CORRELATION OF SPECTRAL REFLECTANCEO CHARACTERISTIC BASED ON SPECTROMETER CROPSCAM MSR 16R AND SATELLITE IMAGE LANDSAT TM (STUDY CASE IN MEDAN-INDONESIA)

by Togi Tampubolon

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Togi Tampubolon

State University of Medan
Jalan Willem Iskandar, Pasar V, Medan 20221, Indonesia
Email : topartam@gmail.com

ABSTRACT

Spectral characteristic of land cover is a reference to the classification process on the processing of satellite image data. Spectral characteristics of land cover can be obtained by measurements using a spectrometer and is based on satellite image processing. This study aims to analyze the spectral characteristics of the spectrometer is based on the measurement results Cropscan MSR 16R and Landsat 5 TM satellite imagery. The scope of this study is the spectral measurements of each type of land cover by using a spectrometer, spectral characterization of the Landsat 5 TM and verification of the Spectral spectrometer measurements and Landsat 5 TM. The results of this study are the spectral characteristics of each type of land cover based on spectrometer measurements and Landsat 5 TM. The spectral characteristics is high correlation.

Keywords: *Spectral characteristics, Spectrometers, Landsat 5 TM.*

INTRODUCTION

According to Di Gregorio (2005), land cover difined as The observed bio-physical cover on the earth surface. Tateishi and Hastings (2002) say that in global scale, land cover information would be very important in decision making process for some problems, such as quality degradation of soil, critical land, biodiversity loss, food security, and climate change. In regional and local scale, land cover information very important to know land capacity, regional planning, environmental management, water source, and inhabitant lived in an area.

Recently, satellite imagery from remote sensing technology roles as the main source to obtain information regarding to land cover. Information assessment from satellite imagery data is conducted by classify the image using visual intrepetation and automatic classification. In case of classification using large number of data, it will be very difficult to do by visual interpretation. Although using automatic, special technique besides conventional method also needed. According to Horvitz et.al. (1988), in period of 1940, expert systems and artificial intelegent has been developed alongside decision making theory. Both of them can be used to make a decision based on human knowledge. This technique become one of alternative in image classification using multi data. Goodenough et.al. (1987) said that one of the most important thing to build expert systems in remote sensing is knowledge. Knowledge roles as controller in expert systems (Quinlan, 1986). Knowledges in expert systems of image processing are knowedges about data, spectral charateristic of object, and image processing technique (Matsuyama, 1987). According to Carlotto et. Al. (1984) knowledge in remote sensing is knowledge about spectral characteristic of the object in sensor. Therefore, for land cover classification purpose, spectral characteristic information of each land cover become the most fundamental. This study aim to analyze spectral characteristics from spectrometer Cropscan MSR 16R and Landsat 5 TM imagery measurement. This study include are spectral measurement of each land cover type using spectrometer, spectral characterization on Landsat 5 TM imagery and verify the spectral value of measurement from spectrometer and Landsat 5 TM imagery.

Study Area and Data

This study is conducted in Medan region and a part of Deli Serdang, North Sumatera, Indonesia. This study area located in 03°34'05" - 03°55'08" S and 98°31'12" - 98°55'12" or 47S UTM zone (447.450 ; 393.500) m until (432.800 ; 491.500) m (Figure 1). This study use multispectral image of Landsat 5 TM acquired on January 27, 2006 and March 30, 2011 with location index is path 129 and row 057.

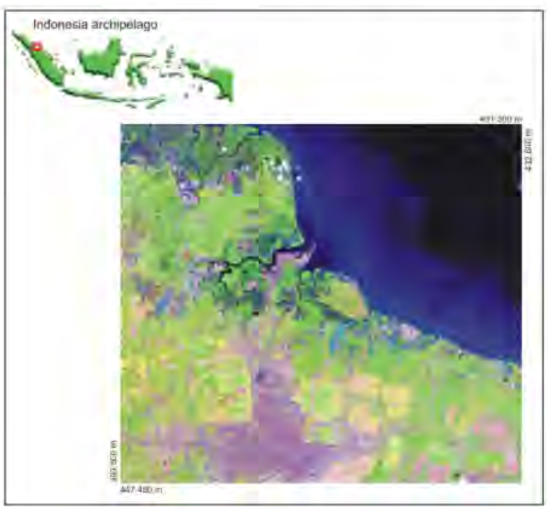


Figure 1. Study Area

Spectral Survey and Image Processing

Spectral survey of land cover was conducted by using spectrometer. Spectrometer is a passive detection device of electromagnetic waves. Device used in this study is Spectrometer type Cropscan MSR 16R produced by Cropscan, Inc. Cropscan MSR 16R has 16 sensors with different wavelength which are 520, 560, 561, 600, 601, 630, 660, 661, 662, 690, 760, 810, 855, 1600, 1650, 1700 nm. Each wave has a pair of sensor, upper sensor to measure received energy and under to measure energy reflected by objects. Energy reflected by an object in certain wavelength could be measured by spectrometer with detection area around 1.5 times of height from object of radiometer when measurement conducted. Spectrometer device and survey technique could be seen at Figure 2.

Figure 2. Spectral measurement technique

Beside spectral measurement using spectrometer, field sample data collection and other data such as plot number, coordinate, land cover type, time, and temperature also has been conducted.

Field sample data collection survey refers to McCoy (2005) , while clustered pattern system was selected for field sample distribution. In this system, field samples are distributed based on land cover pattern classification. According to McCoy, this method has advantage because land cover pattern that will be surveyed has been known so that the identification and access to the location will be easier and the spending time will be more efficient.

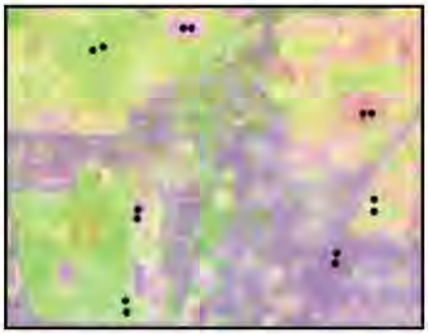


Figure 3. Field sample data collection survey using clustered pattern system and sample point technique

Field sample data collection use sample point technique which position is measured by using GPS handheld. Field sample size is determined by spatial resolution of satellite imagery being used. This study use Landsat 5 TM with 30 meter of spatial resolution. According to McCoy (2005), if the spatial resolution is 30 meter, than the accuracy of GPS handheld should be better than ±0.5 pixel (15 m). In bare land area, accuracy of 15 meter could be obtained. Land cover to be sampled is homogen, the sampling size according Justice and Townshend (1981) in McCoy (2005) formulated as:

$$A = P(1+2L) \quad (1)$$

where :

A= sampling size

P = spatial resolution of satellite imagery

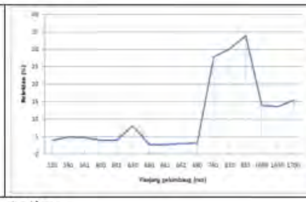
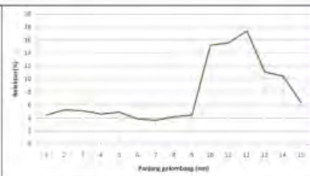
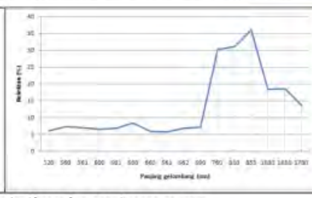
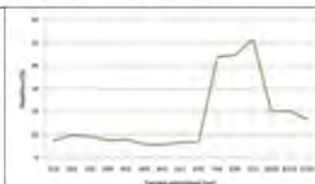
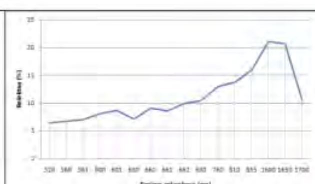
L = estimated location accuracy

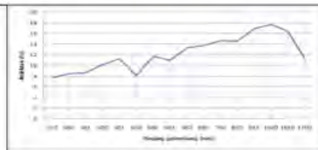
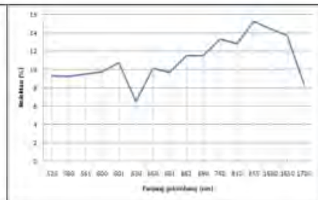
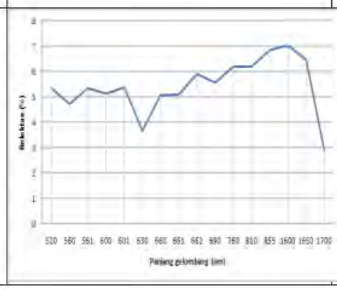
Therefore, if we use Landsat 5 TM with 30 meter spatial resolution (P = 30) and estimated location accuracy 0.5 pixel (L=0.5) then sampling size is 60 m. It means theoritically in 60 x 60 meter has homogen land cover. The number of field sample been collected refer to Jensen (1999) and McCoy (2005), according to them number of sample that is used is 10 times of the number of band will be used. In this case, the number of used band in Landsat 5 is 6 bands, therefore total of used field sample is 60 samples or 60 pixels of each land cover type.

RESULTS AND ANALYSIS

Land cover type has been measured using spectrometer and field sample data collection based on land cover classification system LCCS consist of three seperating steps. Field sample as the result of measurement using spectrometer for each land cover type could be seen in table 1.

Table 1. Result of spectral measurement sample for each land cover type using spectrometer Cropscan MSR 16R

No	Land cover type	Characteristic	Photo
I	Production / management plantation		
	a. Oil palm plantation		
II	Natural / semi-natural plantation		
	a. Forest (group of natural / non natural tree)		
III	Prooductive plantation / management influenced by water		
	b. Watery paddy field		
IV	Natural / semi natural vegetation in watery area		
	a. Aquatic plants		
V	Built land		
	a. Roof		
VI	Bare land		

	a. Bare land		
VII	Wetland		
	a. Wetland		
VIII	Natural aquatic		
	a. river		

The results of spectral value of land cover types measurement in frst seperation step which are vegetation and non vegetation type using spectrometer Cropscan MSR 16 R could be seen in Figure 4.

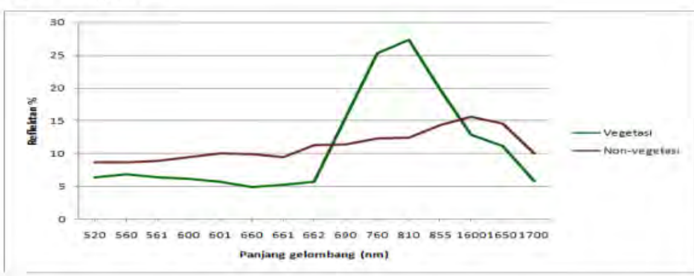


Figure 4. The average spectral value of each land cover type in first seperation step

The results of spectral value of land cover types measurement in second seperation step which are land vegetation, land vegetation influenced by water, or non-land vegetation and non land vegetation influenced by water using spectrometer Cropscan MSR 16 R could be seen in Figure 5.

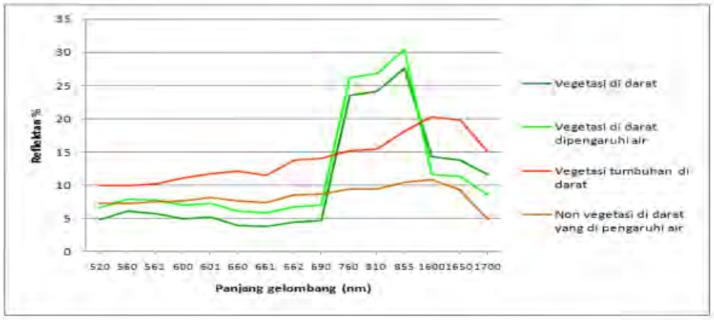


Figure 5. The average spectral value of each land cover type in second seperation step

The results of spectral value of land cover types measurement in third seperation step which are production/ management, natural and non-natural plantationbuilt land, and bare land/ management, land influenced by water and natural aquatic land using spectrometer Cropscan MSR 16 R could be seen in Figure 6.

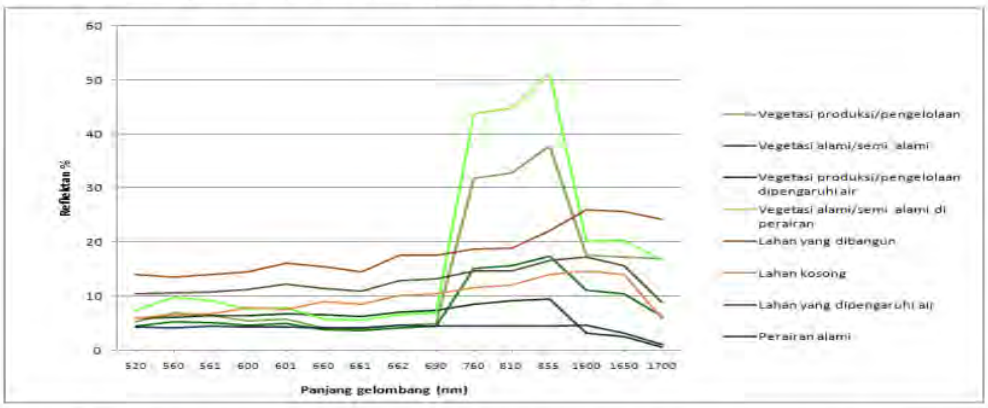


Figure 6. The average spectral value of each land cover type in third seperation step

The result of field survey verify by lansat 5 TM imagery. Before verification, pre-processing conducted to corect the atmospheric and topographic error. Radiometric error correction use nomalization technique by converting digital number to radiance and radiance to reflectance (Markham and Barker, 1986) and topographic correction by reduce topographic error using C-correction model (Teilet et.al., 1982).

Verification is done by graphic plotting and compute the correlation between the two values. Graphically the results of pre-processing of Landsat 5 TM satellite image with spectral reflectance measurements using a spectrometer Cropscan MSR 16R for each type of land cover can be seen in figure 7.

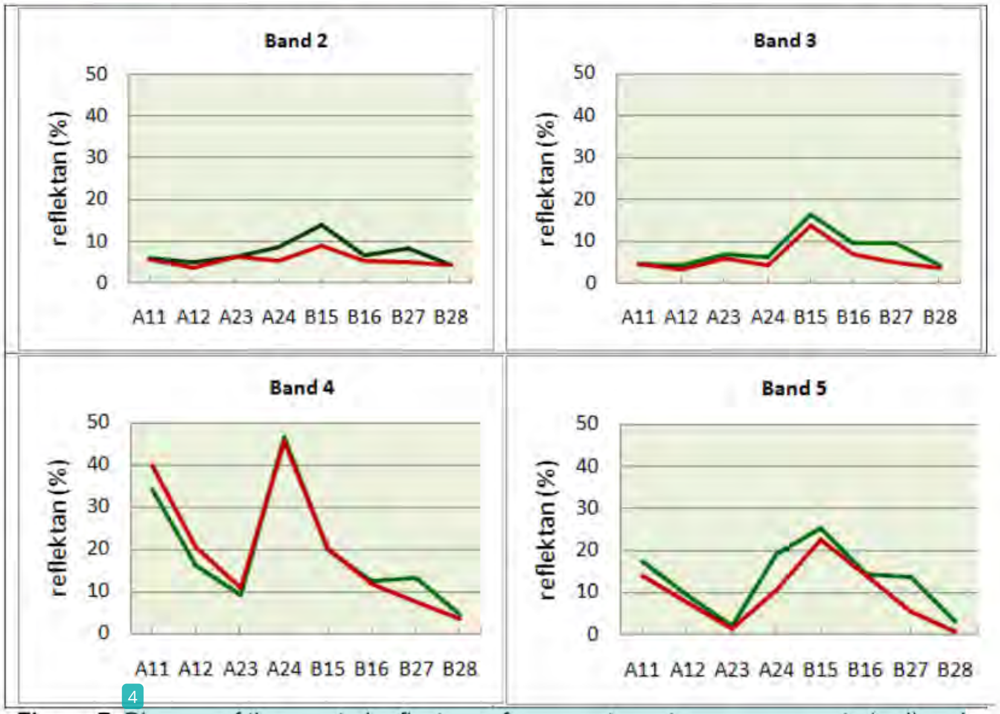


Figure 7. Diagram of the spectral reflectance from spectrometer measurements (red) and Landsat 5 TM satellite image (blue) for each type of land cover

Graphically diagram that forms from the pre-processing is relatively similar to the diagrams that form from the spectral measurements. If seen from the correlations in Table 2, pre-processing spectral reflectance values of Landsat 5 TM satellite image with the MSR 16R Cropscan spectrometer measurements for each type of land cover has a value close to 1, which means it has a high correlation. If a linear regression equation made, it has high determination value that can be interpreted that affected each other.

Table 2. Relationship of spectral reflectance value measurement using spectrometer Cropscan MSR 16R and Landsat 5 TM for each land cover type

Land cover type	Correlation value (Spearman Model)	Linear equation	Determination value R^2 (%)
A11	0.98	y=0,81x+ 3.57	97 %
A12	0.98	y=0,67x+4.42	96 %
A21	0.97	y=0,77x+2.68	94 %
B11	0.98	y=0,93x+5.55	97%
B12	0.92	y=0,81x+6.88	96%
B21	0.61	y=1,40x+5.53	37%
B22	0.95	y=0,43x+4,66	91%

CONCLUSION

Spectral value in spektrometer cropscan MSR 16R and landsat 5 TM imagery are sensitive with land cover type in land cover classification system LCCS so that the uniqueness of spectral characteristic for each land cover type can be known. These spectral characteristic could be used as reference for land cover classification process. Spectral value of each land cover type resulted by using spectrometer MSR 16R and resulted from characterization of Landsat 5 TM has relatively same value and highly correlatated.

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