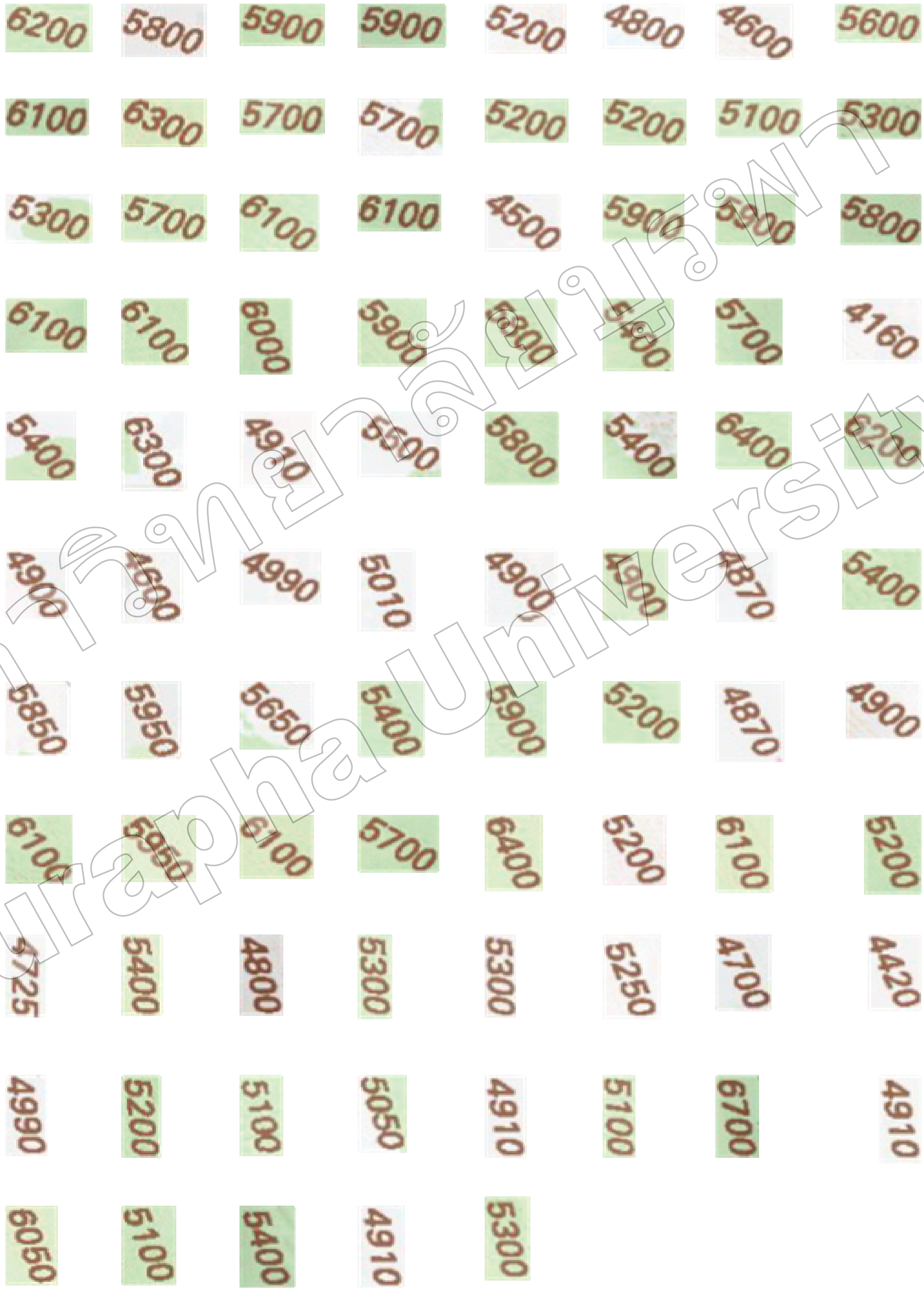
ภาคผนวก

ภาคผนวก ก

ชุดข้อมูลภาพสำหรับการสอน


5800 5800 7100 5900 4910 6500 5200 5650
4940 5370 6200 5300 4990 4910 5370 5800
7400 7500 6150 5200 5300 6100 5620 5700
4890 5400 5620 6100 5400 4985 5700 5400
5300 6700 5100 4995 5900 6300 4500 4980
4960 5900 5640 5700 5005 5500 5700 5700
5700 5100 6100 6200 6300 5300 5300 6200
5015 4900 5100 6200 7100 7400 5300 5700
6600 5400 5200 5300 5300 5100 4400 4980
5800 6200 4400 4980 5100 4715 4950 4910
5350 5750 5500 5900 5650 5800 6300 5800
4725 4730 4940


6200 5800 5900 5900 5200 4800 4600 5600
6100 6300 5700 5700 5200 5200 5100 5300
5300 5700 6100 6100 4500 5900 5900 5800
6100 6100 6000 5900 5800 5400 5700 4160
5400 6300 4910 5500 5800 5400 6400 6200
4900 4600 4990 5010 4900 4900 4870 5400
5850 5950 5650 5400 5900 5200 4870 4900
6100 5950 6100 5700 6400 5200 6100 5200
4725 5400 4800 5300 5300 5250 4700 4420
4990 5200 5100 5050 4910 5100 6700 4910
6050 5100 5400 4910 5300

ภาคผนวก ข

การเผยแพร่ผลงานวิทยานิพนธ์

NECTEC
a member of NSTDA

CERTIFICATE OF CONTRIBUTIONS

Sedtha Pota

HAS CONTRIBUTED TO

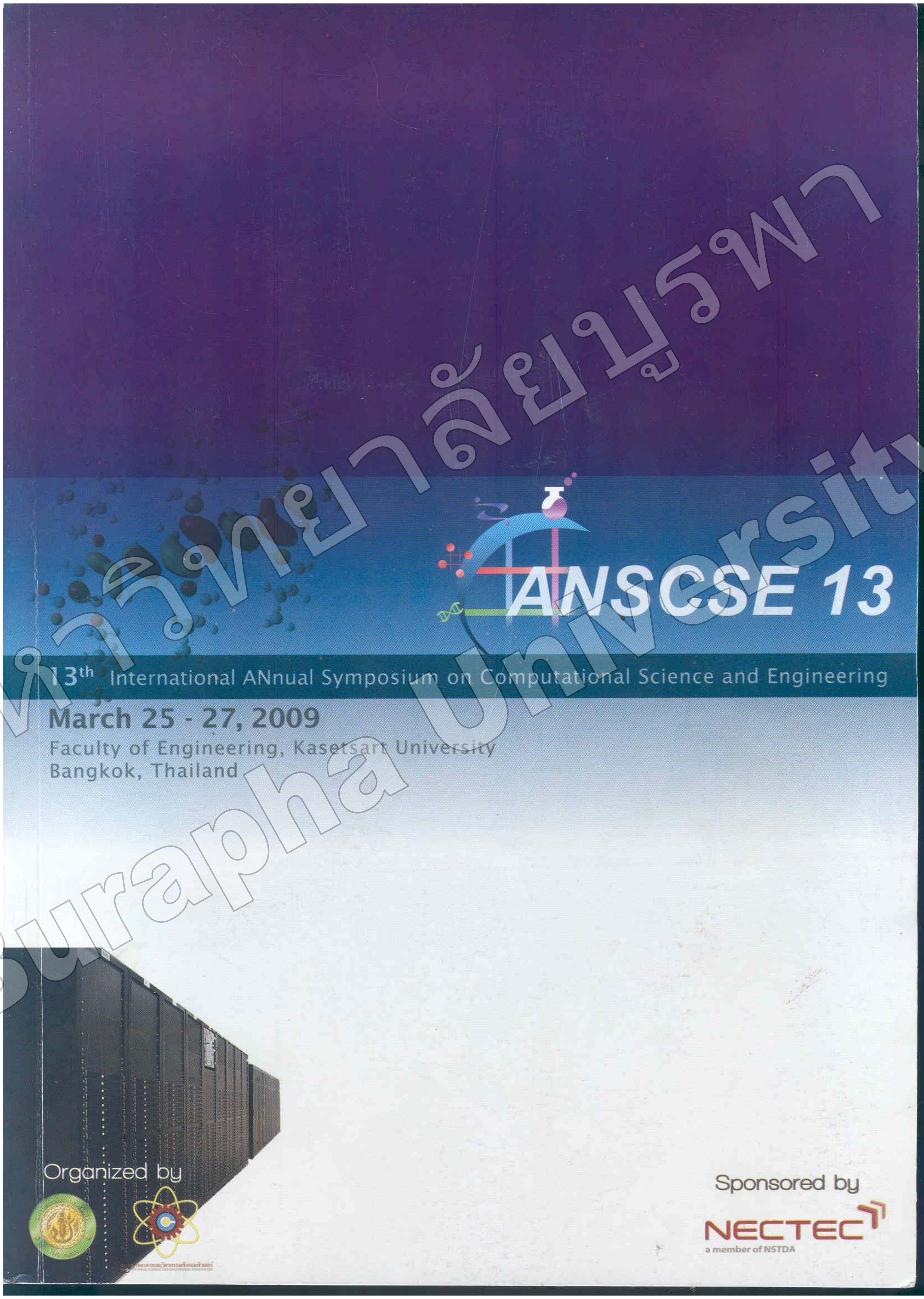
ANSCSE 13
13th International ANnual Symposium on Computational Science and Engineering

13th INTERNATIONAL ANNUAL SYMPOSIUM ON COMPUTATIONAL SCIENCE AND ENGINEERING

25 – 27 MARCH 2009
KASETSART UNIVERSITY, BANGKOK, THAILAND

Dr. Putchong Uthayopas
Chairman,
ANSCSE13

Supa Hannongbua
Dr. Supa Hannongbua
President,
Computational Science and Engineering Association


ANSCSE 13
13th International ANnual Symposium on Computational Science and Engineering
March 25 - 27, 2009
Faculty of Engineering, Kasetsart University
Bangkok, Thailand
Organized by
Sponsored by
NECTEC
a member of NSTDA

Recognition of Altitude Numeric of Index Contour Lines from Scanned Topographic Map Using Density Based Clustering and Back- propagation Neural Network Techniques

Sedtha Pota* **Suwanna Rasmequan** **Krisana Chinnasarn**

Department of Computer Science, Faculty of Science, Burapha University
169 T.sansuk, A.Muang, Chonburi 20131
*** E-mail: sedtha.p@student.buu.ac.th, mr.dancess@gmail.com**

ABSTRACT

Topographic maps are used to find out terrain distance by calculating Euclidean distance of each interval with altitude (sea level height) values from index contour lines. Typically, recognition of altitude numeric of index contour lines is very difficult because topographic maps involve various features and each altitude numeric has been displayed in different directions. Furthermore, scanned topographic maps always have a chromatic aberration problem which leads to false color representation. This paper presents a method to recognize altitude numeric of index contour lines from scanned topographic maps by density based clustering and back-propagation neural network techniques. The experimental results prove that the proposed method reaches a satisfactory level.

Keywords: Index contour line, Altitude, Topographic map

1.Introduction

A topographic map is a way to represent the Earth's surface. The distinctive characteristic of a topographic map is the way in which the shape of the Earth's surface is represented by contour lines. Contour lines provide information about the height of mountains, the depth of the ocean bottom, and the steepness of slopes. In particular, there is an altitude numeric on index contour lines for indicating height of reference surface. Traditionally, topographic maps have been printed on paper. When a printed map is scanned, the computer file that is created may be called a digital raster image. Once we got this type of file format, if we would want to know the values of altitude numeric, we may recognize them by using neural network technique. However, due to a great amount of information that is contained in a scanned topographic map, plus the direction of the numbers is varied, it is quite hard to retrieve the altitude numeric of index contour lines from scanned topographic This paper has proposed techniques and algorithm to recognize an altitude numeric from such a scanned Topographic Map file.

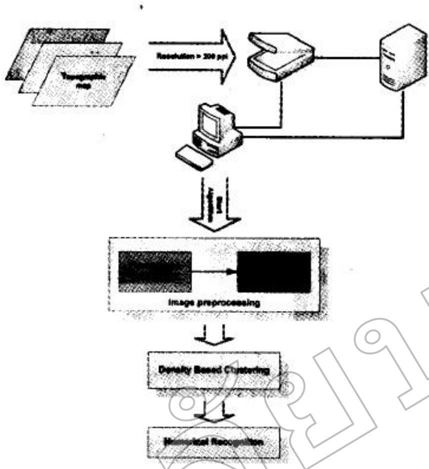


Figure 1: An overview of altitude numeric recognition algorithm

In this paper, we present an algorithm for recognition of altitude numeric which has 3 processes as following:

1. Extract foreground and index contour lines from scanned topographic map using image processing technique.

2. Retrieve altitude numeric from index contour lines using density based clustering technique.

3. Recognize altitude numeric using back-propagation neural network techniques.

The input file type that needed for our experimentation is a scan printed topographic map. Such a file should be scanned with a resolution of at least 200 ppi, otherwise the result will not be satisfied.

2. Related work

Although there are a number of researches and studies on recognition from scanned topographic map, to the best of our knowledge, there is none of them make the study on recognition of altitude numeric of index contour lines. However, we have studied and applied some of the methods to our work as the followings.

Foreground extraction: Topographic maps contain great amounts of information superimposed onto a single 2D layer, resulting in a complex mixture of touching text and graphics components. The information on these maps consists of sets of linear features (such as contour lines, and roads) and area features (such as buildings, and bodies of water). Automatic extraction of these different layers of information poses a substantial challenge due to the heavy interconnection of layers [1]. However, most of the useful information in a topographic map is sets of linear feature which is located in the image foreground. Background colors and textured such as bodies of water and vegetation patterns are used to represent with area features.

Index contour line retrieval: As we mentioned in previous topic, foreground is set of linear features and contour line is one of them. Therefore, we have to extract index contour lines form foreground image after we extract foreground from scanned topographic map. Jinyang [2] extracts contour lines by setting certain thresholds in HIS color space. Although this method can use to extract contour lines, it is not flexible. This is because of the manual thresholds setting. Topographic maps always have a false color problem due to lateral chromatic aberration which in turn is a result of the difference between the refractive index of the scanner's lens for different wavelengths of light [1].

Density based clustering: In 1996, Martin Ester proposed a density-based algorithm for discovering spatial databases with noise [3]. After the algorithm had proposed, there are many researches cited on and applied it to their works. 'Color image segmentation using density-based clustering' is the one of researches that applied the algorithm with color segmentation. Owing to image can be considered as a special spatial dataset in which each pixel as a spatial location and a color value. Therefore, the algorithm was used to discover clusters in spatial will be effective on discovering clusters in an image. Pixels which are similar in color and connective in spatial can be clustered together to form a segmented region [4].

3. Proposed method

In this section, we present an algorithm to recognize altitude numeric of index contour lines from Scanned Topographic Map Using Density Based Clustering and Back- propagation Neural Network Techniques. Firstly, we will describe about image preprocessing which is divided into two sub-processes. Secondly, we will explain about segmentation using density based clustering technique and direction problem solving. Finally, we will discuss about recognition using back-propagation neural network techniques.

Data preparation is one of the significant factors to our experiment. That is, topographic map must be scanned with a resolution of more than 200 ppi. Additionally, there are three basic conditions which are general characteristics of topographic maps that are necessary for our experiment. First, the index contour lines of topographic map must be in brown color and more intensive than intermediate contour lines. Second, the index contour lines must be thicker than intermediate contour lines. Third, the major space of the foreground of topographic map should be contour lines.

3.1 Image preprocessing

According to a variety of information on topographic map, such as sea level, forest territories, road way and rivers, therefore we need to extract only specific information from

those overwhelming information. That is the index contour lines. This step can be divided into 2 processes, the first one is foreground extraction process and the other is index contour line retrieval process.

3.1.1 Foreground extraction

Aria Pezeshk and Richard Tutwiler [1] use Otsu's method to binarize original image. The binarization procedure help removes background colors. For those simple background textures such as dotted patterns are then removed using a median filter with a small window size. Such a process help eliminates thin parts of lines and characters as well and therefore a masked dilation is performed to restore the lost parts. The following equation has been implemented to restore pixels which existed in the original image by preventing uncontrolled propagation of lines and other features:

$$D_{:g} f = g \cap Df \qquad (1)$$

where D is the dilation operator consisting of a square 3×3 structuring element and g is taken as the original binary image. The resulting image is used as a binary mask for each of the RGB channels to extract the foreground portion of the map:

$$Foreground(:,:,i) = image(:,:,i).*mask + 255*(\sim mask); i = 1,2,3 \quad (2)$$

The result image consists of all foreground objects in their original colors and the background was washed out to pure white (255,255,255). This first step preprocess has been implemented in our work. However, the preliminary result needs to be further improved by the following step. This is because the foreground image consists of various linear features such as contour lines, symbols and road ways.

3.1.2 Index contour line retrieval

After we have got the foreground image from previous process, we then try to retrieve index contour lines with histogram analysis method [5] which is more flexible than color separation method [2]. According to topographic maps characteristics, index contour line is normally thicker and more intensive than intermediate contour line so we can use histogram to analyze characteristics of index contour line of the interested map. Typically, standard index contour line color is dark brown so that blue color is darker than others. Although we know about combination of brown color, it is not proper to set certain thresholds. This is due to lateral chromatic aberration that causes a false color problem (a large distribution of each color space which is depended on quality of scanning process). If we set certain thresholds on each color space, we then cannot retrieve all pixels of index contour lines.

Normally each color space of the extracted foreground can be divided into two groups (dark and bright as illustrated in Figure 2), therefore a histogram analysis using Otsu's method has been proposed as a way to classify those index and non-index lines. In addition, we also consider the distribution of the color space to adjust the set value of the ratio among blue, red and green.

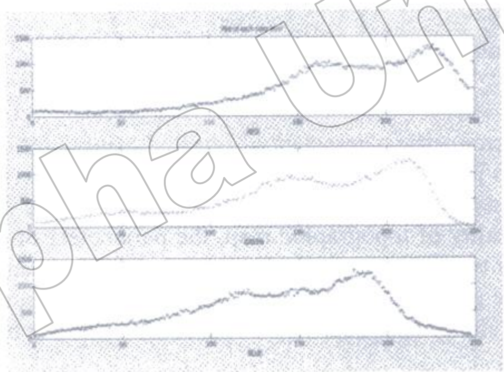


Figure 2: Color space of sample image after foreground extracting

3.2 Altitude numeric segmentation using density based clustering

After we retrieve index contour lines from foreground image in preprocess, the new image will consist of altitude numeric and line. Our objective is to retrieve only altitude numeric of index contour line. Therefore, we apply density based clustering technique to segment altitude numeric from index contour image.

Parameter definitions of the DBSCAN are given below and then follows with a briefly introduction to the main idea of the algorithm.

Given a spatial dataset and objects in it distributes in a two-dimension space:

- The neighborhood within a radius of a given object is called the Eps of the object.
- If the Eps of an object contains at least a minimum number, MinPts, of object with similar property, then the object is called a core object.

- For the set of object, we say that object p is directly density-reachable from object q if p is within the Eps of q, and q is a core pixel (Figure 3).
- Density reachability is the transitive closure of direct density reachability and this relationship is asymmetric. This asymmetric density reachability is density connectivity (Figure 3).

DBSCAN searches for clusters by checking the Eps of each point in the dataset. If the Eps of a point p contains more than MinPts, a new cluster with p as the core object is created. DBSCAN then iteratively collects directly density-reachable objects from these core objects, which may involve the merge of a few density-reachable clusters. The process terminates when no new point can be added to any cluster.

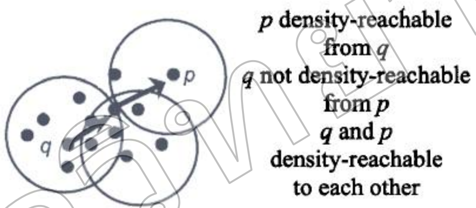


Figure 3: Density-reachability and density-connectivity

In this process, we have to determine the parameters of Eps and MinPts for our index contour image which we got from previous process. The selection of a set of suitable parameter is very important. This is because of the segmentation result depends largely on the given parameters. According to the resolution and quality of topographic map, the parameters of each map are not the same. Therefore, we survey our test map and find out a set of suitable parameters to use with DBSCAN algorithm. After we have got a set of parameters, we the tested it until we get a satisfy performance. We then calculate an eigenvector and eigenvalue of each altitude numeric image for transforming to be upright numeric.

3.3 Back-propagation neural network

Standard back-propagation neural network [6] with three layers of 200x400x10 nodes is used for recognition after we got all upright altitude numeric. The neurons at input layer take the altitude numerical image obtained from section 3.2 and transfer data to the hidden layer. The number of hidden layers will be double of its input layer. Hidden layer used to calculate the weight of neurons from its input layer and generate a signal with the help of sigmoid activation function, and transfer the signal to the output layer. The number of output layers is 10. The objective function for this paper is LSM with $\varepsilon \leq 0.01$

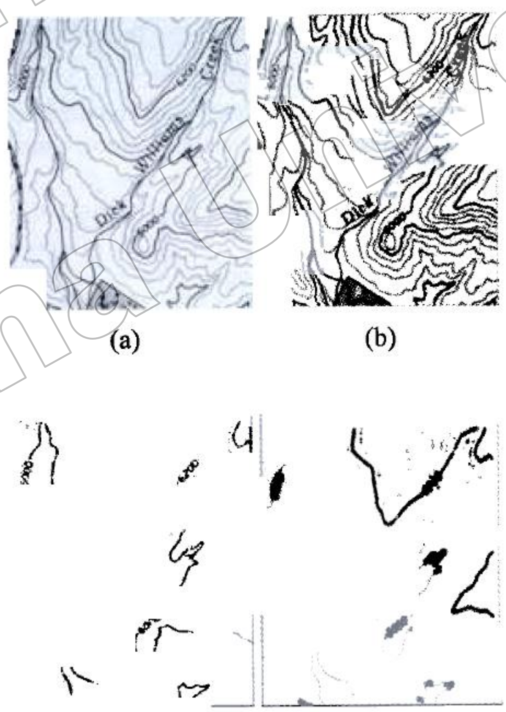
4. Experimental results

To verify our proposed method, experiments were performed on images with different resolution on Pentium Core2duo 1.66 GHz notebook. As example, we use a sample 440 × 565 United States Geological Survey (USGS) image in figure 4(a) and 4(b) shows its foreground. Figure 4(c) shows binary index contour image which created by histogram analysis method. The performance of figure 4(c) presents that our proposed method is efficiency. Figure 4(d) presents segmented image using density based clustering in the first round and Figure 4(e) shows the second iteration of the density based algorithm. Figure 4(f) shows a sample of upright transform altitude numeric.

5. Conclusion

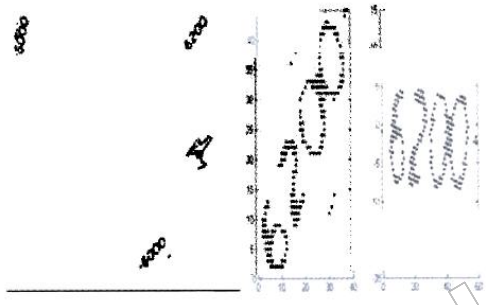
This paper has proposed a combination of Back-propagation neural network techniques and density based clustering to recognize altitude numeric of index contour lines from scanned topographic map.

The experiment results confirm that the proposed method is suitable for the environment stated above. However, in the future studies we aim to improve the way in which the recognition can be done with more general type of map.



(a) (b)

(c) (d)



(e) (f)

Figure 4: Performance of proposed method on sample USGS map: (a) Original image, (b) foreground image, (c) Image using histogram analysis method, (d) segmented altitude numeric using density based in first round, (e) second round of segmentation, (f) Numeric transformation before recognizing

6. References

[1] Aria Pezeshk, Richard L. Tutwiler, "Contour Line Recognition & Extraction from Scanned Colour Maps Using Dual Quantization of the Intensity Image", Proceedings of IEEE Southwest Symposium Image Analysis and Interpretation, 2008, page 173 – 176.

[2] Du Jinyang and Zhang Yumei, "Automatic extraction of contour lines from scanned topographic map", Proceedings of IEEE International Geoscience and Remote Sensing Symposium, 2004, vol.5, page 2886 – 2888.

[3] Martin Ester, Hans-Peter Kriegel, Jorg Sander and XiaoWei Xu, "A Density-Based Algorithm for Discovering Spatial Databases With Noise," Proceedings of 2 " International Conference on Knowledge Discovery and Daro Mining, 1996.

[4] Qixiang Ye, Wen Gao and Wei Zeng, "Color image segmentation using density-based clustering", Proceedings of IEEE International Acoustics, Speech, and Signal, 2003, vol.3, Page III345 – 348.

[5] Rafael C. Gonzalez, Richard E. Woods and Steven L. Eddins, Digital Image Processing using Matlab, Prentice Hall, 2004.

[6] Simon Haykin, Neural Networks: A Comprehensive Foundation, 2nd edition, Prentice Hall, 1998.