CHAPTER 1

INTRODUCTION

1.1 PREAMBLE

Image segmentation is one of the basic early vision problems in computer vision paradigm. Detection and tracking of moving objects in a given scene serves as the front end of an automated vision system. Often the challenge in many applications in the background pixels of the pixel gray scale is significantly different gray levels. In some cases, the scene with many objects and background can be. Threshold in the background, individual objects, such simple situations, but it is an effective tool. Operating segments of their shape, size, relative positions, and other characteristics can be analyzed on the basis of the threshold image regions later. Thresholded image requires less storage space than the original one and hence more suitable for transmission.

1.2 THE GENESIS OF THE THESIS

Image segmentation is one of the most important problems, further complicated in the field of computer vision. Its main function is the basis for most subsequent analysis tasks images, which stems from the fact. Disjoint regions of the image plane of the distribution of the final segmentation is considered the basis of the threshold image regions later a wide variety of image processing tasks. This interesting vision problem of the machine still has a growing number of publications.
1.3 OVERVIEW OF THE RESEARCH WORK

Object detection and monitoring must be done detection and analysis of bio-medical image, and so on. cracking, such as fault diagnosis, monitoring, control, monitoring and real-time visual tracking threshold for a simple and effective strategy provides a possible solution for real-time applications running, its simplest form, for example, the object and the bottom, the two groups of pixels in the image gray values equal to or below the threshold, pixel gray values above the threshold, including some of these and other as well as treats classified. This is called threshold at two levels. Generally one can select more than one threshold and used to divide the set of gray values in several sub-ranges.

Since then, each grayscale value corresponds to an object class, several ranges correspond to multiple objects, background and so many classes. This process is known as a multi-level threshold. Image segmentation, where major efforts to support the development of strategies for the new threshold has been stable for more than three decades. Proposed methods can be classified as; (I) global thresholding techniques, and (ii) the Adaptive Threshold methods. Global thresholding methods can be classified as an appendix; (A) Threshold two levels, and (b) multi-level threshold. In this regard, a number of techniques have been reported in the literature. Plans and strategies for the literature suggests an overall threshold may be taken as a whole; (I) histogram based methods, (ii) based on entropy methods, (iii) based classification methods, (iv) higher order methods based on statistical methods, (v) based on local features. Images were obtained in a non-uniform lighting conditions to address real-world environment, many methods have been proposed for adaptation. A variety of techniques, the problem is formulated in a stochastic optimization problem and optimization techniques, such as particles and therefore, a genetic algorithm. Swarm optimization was
used to determine the optimal threshold. In general, the methods used to obtain data or information in any shape or form is based on the histogram. Parametric and no additional parametric methods, these methods can be classified as. A brief description of the methods that have been proposed in the different approaches shown. Below are brief descriptions of proposed methods based on different approaches. In the following, the proposed methods based on different approaches have briefly been described.

1.3.1 Non-parametric Shape based Methods

One of the landmark work on non parametric method is Otsu's (1979) method Where to find the optimal threshold has been the use of information and histogram form. Result gray level classes to be separated, as in this study, the optimal threshold was reached. You minimize conflicts with built-in turn-class maximize the variance between classes of optimal threshold is determined by this method. Otsu method twofold problem and promising results can be extended to multi-class problems. But computationally expensive problems multiclass Otsu method. This method has proven effective in the histogram bimodal distribution is clearly exposed. A fast search scheme has been presented by Reddi et al (1984) interclasista between dark and bright regions, contrary to maximize one or more thresholds. The authors of an otherwise available Reddi et al (1984) studied the issue of convergence proposed by Otsu method works faster. You minimize conflicts with built-in turn-class maximize the variance between classes of optimal threshold is determined by this method. They are also small compared to the background area object, a bi-histogram method, and in such a situation, highlighted the Otsu segmentation method produces optimal threshold bad results. The image was corrupted by additive noise, a clear and bi-mode failure Otsu histogram segmentation scheme thereby lost the results the scheme in Otsu segmentation fault.
Otsu method has limitations, it is not part of the method, the distribution function of image does not depend on the availability of integrated features, based on the histogram mode Boukharouba Hay et al (1985), presented by eliminating automatic method segmentation image. Since the shape of the histogram method exploits the subtle variations, the method is almost flat histograms can be successfully treated. The optimum correlation threshold function found in the art bilevel original image and image threshold obtained by maximizing the ratio Brink (1996), and is suggested for optimum threshold. As a result, it has been-function Brinks (1996) is maximized by Cseke et al (1990) The method of Otsu (1979) notes that the method is the same. Dong and Yu (2004) and the distribution unit two-dimensional histogram to determine the optimal threshold to provide iterative search process fast and efficient. Threshold is contrary to the idea of approaches based on this, (2006), Hou et al Otsu method, and on the eve of the class with the class of expatriates expats results may be biased towards large component of variance showed that. Only then, demonstrate that contrary to the threshold minimum error method based on the class methods (MCVT) the minimum threshold. The method of Otsu (1979) notes that the method is the same. Dong and Yu (2004) and the distribution unit two-dimensional histogram to determine the optimal threshold to provide iterative search process fast and efficient. Threshold is contrary to the idea of approaches based on this, (2006), Hou et al Otsu method, and on the eve of the class with the class of expatriates expats results may be biased towards large component of variance showed that. Only then, demonstrate that contrary to the threshold minimum error method based on the class methods (MCVT) the minimum threshold. Recently, Liu and Yu (2009) Otsu method multilevel thresholds, K-means objective function, and reduces both the intraclass variance, based on the same criteria are shown. Use the attributes above criteria developed for the new threshold.
Threshold automatic detection of low contrast, low signal to noise ratio, complex patterns and images, the image gray level and its dual counterpart, the optimal threshold correlation between phase detection is a difficult task, as was proposed by Belkasim et al (2003) and esta method has to be better than many other methods. Histogram distribution is very typical, because it is clear segmentation of color images, blind, or class distribution is displayed in a valley alone is a difficult problem. In such cases, the proposal Kwon (2004) is a technique to detect the optimal threshold based on the cluster analysis. His technique can blind segment Color correct images. To address these issues, there has been a reference point Thresholding Qiao et al (2007), recommended by a small segment of individual objects. These criteria vary the intensity of the operation and development of knowledge about objects and background within the dispersion class and Wen-Nung (1993) is based on the weighted sum of different intensity. Could it be that the proposed algorithm successfully cut synthetic and real images of small objects.

Use proposed optimum threshold information in the form of a histogram Furthermore, the spatial characteristics found histogram based schema Zhang and Zhang (2009). They discriminability of spatial histogram features and correlation function and mutual information to measure the Fisher criterion is used. Stressing the homogeneity of the background object, emphasizing the heterogeneity of the distribution of gray levels has been the benchmark for the new discriminant been overcome some shortcomings in Otsu's method of Chen et al (1994) proposed.

Threshold Thresholding A new approach Fuang-ration scheme is proposed and became the eve of the region of interest within a diverse range of background restricted classification is determined by minimizing errors Hui Ng (2006) proposed. The success MRI (MR), and can be tested with CT
images. In view of the small objects in a scene, and esta difficult problem of segmentation, a new threshold has been the benchmark of current knowledge of the different acerca intelligence Qiao et al (2007) was developed. Thresholding the object and the background of the criteria and the dispersion within a class based on the weighted sum of different intensity. As a result, Wilkinson et al (2003) and Parzen window technique histogram is obtained by integrating the new function proposed criterion. Threshold method and minimum errors maxi-mum Otsu cross entropy method proved better than the method of function and optimize this reference in global optimum threshold is achieved better than Otsu's minimum error threshold method and maxi-mum cross entropy method.

Another modification technique histogram histogram based on the modified beam theory and general information for optimal threshold to minimize You and Pal (2007) are offered by. Offers Dong et al (2008), the objective function is iterative algorithm based on minimizing the sum of squared errors weighed. Otsu algorithm are proposed method, but requires less computational burden is proof of that. In addition to finding the optimal threshold segmentation, edge detection, thresholding method is dealing with unimodal histogram Carnicer and Cuevas (2008) proposed. The unimodal histogram algorithm has performed satisfactorily in different images. A transition region Hacker et threshold algorithm is based al (2001) proposed by it is robust and easy to place algorithm. Instead of defining the threshold for the histogram Chengxin et al (2003) Thresholding partition interval histogram intervals for automatic segmentation scheme volume has been developed. Efficient Algorithm Threshold method and minimum errors maxi-mum Otsu cross entropy method success Cai and Liu (1998) by the size of the breast tissue can be demonstrated that the segmentation.
Also Otsu method based on the standard deviation of the new strategy has been to threshold and Liu Li (2009) and the proposed method different images can be tested successfully. In addition, we are in fractional differentiation strategy based on the notion Nakib Thresholding et al (2009), and this segment is also offered by many real-world images have been possible. Thresholding discuss support has been implemented so far out of line. Ali Al-Osaimi in the attempt (2008) to establish an artificial vision system for automatic thresholding scheme Been in real time. A threshold algorithm was De Maria et al (2008) and histogram-this scheme has been implemented in real-time, real-time FPGA based controller has been created and developed later. Recently, Lai Jian et al (2009) using Altera Cyclone II FPGA chips Could have been applied in real-Otsu method to segment images in real-time environment while. Threshold based on histogram method developed to detect stars in astronomical images automatically Mehmet and Eid al (2000) has been proposed.

1.3.2 Evaluation Method

Thresholding the past three decades, many algorithms have been proposed to achieve proper classification and there, so there was a need to evaluate the performance of this amount. Lievers and Pilkey (2004) was the performance analysis and computation block threshold efficient algorithm for the evaluation of events that was introduced. Towards the end of this, Zhang and Desai (2001) have proposed methods; Analysis (I), (ii) the empirical goodness, and (iii) an empirical variance. In this paper, I have provided a degree of skill evaluation algorithm. The algorithms are evaluated based on the criteria of goodness and inconsistency. His next work of Zhang (2001) has reviewed the evaluation methods based on kindness and inconsistency. I also like some of the inner region of the same criteria, regional inter-regional
basis, in addition, we are in fractional differentiation strategy based on the notion the forty number of mis-segmented pixels, the image of the position of objects in the number of mis-segmented and segmented objects of different values of functions. Sezgin Sanku (2004) thresholding methods and programs are based on nondestructive testing and evaluation study.

1.4 ENTROPY BASED THRESHOLDING METHODS

In parallel with the concept of using nonparametric shape of the histogram, the histogram of the new concept of histogram based threshold gray level of research domains entropy (1980), presented by Pun. Posteriori maximization of entropy for a priori determined to set thresholds have been. Consistently, (1989) facilitated the gray level histogram Tansese derivation of entropy threshold based on the asymmetry of automatic threshold selection. Vincenzo and Vittorio (1995) also use the method of their esta work programs advocated for multi-thresholding. Pun (1981) was the main concept-Kapur et al (1985) and based on entropy analysis of a new algorithm was proposed for real and artificial histograms. The concept of entropy-based threshold is not suitable for modifying the Shannon entropy can be seen by many researchers introduced a new definition of entropy and related esta Pal and Pal (1991) exploited. This is proving to be effective in many cases. The concept of entropy and segmented versions of the image while minimizing the cross entropy is optimal threshold Lee and Lee (1993) and Pendoc Brink (1996) and Pal and Pal (1993) is selected, has been extended. Threshold based on cross entropy is the first Li and Lee (1993) and The unimodal histogram algorithm has performed satisfactorily in different images the proposed information provided by an impartial assessment of the theoretical sense method, the image is binarized version.
In addition to the Cross Entropy Entropy on codirector of a matrix based image entropy Entropy Thresholding Chang et al (1994) proposed was used. Built-de ester entropy local work and methods described and relative entropy Otsu threshold (1979) and Kittler's method (1986) was compared with the local Althouse (1995), is of interest. Iterative method based threshold entropy cross was proposed by Li et al (1998) and many more at esta true threshold based on entropy is an extension Sahoo et al (1997) for the test can be carried out by images based on Renyi Entropy Threshold is this.

Overall, it was the gray-level image entropy probability distribution on the set. The important result of improved spatial information of the image is measured by entropy measure of entropy criterion function has been included to prepare the Brink (1996) was edited by. Jinsong, and (1999) Methods Hongqi Kapur et al (1985) and performed by Sahoo et al have proposed using a genetic algorithm (1997). Glover and the Netherlands both single and multi-thresholding methods described above are more or less based on the Shannon entropy 1988 with all entropy-based methods have been solved using a genetic algorithm. (2000) Nicolas amount of entropy and entropy are based on Shannon entropy Thresholding using criteria that are better than this scheme esta prepared based segmentation is shown in the results. Calculation of load threshold based maximum entropy was Yasser (2003) offered by Iron Learning (RL) paradigm is reduced using Q-learning algorithm. Yin method has shown that the algorithm is suitable for applications multilevel thresholding. In Yin's method, it has also been shown that the algorithm is suitable for multilevel thresholding applications.

Besides, a thresholding algorithm using Tsallis entropy has also been proposed by Moreover, using Tsallis entropy threshold algorithm and we Talibdoan Eloteifi (1998), and the transition region, the local entropy based method has been proposed for extracting the Chengxin, et al (2003) proposed.
Later, the vessel detection algorithm based on local entropy Chanwimaluang and Fan (2003) and the method developed by the promising results in many samples. Relative entropy threshold algorithm based on two-dimensional histogram of us, instead of a one-dimensional histogram of the image to the optimal threshold Get Zhu Hui et al (2002) have proposed was used. Yang Shu et al (2005) have proposed fast algorithm based on the selection of the entropy of a single dimension. On the eve of the account exactly what has been recently Renyi entropy and minimum cross entropy based Threshold Threshold has been proposed for the determination of SAR images Shareha et al (2008) proposed. Also known as entropy extensive Tsallis relative entropy has been used for the preparation of the strategy and the optimal detection threshold was Tsallis entropy generalized entropy formalism to apply information theory. Biomedical images Entropy thresholding algorithms base Dizdaroglu 2009 approved for ultrasound images. Entropy based thresholding algorithms have also been validated for biomedical images specifically ultrasound images by Dizdaroglu 2009.

Is spatial correlation between pixels in the United States Shafait et al (2008) have no effect on the basic concept of the separation of the background object found. Spatial distribution of the gray levels per pixel images should be considered in conjunction with the two-dimensional entropy thresholding method based on the first two (2006) was presented by. Noise ratio (SNR) when the signal drops in Qingming et al (2005) based on 2-D entropy approach proposed to produce such impressive results. Accordingly, the Chen et al (1994) proposed threshold based on the two-dimensional entropy algorithm for reducing the computational load is fast. It was one of edges reduced processing times shown. Furthermore, based on wavelet transform algorithm is faster 2D entropy Thresholding Qing Wang et al (2008) have been proposed by. In particular, ultrasound images, the algorithm is based on the minimum cross entropy of two-dimensional Zikuan Chen
(2008) and developed by the algorithm can be successfully tested for ovarian cysts. Additional algorithm based on two-dimensional entropy of the extended algorithm is optimal threshold has flown the Tsallis entropy-Le Havre-Charvát. Thresholding strategy 2D Tsallis entropy has been used recently as a result of additional iron two-dimensional threshold segmentation algorithm with previously proposed methods produce better results. Recently, Tian Hou (2009) using two-dimensional histogram Tsallis entropy thresholding method offered oblique image segmentation. Been method also has the advantage ESTA other methods.

1.4.1 Multi-thresholding Approach

A major research effort to distinguish between the object and the background of a scene, and considering that the focus was on a two-level classification. This is an optimal threshold to be determined. This offer multiclass problems simple thresholding methods can be applied to multi-threshold paradigm that has often been argued. In this sense, it was on the eve of a recursive technique and Xiaoyi and Daniel (1995), and the multiple algorithm esta histogram thresholds can be detected successfully. Very thresholds and large, the histogram was obtained by segmenting the histogram. The concept of multi-threshold algorithm has three phases of the scheme Papamarkos et al (2000 and 1994) proposed; (I) the grouping of the hill, (ii) histogram segmentation, and (iii) reduction technique for gold. The algorithm can successfully identify two peaks. While multimodal histogram, a method of Gaussian kernel that was too a thresholds to detect problems multiclass Tarasev (1989) offered. From the class of algorithm performance can be compared to methods based on the concept of dispersion and entropy. Thresholding strategy 2D Tsallis entropy has been used recently as a result of additional iron two-dimensional threshold segmentation algorithm with previously proposed methods produce better results.
To accelerate the convergence of support schemes, multi-thresholding three-speed multi-thresholding Du-Ming et al (1995) have been proposed. One of the recurrent nature of support and, therefore, have reached the highest thresholds using esta As a result, after the start of a two-level threshold. Later, Yin (1999), Genetic Algorithm (GA) and genetic algorithm was used to make the optimal technique Thresholding using a more practical approach to high-speed multi-Thresholding proposed scheme. Third-speed multi-Thresholding based on maximum entropy theorem esta techniques and computationally cheaper and quickly calculates the threshold. GA also has soft computing techniques are based technique multi-threshold is an analysis of key components (PCA) is carried out by Papamarkos et al (2000) and Kohonen self-organizing feature map (SOFM) neural network is proposed.

Songcan and Min (2005), which have a lot of support under the direction histogram thresholding algorithm provides multiple thresholds are reached. This method requires no prior assumption of the image. The new technique, et al histogram region (2000) art of interest based on the selection of the threshold value as a function of the location of the mass peak Sezgin and Sankur (2001), and Slobodan have been proposed by dichotomization. The algorithm has been designed especially for automated inspection applications. Group as part of the Gaussian function and a hybrid optimization technique based on the minimum variance Erwie Otsu et al (2005) and the proposed method the speed limit is set in the context of Otsu method. Arora et al (2008) using a multi-thresholding technique helps the media and the opposition has to offer. Again, Maitra and Chatterjee (2008) developed an algorithm of particle swarm optimization based multi-threshold. This approach employs both cooperative learning and comprehensive learning. The algorithm could be found to be quite effective to determine multiple thresholds and outperform many other GA based algorithms. GA, when applied as an optimization technique to determine the threshold, is found to be
computationally intensive and in this regard Cao et al (2002) have proposed a strongest schema based GA which could be successfully applied to multi-thresholding.

A biological inspired computing based multi-thresholding algorithm has been proposed by Ren-Jean Liou et al (2009), where the algorithm is based on honey bee mating optimization. The performance of the algorithm is found to be superior to PSO based algorithm. It has been observed that the landmark work of Otsu's thresholding when extended to multi-class problems is very time consuming. In order to reduce the computational burden, very recently Huang and Wang (2009) have proposed a two stage multi-threshold Otsu's method, which is less time consuming than Otsu's method. The method is found to be more efficient with an accuracy equivalent to Otsu's method.

1.5 CONTRIBUTIONS OF THE THESIS

The major contribution of the thesis can be summarized as follows:

1. A Refined Artificial Bee Colony Optimization based clustering scheme is developed to determine the niches of the nonlinear multimodal function by maintaining stable sub-populations at each niche.

2. The Refined Artificial Bee Colony Optimization based algorithm is shown to converge to the optimal solution with better fitness value. For Refined Artificial Bee Colony Optimization based scheme, new interconnection model is proposed to accelerate convergence for obtaining optimal solution.
3. Refined Comprehensive Learning Particle Swarm Optimizer based clustering is used to develop a feature less and feature based global thresholding scheme for segmentation.

4. A new Tabu Search algorithm based on Minimum Mean Square Error (MMSE) has been proposed. Two thresholding schemes such as Feature based MMSE and Feature Less MMSE have been proposed.

5. Segmentation of images using hybrid Comprehensive Learning Particle Swarm Optimizer & Artificial Bee Colony Optimization thresholding is proposed. Thresholding schemes are developed based on information theoretic approach. The proposed hybrid Comprehensive Learning Particle Swarm Optimizer & Artificial Bee Colony Optimization thresholding schemes are based on both window merging and window growing concept.

1.6 ORGANIZATION OF THESIS

Chapter 1 provides a detailed review of literature pertaining to the topics of research considered in this thesis is summarized and the motivation for the present work is also brought out in the introductory chapter.

The experimental result indicated that better solutions with less execution time are obtained by a combination of Genetic Algorithm and Tabu Search. An extensive study on the application of hybrid Genetic Algorithm for multilevel thresholding for image segmentation is discussed in Chapter 2. As seen from the experimental results, non-extensive entropy based image thresholding using hybrid Genetic Algorithm is useful for image segmentation. An interesting feature of the proposed method is that Tsallis entropy uses global and objective property of the image histogram and is
easily implemented. The Tsallis parameter ‘q’ can be used as a tuning parameter for improvising image thresholding results. It is observed that the results obtained are superior to that of BFO, ABC, PSO and GA. The proposed method is faster (CPU time is less) than other techniques. The numerical illustrations demonstrate that the proposed algorithm outperforms other methods.

Chapter 3 presents an extensive study on the application of a hybrid algorithm integrating a metaheuristic with a deterministic technique for multilevel thresholding for image segmentation problem. As seen from the experimental results, non-extensive entropy based MTET image thresholding using Hybrid RCPSO algorithm is effective for image segmentation applications. The proposed hybrid method yielded a near optimum (compared to exhaustive search) threshold value for q=0.7, the segmentation results are promising. It is demonstrated that the simulation results obtained using the hybrid RCPSO method are superior to that of ABC, PSO and GA methods in terms of producing quality thresholds.

Chapter 4 demonstrates the study on the application of a new hybrid algorithm integrating a metaheuristic with a deterministic technique for multilevel thresholding in image segmentation problem. As shown in the experimental results, non-extensive entropy based MTET image thresholding using hybrid RABC algorithm is effective for image segmentation applications. It is established that the simulation results arrived at using the hybrid RABC method are superior to that of ABC, PSO and GA methods in terms of producing quality thresholds efficiently and effectively.

Conclusions drawn on different works of this thesis have been provided in Chapter 5. The scope of future work has been highlighted.