Middle-East Journal of Scientific Research 23 (9): 2166-2172, 2015
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2015.23.09.22582

Underwater K-Means Clustering Segmentation Using SVM Classification

[1]M. Rajasekar, [2]A. Celine Kavida and [3]M. Anto Bennet

[1]Department of CSE, Veltech multitech Dr. Rangarajan Dr. Sakunthala Engineering College, Chennai-600062, India
[2]Department of Physics, Veltech multitech Dr. Rangarajan Dr. Sakunthala Engineering College, Chennai-600062, India
[3]Department of ECE, VEL TECH, Chennai-600062, India

Abstract: In this paper we are going to recognize underwater images using k-means clustering segmentation. The images are filtered by median filtering. Then the images are enhanced segment wise by performing k-means clustering algorithm. We take the centroid values of each area of the image and adjust the enhancement of neighbouring pixels in that area of the image. The feature extraction is done by Histogram of Gradient (HOG) algorithm. For this we analyze the value of magnitude and angle parameters through gradient of pixels. Once the feature extraction is finished, classification is done using SVM classifier. Before this we train datasets of all underwater images according to their HOG feature and save them as (*.mat) files. The resultant image features is compared with trained datasets and classifies to which plant it belongs to. The experimental results show the clear cut verification of a given image by using this clustering algorithm and SVM classifier.

Key words: Underwater images · k-means clustering segmentation · Histogram of Gradient (HOG) · SVM classifier

INTRODUCTION

To process the underwater image and segment it using K-means clustering algorithm. The system provides feature extraction from which the organism in the image is identified clearly and it avoids the confusion between look alike organisms. Image processing is a method of digital processing in which the input is image and output is any signal or enhanced image. Underwater images suffer from a greater noise than normal images. New filters are being applied to remove this noise. Image noise is random variation of brightness or color information in images and is usually an aspect of electronic noise. One of the process by which the image is segmented is K-means algorithm. K-Means algorithm is an unsupervised clustering algorithm that classifies the input data points into multiple classes based on their inherent distance from each other. Images are considered as one of the most important medium of conveying information. Image processing is any form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it. An image is an array, or a matrix, of square pixels (picture elements) arranged in columns and rows.

Underwater image processing is a big challenge as depth of water increases the image quality decreases. Underwater images are more dull and dusty in look and we won't be able to identify the pictures clearly. Moreover most of the organisms in under water are not identified yet as there are millions of species in it. The underwater image preprocessing is first done by converting the color image into a grayscale image. Grayscale is a range of shades of gray without apparent color. The darkest possible shade is black, which is the total absence of transmitted or reflected light. The lightest possible shade is white, the total transmission or reflection of light at all visible wavelength. This is done as processing with two shades of color is easier.

Corresponding Author: M. Rajasekar, Department of CSE, Veltech multitech Dr. Rangarajan Dr. Sakunthala Engineering College, Chennai-600062, India.

Underwater images suffer from a greater noise than normal images. New filters are being applied to remove this noise. Image noise is random variation of brightness or color information in images and is usually an aspect of electronic noise. It can be produced by the sensor and circuitry of a scanner or digital camera. Image noise is an undesirable by-product of image capture that adds spurious and extraneous information. Image filtering is used to Remove noise, Sharpen contrast, Highlight contours, Detect edges. Median filtering is a nonlinear method used to remove noise from images. After removing the noise the image's quality need to be increased. In order to increase the quality the image is contrasted. To contrast the image segmentation of the image is performed. Image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. This segmentation is done by K-MEANS clustering algorithm. K-Means algorithm is an unsupervised clustering algorithm that classifies the input data points into multiple classes based on their inherent distance from each other. Morphological image processing is a collection of non-linear operations related to the shape or morphology of features in an image. Morphological operations rely only on the relative ordering of pixel values, not on their numerical values and therefore are especially suited to the processing of binary images. The image is contrasted and a good quality image is obtained after the morphological image processing. The feature is extracted from the image using the HOG (Histogram of oriented gradients) algorithm. It uses three characteristics as gradient, median and angle. The organism in underwater can be identified using this algorithm.

Literature Survey: The objects in the underwater images are not clearly visible due to low contrast and scattering of light and the large noise present in the environment. Hence it is difficult to segmentation in such environment without losing the details of the objects. In this paper a method of segmentation is presented for underwater images, in which the image quality is first enhanced using contrast limited adaptive histogram equalization method and then histogram thresholding is used to segment the objects. Paper discusses the comparative analysis of various Histogram thresholding techniques[1-4].

[5] This paper will present an enhancement technique based upon a new application of histograms on transform domain coefficients called logarithmic transform coefficient histogram shifting (LTHS). A measure of enhancement based on contrast entropy will be used as a tool for evaluating the performance of the proposed enhancement technique and for finding optimal values for variables contained in the enhancement. The algorithm's performance will be compared quantitatively to classical histogram equalization using the aforementioned measure of enhancement.

In this paper [6] we propose an image enhancement algorithm that is based on utilizing histogram data gathered from transform domain coefficients that will improve on the limitations of the histogram equalization method. Traditionally, classical histogram equalization has had some problems due to its inherent dynamic range expansion. Many images with data tightly clustered around certain intensity values can be over enhanced by standard histogram equalization, leading to artifacts and overall tonal change of the image. In the transform domain, one has control over subtle image properties such as low and high frequency content with their respective magnitudes and phases. However, due to the nature of many of these transforms, the coefficient's histograms may be so tightly packed that distinguishing them from one another may be impossible. By placing the transform coefficients in the logarithmic transform domain, it is easy to see the difference between different quality levels of images based upon their logarithmic transform coefficient histograms [7,8].

Image enhancement is one of the most important issues in low-level image processing. The goal of image enhancement is to improve the quality of an image such that enhanced image is better than the original image. Conventional Histogram equalization (HE) is one of the most algorithms used in the contrast enhancement of medical images, this due to its simplicity and effectiveness. However, it causes the unnatural look and visual artefacts, where it tends to change the brightness of an images. The Histogram Based Fast Enhancement Algorithm (HBFE) tries to enhance the CT head images, where it improves the water-washed effect caused by conventional histogram equalization algorithms with less complexity. It depends on using full gray levels to enhance the soft tissues ignoring other image details. We present a modification of this algorithm to be valid for most CT image types with keeping the degree of simplicity. Experimental results show that The Modified Histogram Based Fast Enhancement Algorithm (MHBFE) enhances the results in term of PSNR, AMBE and entropy [9,10]. Enhancing an image in such a way that maintains image edges is a difficult problem. Many current methods for image enhancement either smooth edges on a small scale while improving contrast on a global scale or enhance edges on a large scale while amplifying noise on a small scale. Many applications of histograms for the purposes of image processing are well known. However, applying this process to the transform domain by way of a transform coefficient histogram has not yet been fully explored. This paper proposes three methods of image enhancement: a) logarithmic transform histogram matching, b)logarithmic transform histogram shifting and c) logarithmic transform histogram shaping using Gaussian distributions. They are based on the properties of the logarithmic transform domain histogram and histogram equalization. The presented algorithms use the fact that the relationship between stimulus and perception is logarithmic and afford a marriage between enhancement qualities and computational efficiency [11-18].

Experimental Section: The techniques used in this proposed method are K-means clustering for enhancement, median filter for filtering and svm classification for feature extraction. K-Means algorithm is an unsupervised clustering algorithm that classifies the input data points into multiple classes based on their inherent distance from each other. The algorithm assumes that the data features form a vector space and tries to find natural clustering in them. The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighboring entries. The median filter is better than other filters at removing noise whilst preserving edges. HOG algorithm is used in feature extraction. The technique counts occurrences of gradient orientation in localized portions of an image. In our proposed system, to enhance the underwater image by region wise we applying k-means clustering algorithm from this we obtain the mean value (avg pixel intensity) of each region and clustering the total intensity and shows improvised one. And also we use the median filtering of 2D- level and eliminate the noise from your image at each pixel wise. it's called as clear image or enhanced image. Next process of filtering is to keep this image and classify the underwater image category by using of SVM classifier. Main theme of this classifier to reduce the complexity of recognition of plant, rock or something of underwater models shown in Fig 1.

Input Image: Image processing is any form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image. The input is a two dimensional picture of an underwater image. This input image contains any pictures of plants which need to be classified. The given input image contains more noise as it is underwater image. The underwater image is noisy since no perfect lens has been made to take underwater pictures. The sand or lack of light causes the picture to be unclear and difficult to identify the objects in the image. In the GUI there is a button provided for selecting the input image. The input image to be classified is selected from the corresponding file using this button. There is a separate access box in the GUI to display the selected image. This ensures the user that the correct image has been selected.

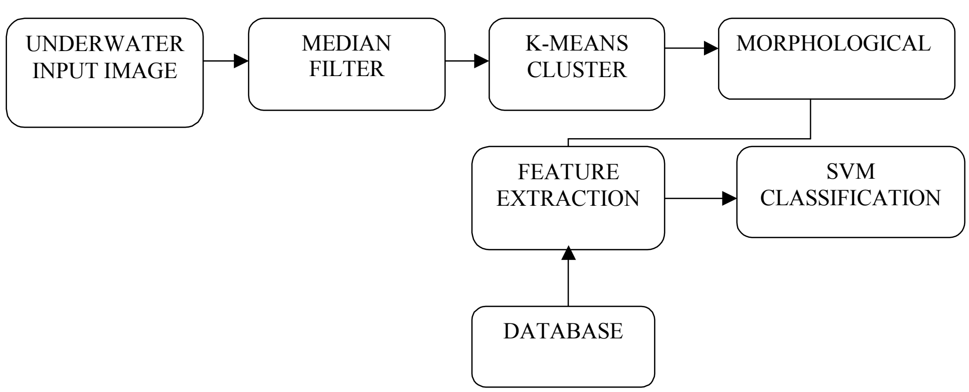


Fig. 1: System Architecture

Median Filter: The median filter is a nonlinear digital filtering technique, often used to remove noise. Such noise reduction is a typical pre-processing step to improve the results of later processing (for example, edge detection on an image). The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighboring entries. The pattern of neighbors is called the "window", which slides, entry by entry, over the entire signal. If the window has an odd number of entries, then the median is simple to define: it is just the middle value after all the entries in the window are sorted numerically. For an even number of entries, there is more than one possible median, see median for more details. Median filtering is a kind of filtering technique which is better in preserving edges.

K-Means Clustering: K-means clustering is a method of vector quantization, originally from signal processing, that is popular for cluster analysis in data mining. K-means clustering aims to partition *n* observations into *k* clusters in which each observation belongs to the cluster with the nearest mean, serving as a prototype of the cluster. This results in a partitioning of the data space into Voronoi cells., *k*-means clustering tends to find clusters of comparable spatial extent, while the expectation-maximization mechanism allows clusters to have different shapes.

Morphological Operation: Morphological operations apply a structuring element to an input image, creating an output image of the same size. In a morphological operation, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbors. The most basic morphological operations are dilation and erosion. Dilation adds pixels to the boundaries of objects in an image, while erosion removes pixels on object boundaries.

Feature Extraction: Feature detection, feature extraction and matching are often combined to solve common computer vision problems such as object detection and recognition, content-based image retrieval, face detection and recognition and texture classification. One of the common feature extraction technique is Histogram of Oriented Gradients (HOG).

Histogram of Oriented Gradients: The technique counts occurrences of gradient orientation in localized portions of an image. The essential thought behind the Histogram of Oriented Gradient descriptors is that local object appearance and shape within an image can be described by the distribution of intensity gradients or edge directions. The implementation of these descriptors can be achieved by dividing the image into small connected regions, called cells and for each cell compiling a histogram of gradient directions or edge orientations for the pixels within the cell. The combination of these histograms then represents the descriptor.

SVM Classifier: The final step in object recognition using Histogram of Oriented Gradient descriptors is to feed the descriptors into some recognition system based on supervised learning. The Support Vector Machine classifier is a binary classifier which looks for an optimal hyperplane as a decision function. Once trained on images containing some particular object, the SVM classifier can make decisions regarding the presence of an object, such as a plants, human being, in additional test images. An SVM classifies data by finding the best hyperplane that separates all data points of one class from those of the other class. The best hyperplane for an SVM means the one with the largest margin between the two classes. Margin means the maximal width of the slab parallel to the hyperplane that has no interior data points. The support vectors are the data points that are closest to the separating hyperplane; these points are on the boundary of the slab.

Experimental Results: First, an approximate method to represent the imaging quality of the boundary of the shadow region based on the various filter is provided for the first time, which built up the relationship between the parameters of the Normal image and underwater image shown in fig 2 and 3.

First window get the input underwater image is selected from the corresponding file. The median filter is a nonlinear digital filtering technique, often used to remove noise in the second window that also Median filtering is a kind of filtering technique which is better in preserving edges. The third window segment the underwater image for further processing. The underwater image enhancement and feature extraction have been achieved by k- means clustering and hog algorithm. This feature extraction has been efficient in classification of the underwater plant images using svm classifier. This classification thus has a greater advantage of distinguishing the underwater plants based on the feature extracted and determining their use as medicine or manure.

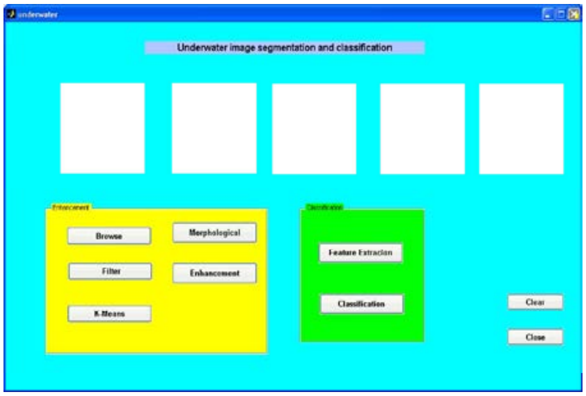


Fig. 2: Input Image

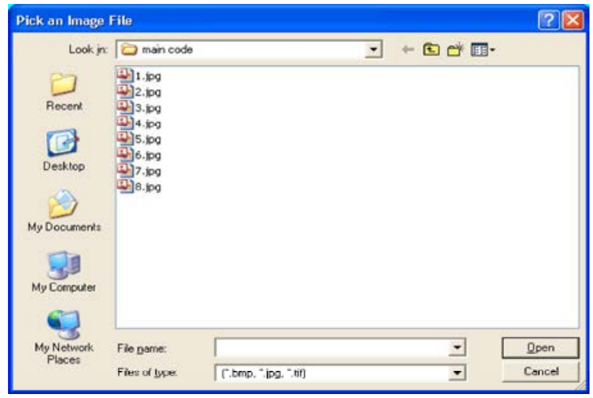
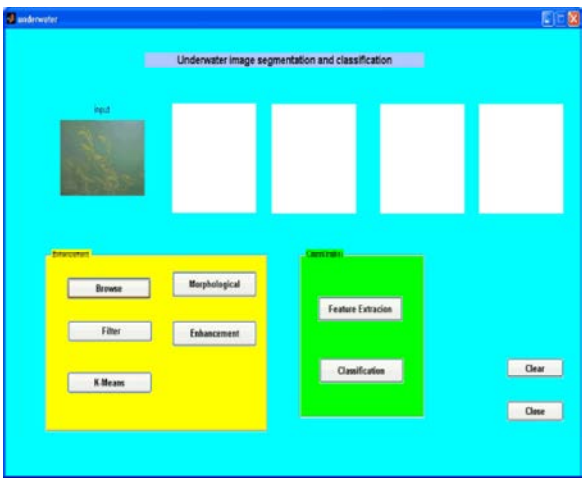


Fig. 3: Browse the image



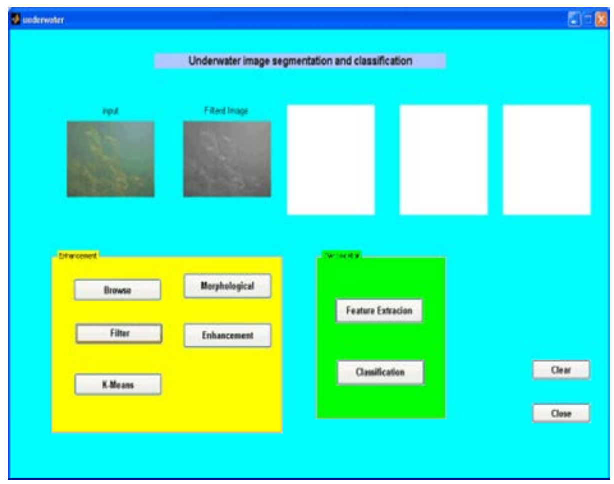


Fig. 4: After filtering the Original Image

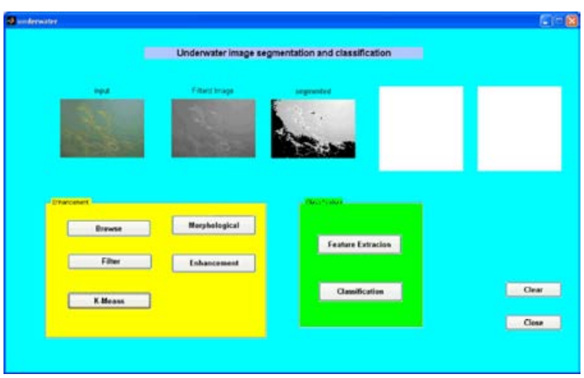


Fig. 5: K-MEANS CLUSTERING SEGMENTATION

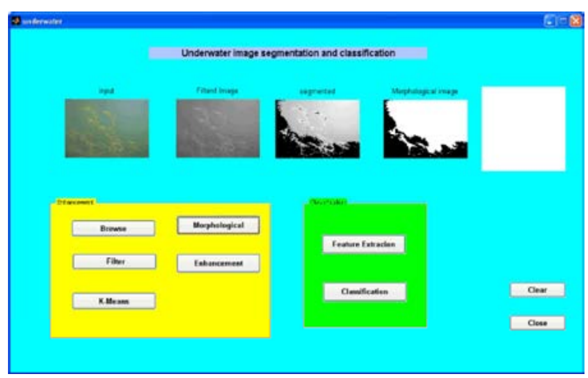


Fig. 6: MORPHOLOGICAL OPERATIONS

Compare with the database normal image and underwater images based upon percentage calculation. Its application for medicine field and agriculture shown in fig 4,5.6,7,8,9. Thus the comparison between the existing and the proposed system is explained in the fig 10 the enhancement, contrast, feature extraction and classification are increased in the proposed system when compared to existing system. The limitations detected in the existing system are reduced in the proposed system. The main limitation of poor extraction of features is done overcome in the proposed system and done minutely shown in Table 1.

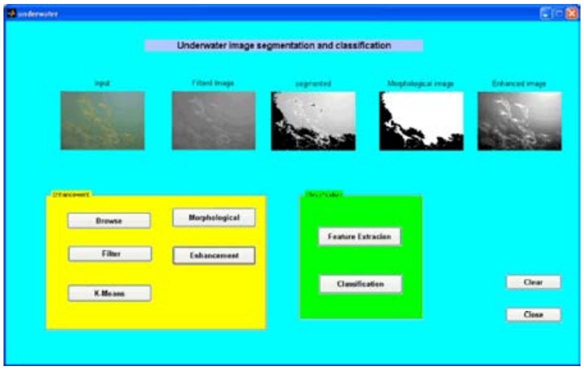


Fig. 7: Enhanced Image.

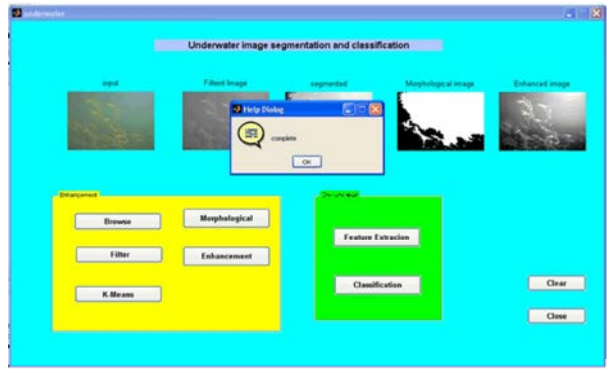
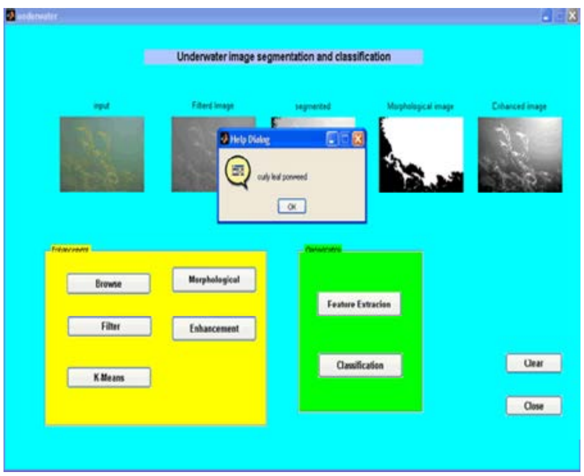


Fig. 8: Feature Extraction



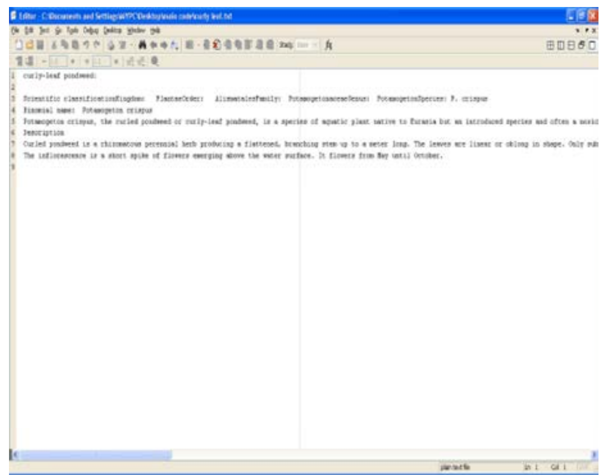


Fig. 9: Estimated Image

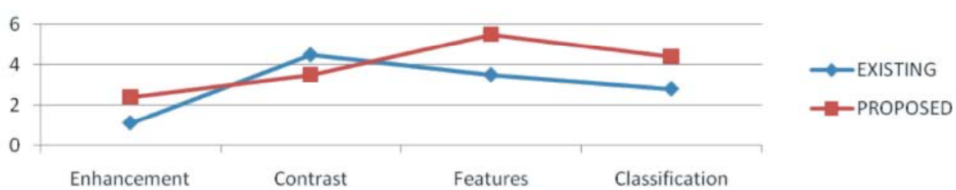


Fig. 10: Comparison of Underground images

Table 1: Performance comparison between Existing and Proposed of Underground Images

Performance	Existing	Proposed	Variation
Enhancement	110	240	130
Contrast	600	400	200
Feature Extraction	350	550	200
Classification	280	440	160

CONCLUSION

The underwater image enhancement and feature extraction have been achieved by k- means clustering and hog algorithm. This feature extraction has been efficient in classification of the underwater plant images using SVM classifier. This classification thus has a greater advantage of distinguishing the underwater plants based on the feature extracted and determining their use as medicine or manure. Thus this paper can be used in medical field and agriculture. The theoretical and experimental results show that the classification of the plants is clear and 100% perfect. This paper can be further enhanced to make classification of fishes and many other organisms in underwater. There are many species in underwater which exploited properly due to the knowledge of the species. The objects in the underwater such as drowned ships and aircrafts can be identified if further enhancements are made in this paper.

REFERENCES

1. Chen Soong-Der and Abd. Rahman Ramli, 2003. Minimum Mean Brightness Error Bi-Histogram Equalization in Contrast Enhancement, IEEE Trans. on Consumer Electronics, 49(4): 1310-1319.
2. Agaian Sos, S., Karen Panetta and Artyom Grigoryan, 2001. Transform based image enhancement with performance measure, IEEE Trans. On Image Processing, 10(3): 67-381.
3. Agaian Sos, S., Karen P. Lentz and Artyom M. Grigoryan, 2000. A New Measure of Image Enhancement, IASTED International Conference on Signal Processing and Communication, Marbella, Spain.
4. Morrow, W.M., 1992. Region-Based Contrast Enhancement of Mammograms, IEEE Trans. on Medical Imaging, 11(3): 392-406.
5. Agaian Sos, S., 1999. Visual Morphology, Proceedings of SPIE, Nonlinear Image Processing X, San Jose CA, 3646: 139-150.
6. Ji, T.L., M.K. Sundareshan and H. Roehrig, 1994. Adaptive Image Contrast Enhancement on human Visual Properties,IEEE Trans. on Medical Imaging, 13(4).
7. Tang Jinshan, Eli Peli and Scott Acton, 2003. Image EnhancementUsing a Contrast Measure in the Compressed Domain, IEEE Signal Processing Letters, 10(10).
8. Beghdadi, A. and A.L. Negrate, 1989. Contrast enhancement technique based on local detection of edges, Comput. Vis. Graph. Image Process., 46: 162-274.
9. Tang Jinshan, Eli Peli and Scott Acton, 2003. Image Enhancement Using a Contrast Measure in the Compressed Domain, IEEE Signal Processing Letters, 10(10).
10. Kim, J.K., J.M. Park, K.S. Song and H.W. Park, 1997. Adaptive mammographic image enhancement using first derivative and local statistics, IEEE Trans. Med. Imag., 16: 495-502.
11. Gordon, R. and R.M. Rangayan, 1984. Feature enhancement of film mammograms using fixed and adaptive neighborhoods, Applied Optics, 23: 560-564.
12. Aghagolzadeh, S. and O.K. Ersoy, 1992. Transform image enhancement, Optical Engineering, 31(3): 614-626.
13. Chen Soong-Der and Abd. Rahman Ramli, 2003. Minimum Mean Brightness Error Bi-Histogram Equalization in Contrast Enhancement, IEEE Trans. on Consumer Electronics, 49(4): 1310-1319.
14. Agaian Sos, S., Karen Panetta and Artyom Grigoryan, 2001. Transform based image enhancement with performance measure, IEEE Trans. On Image Processing, 10(3): 367-381.
15. Agaian Sos, S., Karen P. Lentz and Artyom M. Grigoryan, A New Measure of Image Enhancement, IASTED International Conference on Signal Processing and Communication, Marbella, Spain.
16. Agaian Sos, S., 1999. "Visual Morphology", Proceedings of SPIE, Nonlinear Image Processing X, San Jose CA, 3646: 139-150.
17. Ji, T.L., M.K. Sundareshan and H. Roehrig, 1994. Adaptive Image Contrast Enhancement on human Visual Properties, IEEE Trans. on Medical Imaging, 13(4).
18. Morrow, W.M., 1992. Region-Based Contrast Enhancement of Mammograms, IEEE Trans. on Medical Imaging, 11(3): 392-406.