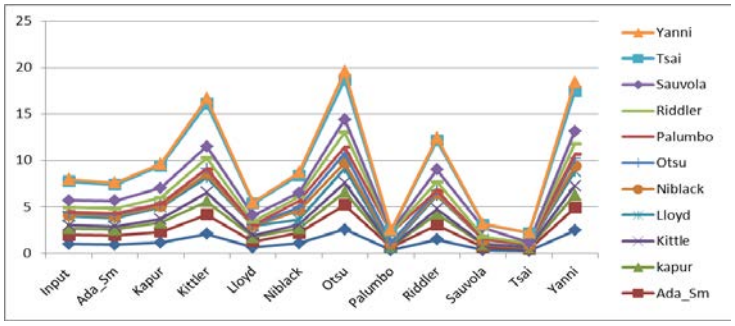

Fig. 15 Multidimensional values-graph for Normalized cross-correlation (NCC)

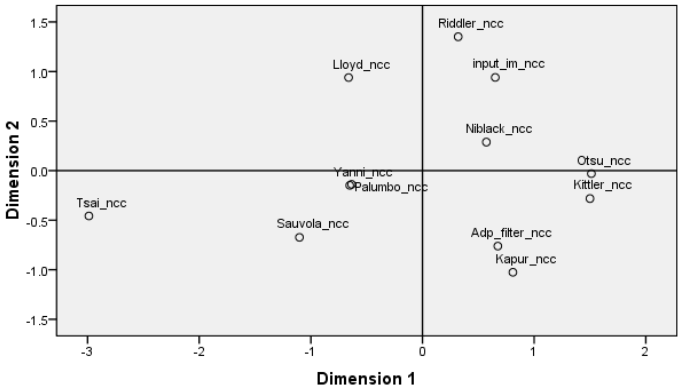

Fig.16 Normalized cross correlation (NCC) Euclidean Distant Model

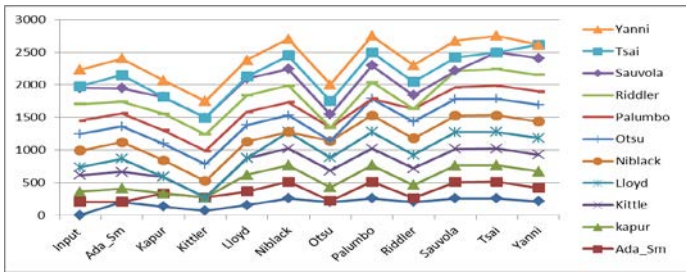

Fig. 17 Multidimensional values- graph for Maximum Difference (MD)

The graph in Fig. [19] represent of input image of CSR-OCT with different segmentation methods by Statistical techniques of MSE, NCC and MD. MSE values have higher values in comparing with NCC and MD.

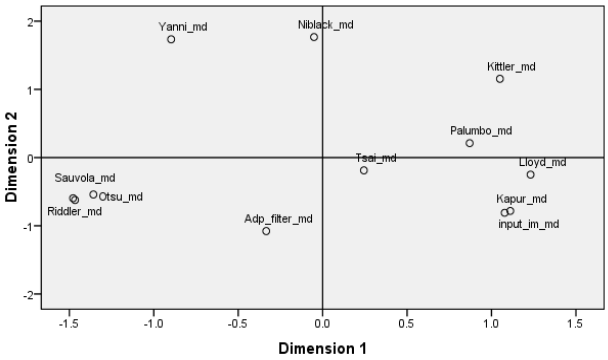

Fig. 18 Maximum Difference (MD) Euclidean Distant Model

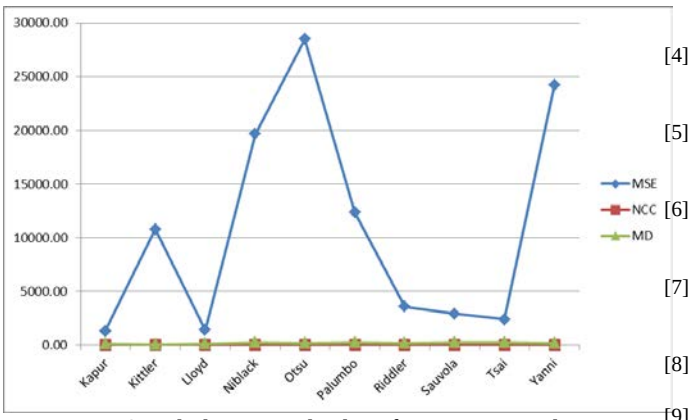

Fig. 19 Multidimensional value of input image and Segmentations methods

In the taken sample segmentation methods, gives clear output in the methods of Kanpur, Kittler, Lloyd and Riddler. Other segmentation which gives unclear segmentation methods are Otsu, Palumbo, Sauvola and Yanni. Segmentation result give partial outputs are Niblack and Tsai. Analysis of Fig. 14, Otsu and Yanni segmentation methods are the high rank and Palumbo segmentation method are is least rank in MSE. In Fig.16, Tsai and Sauvola segmentation methods are the high rank and the least rank are Otsu and Kitter segmentation methods in NCC. Similarly for MD, Fig. 18 Riddler and Sauvola segmentation methods are the highest rank and Lloyd segmentation method is the lower rank by MDS values.

IV. Conclusions

This study contributes from the result to understanding of relation to identify the similarity or dissimilarity between the segmentation methods in OCT-CSR image. Multi-dimensional scaling support and ranked most on symptoms sequence according to prevalence. Clustering of segmentation methods is obtained in MSE. The clustering analysis can be done with respective of the four quadrant with respective of dimensions. Based on the smaller in distant of Euclidean Model, group the relation of similarly and dissimilarly is done. Segmentation value of NCC and MD are located in right side of Dimension 1. MSE have higher in values in compare of NCC and MD. Based on the clustering of MSE, most of the similar segmentation methods is identified.

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References

[1] J. Natalia, C. Anastasova, "A Review of Multidimensional Scaling (MDS) and its Utility in Various Psychological Domains", Tutorials in Quantitative Methods for Psychology, University of Ottawa, Vol. 5(1), p. 1-10, 2009.

[2] Sankur B., Sezginb M. Image Thresholding Techniques: a Survey over Categories. Journal of Electronic Imaging, vol. 13(1), (2004) pp. 146-165.

[3] Mehmet Sezgin, Bulent Sankur, "Survey over image thresholding techniques and quantitative performance evaluation", Journal of Electronic Imaging, 13(1), 146–165 Jan. 2004.

[4] T.W. Ridler, S. Calvard, Picture thresholding using an iterative selection method, IEEE Trans. System, Man and Cybernetics, SMC-8 (1978) 630-632.

[5] Otsu, N., "A Threshold Selection Method from Gray-Level Histograms," IEEE Transactions on Systems, Man, and Cybernetics, Vol. 9, No. 1, 1979, pp. 62-66.

[6] J.N. Kapur, P.K. Sahoo, A.K.C. Wong, A New Method for Gray-Level Picture Thresholding Using the Entropy of the Histogram," Graphical Models and Image Processing, 29 (1985) 273-285.

[7] D.E. Lloyd, Automatic Target Classification Using Moment Invariant of Image Shapes, Technical Report, RAE IDN AW126, Farnborough-UK, December 1985.

[8] W.H. Tsai, Moment-preserving thresholding: A new approach, Graphical Models and Image Processing, 19 (1985) 377-393.

[9] J. Kittler & J. Illingworth: "Minimum Error Thresholding" Pattern Recognition, Vol 19, nr 1. 1986, pp. 41-47.

[10] W. Niblack, An Introduction to Image Processing, Prentice-Hall, 1986, pp: 115-116.

[11] P.W. Palumbo, P. Swaminathan, S.N. Srihari, Document image binarization: Evaluation of algorithms, Proc. SPIE Applications of Digital Image Proc., SPIE Vol. 697, (1986), pp:278-286.

[12] M.K. Yanni, E. Horne, A New Approach to Dynamic Thresholding, EUSIPCO-9: European Conf. on Signal Processing, Vol. 1, Edinburg, 1994, pp: 34-44.

[13] J. Sauvola, M. Pietaksinen, Adaptive document image binarization, Pattern Recognition, 33 (2000) 225-236. C.K. Leung, F.K. Lam, Performance analysis of a class of iterative image thresholding algorithms, Pattern Recognition, 29(9) 1523-1530, 1996.

[14] G Mohandass, Dr. R. Anandanatarajan "Statistical Analysis of Reliability in edge detection techniques using Optical Coherent Tomography image" Indian Journal of Computer Science and Engineering (IJCSE), ISSN: 0976-5166, Vol. 4 No.2 Apr-May 2013.