International Journal of Engineering Research-Online
A Peer Reviewed International Journal
Articles available online http://www.ijoer.in

Vol.3., Issue.5., 2015
(Sept.-Oct.)

RESEARCH ARTICLE

ISSN: 2321-7758

ACCURACY ASPECTS OF LAND USE MAPPING USING REMOTE SENSING SATELLITE DATA

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ABSTRACT

Nowadays remote sensing technology is used for satellite image classification. Image classification is a particular case of pattern recognition in a remotely sensed image. The aim of the classification process is to classify all pixels in an image into land cover classes based on the predefined classification model. The term pattern in case of image classification refers to the set of radiance measurements obtained in the various wavelength bands for each pixel. There are numerous classification algorithms. Classifiers are described under broad categories such as supervised and unsupervised classifiers, parametric and non parametric. After classification of image, accuracy assessment of different classes is done by using software and ground truthing. Some issues in the classification accuracy are image resolution, types of classifications, number of classes, separability of classes, ground truthing accuracy, training data sets, sampling of training data sets etc. These issues are discussed in this study

Keywords- Image classification, Accuracy assessment, Resolution, Training data, Ground Truthing, Sampling.

INTRODUCTION

Earth resource satellites data are very useful for the study of land use change detection [1] With the application of remote sensing and Geographical Information System (GIS) techniques, land use mapping has been used to improve the selection of areas designed to agricultural, urban and industrial areas of a region [2] Image classification is a particular case of Pattern Recognition. The overall objective of the classification process is to automatically classify all pixels in an image into land cover classes based on the predefined classification model. The term pattern in case of image classification refers to the set of radiance measurements obtained in the various wavelength bands for each pixel. Digital change detection techniques by using multi-temporal satellite imagery helps in understanding landscape dynamics.[3]. High spatial resolution satellite imagery and more advanced image processing and GIS technologies, have resulted into more routine and consistent monitoring and modeling of land use patterns. Remote-sensing has been widely used in updating land use maps. Land use mapping has become one of the most important applications of remote sensing [4].

Researches on land use mapping have been done by various scholars especially by using remote sensing data [5]. Based on 20 years of satellite data from 1990 to 2010 of land use/land cover change, it was found that built up area has sharply increased due to construction of new buildings in agricultural and vegetation lands.[6] The analysis also showed that changes in land use pattern have resulted in the loss of forest area, open spaces, etc. [7] .

Accuracy assessment is required after classification of remote sensing data as without this classification is of no use. Researchers have done work on finding accuracy by three different methods for extracting land-cover/land-use information from high-resolution imagery of urban environments: (a) combined supervised/ unsupervised spectral classification, (b) raster-based spatial modeling, and (c) image segmentation classification using classification tree analysis.[8] .In this paper factors affecting accuracy of remote sensing data are analysed using ERDAS Imagine software.

II. METHODOLOGY:

There are numerous classification algorithms. Classifiers are described under broad categories such as supervised and unsupervised classifiers, parametric and non parametric, knowledge base classifiers.

Supervised classification procedures tend to require considerable interaction with the analyst, who must guide the classification by identifying areas on the image that are known to belong to each category. These areas are referred to as training sites. The training sites or samples of known identity are then used to classify pixels of unknown identity. Reflectance value of each pixel in the image is then compared numerically to each category in the interpretation key labeled with the name of the category it looks most like. Supervised classification methods in ERDAS Imagine software include parallelepiped, maximum likelihood, minimum distance, and Mahalanobis distance classifiers.

All three satellite images (LISS-III,LISS-IV and LANDSAT-8) were geo-referenced in UTM system and spheroid WGS84 using Erdas Imagine image processing software. Toposheet is geo-referenced with the help of corner point coordinate. Then toposheet to image registration is done to geo-referenced LISS-III image. Re-sampling was done using Nearest Neighborhood algorithm because it most closely preserves the spectral integrity of the image pixels .After completing these processes the classification started. Steps of this research work are discussed below:

1. The Bhopal data was added to the Viewer as a raster layer and the imported raster data viewing of three bands is shown in figure 2. The Bhopal data was defaulted to open as a color infrared image where Bands 4 (near infrared), 3 (red), and 2 (green) were represented by the colors red, green, and blue respectively. Once the image was opened, the classification process could begin.

The methodology is shown in the flow chart figure 1.

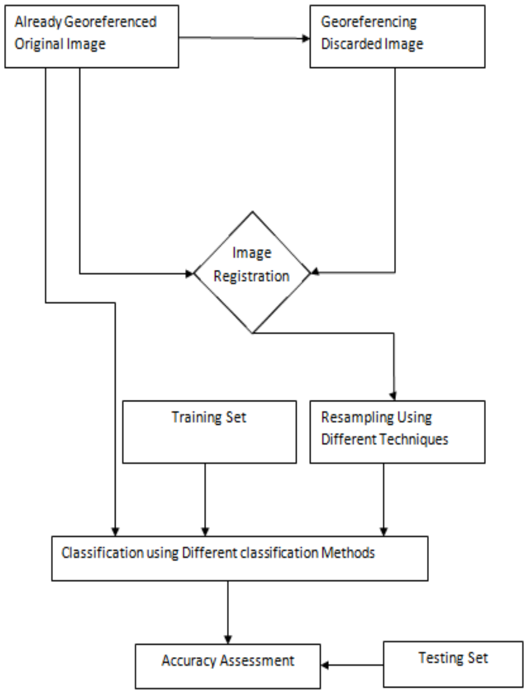


Fig. 1: Flow chart of the Methodology

2. The Toposheet of Bhopal (55E7) was scanned and then input was given and registration of Bhopal toposheet is was done. After toposheet registration the imported image was registered with the help of this toposheet. The scale of the Bhopal (55E7) toposheet was 1:50,000.The used registration techniques are called toposheet to image registration.
3. .As the accuracy analysis of classification was done by field visits. A portion of Bhopal city was taken as the study area. The area of interest (AOI) for this study was subdivided from original

image. .Therefore, a subset of the Bhopal image was created to remove all data extraneous to this study. The initial AOI selection process began by opening the "AOI > Tools" menu and drawing a polygon.

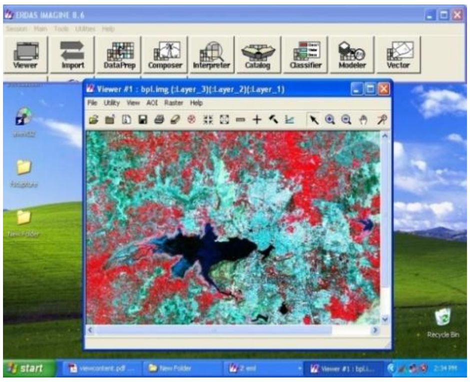


Fig. 2, Three band image of Bhopal

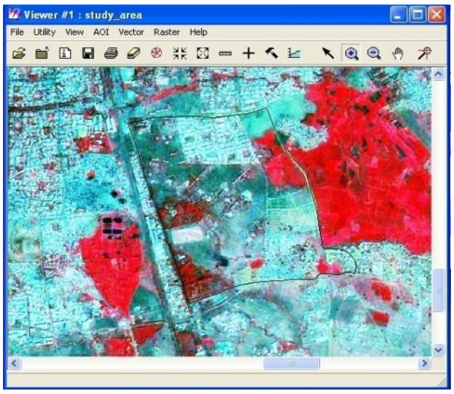


Fig. 3 ,Selecting Study area

4. "Data Prep" menu was accessed in order to subset the Bhopal image based on the previously created AOI. The resulting, reduced size image file (Fig.4) became the primary dataset for the remaining image classification procedures. Before the actual classification procedures could begin, two more subsets had to be created (i.e. one training subset and one classification subset.) In order to facilitate division of the area Real subdivision into two additional subsets, a site specific land use and land cover classification schema was developed for the study area.

The classification process breaks down into two parts: training and classifying (using a decision rule). Of the two parts, the training process is conducted first. The supervised classification training process allows the software to recognize each land use and land cover class based upon user defined training signatures.

Training signatures are identified through the creation of specific AOIs representative of each land use or land cover class. Training signature AOIs are created in the same manner as the Bhopal AOI . Once each training signature AOI was created, it was input to the Signature Editor via the "Classifier > Signature Editor" menu. Once an AOI and signature was created for each of the subsets applicable land use and land cover classes the collection of signatures was saved as signature file. (Figure 4) to be used in the supervised classification attempt.

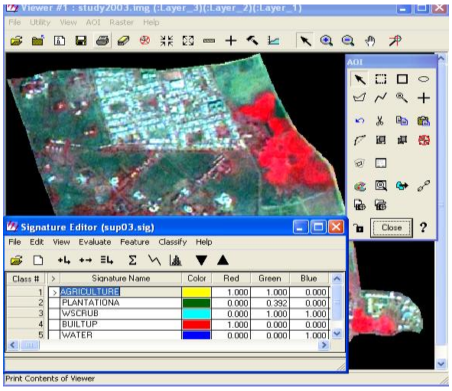


Fig.4, Signature Analysis

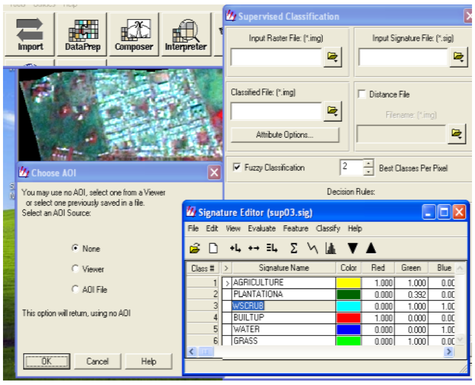


Fig.5,Supervised classification

III Supervised Classification:

Supervised classification was conducted via the "Classifier > Supervised Classification" menu. The previously created classification AOI was input from a viewer (Figure 5). Two types of decision rules (i.e. non-parametric and parametric) were set for the classification process.

IV Non-parametric Decision Rule:

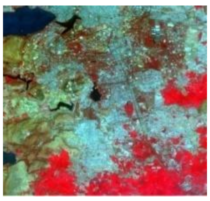
The "Feature Space" option with a secondary parametric classification for unclassified cells and for overlapping regions was selected as the non-parametric decision rule (Figure 5). The feature space decision rule compares pixels to the training signatures (i.e. signature file created in Step 5) created from the training AOIs. The non parametric decision gives better result in classification when the urban area contains some rural portion of land. The main disadvantages to the feature space decision rule can be overcome by incorporating a parametric decision rule into the classification process. (Erdas manual)

V Parametric Decision Rule:

A parametric, maximum likelihood decision rule using probabilities was selected for the classification process to overcome the shortfalls of the non-parametric (i.e. feature space) rule. As one would infer, the maximum likelihood decision rule assesses the probability (i.e. likelihood) of a pixel falling within a particular land use or land cover class. The maximum likelihood decision rule was chosen because it is the most accurate of the decision rules available within the ERDAS Imagine software package. (ERDAS Manual)With the help of these parametric rule the image was classified in different classification category .There are some important arrangement of parametric and non-parametric classification of selected image. Accuracy assessment was done after supervised classification. Various researchers have reviewed the methods of resampling in high resolution imagery[9]. They have used three resampling methods; Nearest Neighbor, Bilinear Interpolation and Cubic Convolution, and reported that Nearest Neighbour is best used for categorical data like land use classification or slope classification.[10]. Finally the accuracy assessment was done for all the classification method. The method used to assess accuracy: Error matrix and Kappa Statistics.

VI PIXEL BASED CLASSIFICATION

The below figure shows the original LISS-IV image those are taken for the classification and those are taken from the LISS scanners. LISS-IV images are multispectral images those have high spectral resolution and low spatial resolution.



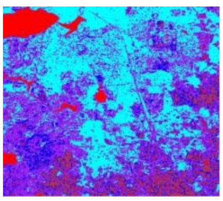


Figure 6 &7: LISS-IV Unclassified Image and Classified Image using Maximum likelihood Classification

Figure 8:Legend showing different Classes

Results and Discussions

The results of classification accuracy, Kappa coefficient and increase in accuracy by resampling is shown below in figure 9,10 and 10..

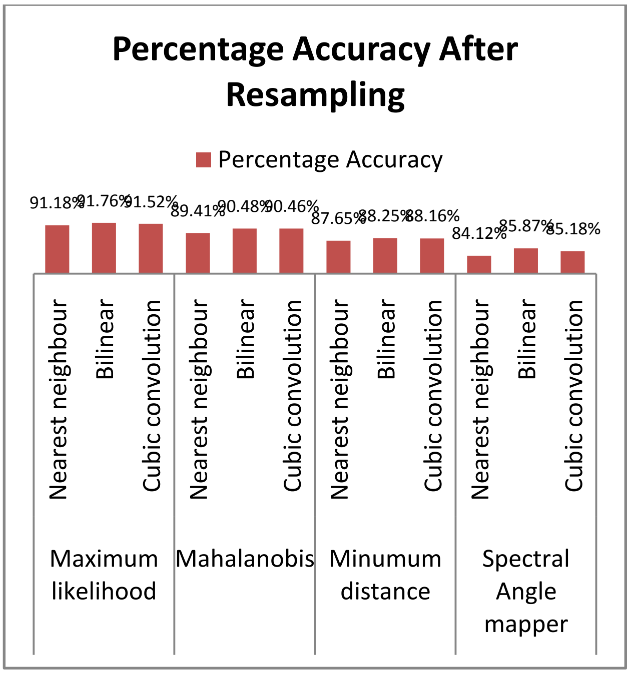


Figure 9, showing percentage accuracy after resampling

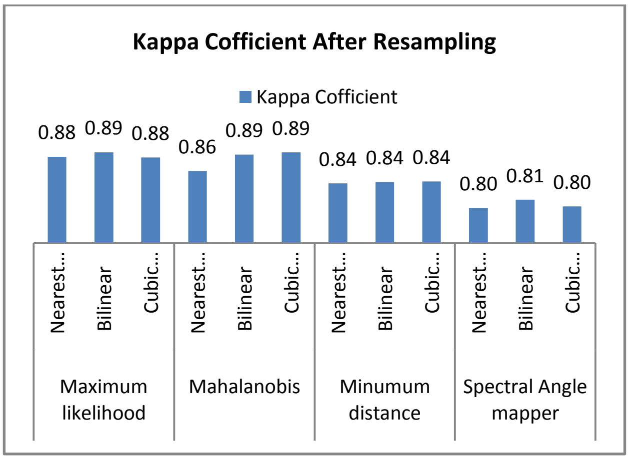


Figure 10, showing percentage accuracy after resampling

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Vol.3., Issue.5., 2015
(Sept.-Oct.)

Different classifications methods give different accuracy for different sensors images.(LISS-III, LISS-IV and LANDSAT-8).Unsupervised method gave less accuracy then supervised method.

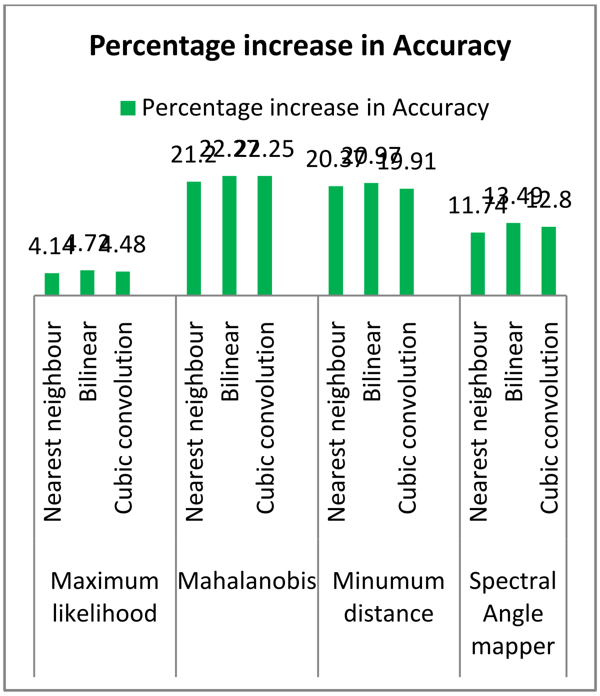

Figure 11, showing increase in accuracy after resampling

The image with higher resolution (LISS-IV) gave better accuracy. Different resampling techniques gave different accuracy for different sensors images. For different classifications resampling techniques behaves differently. Cubic convolution method performs same as for all LISS3, LISS4 and LANDSAT-8 images. In remote sensing applications resampling is used for re-projection, rectification etc., where we have to perform combined scaling and rotation operation. LISS-IV image with bilinear interpolation gives better result as compared to other techniques, for LISS4 image Nearest Neighbor gives better result as compared to other techniques and for LANDSAT-8 image Nearest Neighbor, cubic and gives better and almost similar results.

CONCLUSION

In this study,we have presented classification on LISS-III, LISS-IV and LANDSAT-8 images. The Multispectral image has been classified into 5 classes viz. water, vegetation, built up area , agricultural land and land.The effect of resampling methods have been analyzed for various classification methods using the IRS data. However further investigation is needed to evaluate the performance of various resampling techniques for other data products of IRS PAN Sensor images. Image fusion technique may be applied to improve classification accuracy. Image classification may be done by other methods also and accuracy may be checked. Ground truthing may be done using DGPS for better accuracy.

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