INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH & DEVELOPMENT

ISSN 2278 – 0211 (Online)

Analytical Spectral Devices (ASD) Signature Collection and Validation Using IRS P6-Lissiv and Ground Truth Spectoradiometer

M. Rajamanickam
Assistant Professor, Centre for Disaster Management, PRIST University, Thanjavur, Tamil Nadu, India
J. Dinesh
Assistant Professor, Saraswathy College of Engineering & Technology, Oakum, Tindivanam, Tamil Nadu, India
V. Santhosh Raja
P.G. Scholar, Department of Civil Engineering, PRIST University, Trichy Thanjavur Highway, Vallam, Thanjavur, Tamil Nadu, India
D. Muthu
Senior Assistant Professor, School of Civil Engineering, SASTRA University, Thanjavur, Tamil Nadu, India

Abstract:
Field spectroscopy is a nondestructive way to collect information on natural resources and is becoming a common exercise in remote sensing field campaigns. Specific absorption features of reflectance spectrum can be used to identify a number of important rock forming minerals, and have been used by geologists for geologic mapping and studies of volcanoes. The spectral database provides a source of reference spectra useful in classification of hyperspectral images. In this research focus on application of ground truth spectoradiometer for inventory of manmade feature, natural feature spectral studies for better understanding spectral signatures and reflectance in global level.

1. Introduction

Analytical Spectral Devices (ASD), Field Spec Full Range field spectrometer provided by the Jet Propulsion Laboratory. The ASD spectrometer covers the 0.35-2.5 nm range with approximately 3 nm (VNIR) and 10 nm (SWIR) spectral resolution and 1 nm spectral sampling.An attachment containing a halogen light source was used to illuminate the samples.This results in a high-quality spectrum with 2151 spectral bands, allowing identification of specific minerals.At all study sites with the ASD radiometer mounted on a yoke device 2 m above the surface.We also made ‘pure’ spectral signature measurements of the green, soil, and NPV components at each site. Different plant/ shrub species encountered over the 100 m transect were measured directly so that the field of view of the radiometer only sensed a particular ‘pure’ component. We made simultaneous measurements of leaf area index (LAI) and the fractional component covers along the 100 m 0-7803-transects. Radiometric and biophysical field measurements were conducted inside and outside the Annamalai Campus. We also measured altered areas of roads, dry tanks, building roofs and agriculture fields within the Annamalai Campus. All ASD spectra were converted to reflectance values with the use of a standard reference, Spectral on panel.Figure.1.showing portable ground truth spectro radiometer, spectrum collection and spectrum processing. There are various hyperspectral image classification and FTIR Spectum application discussed by (Harsanyi JC, Chang CI (1994),Korb et.al,1996,Kruse,1993,2002, yuahas,1992

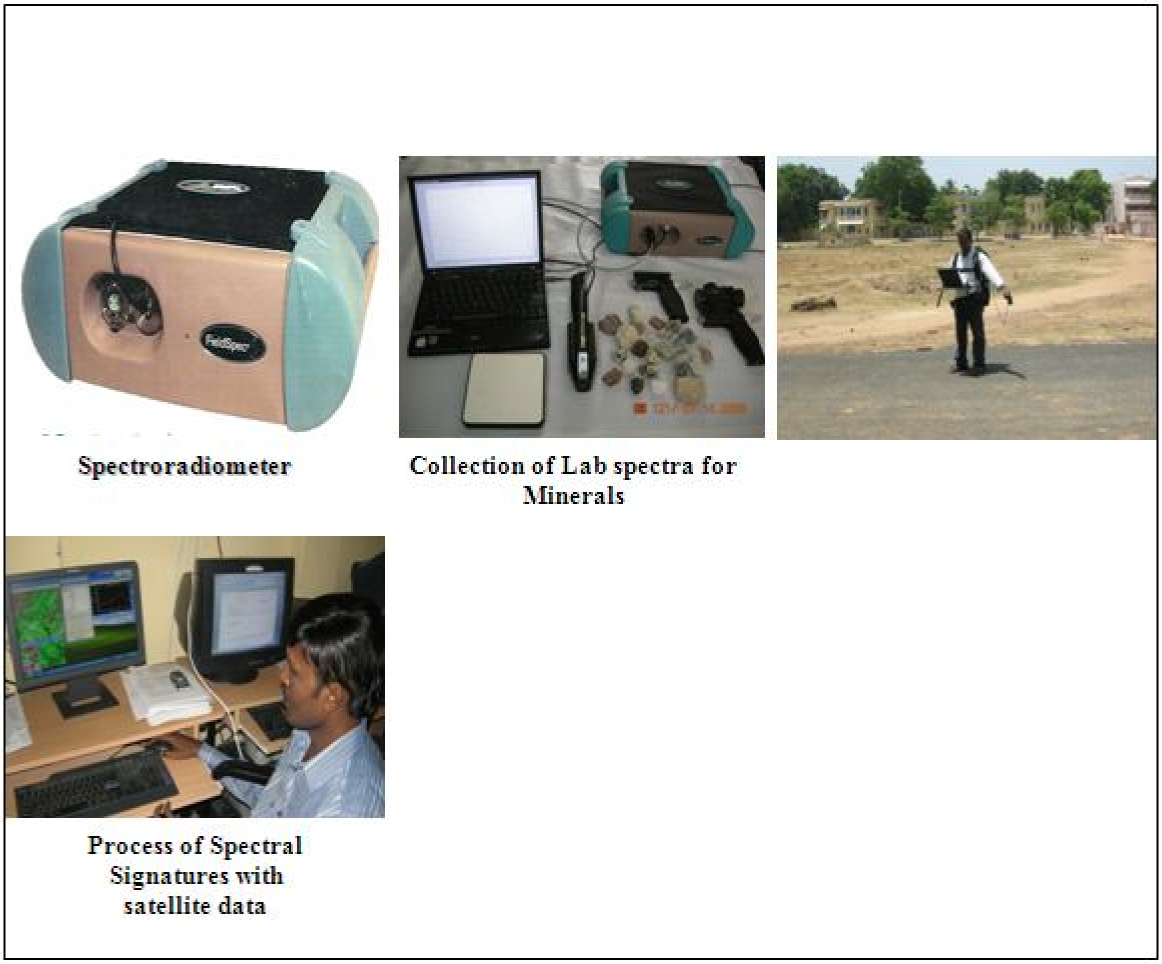


Figure 1: Spectroradiometer and signature collection

2. Study Area

Chosen Man made objects GPS location in ANNAMALAI UNIVERSITY CAMPUS

a. Cement Road: N 11 23’398’; E 79 42’615’
b. Terrace of Buildings Rose Hostel 11 23’468’; E 79 42’582’
c. Dental Building: N 11 23’685’; E 79 42,939’
d. Water/Dry Tanks: N 11 23’376’; E 79 42’765’

The mentioned above man-made object and land cover features were identified in high resolution satellite image IRS P6 LISS IV data having 5.8 spatial resolutions Shown in Figure.2 and Figure.3.Enhanced IRS P6 Data (5.8m) image showing building structure of Chidambaram town area.

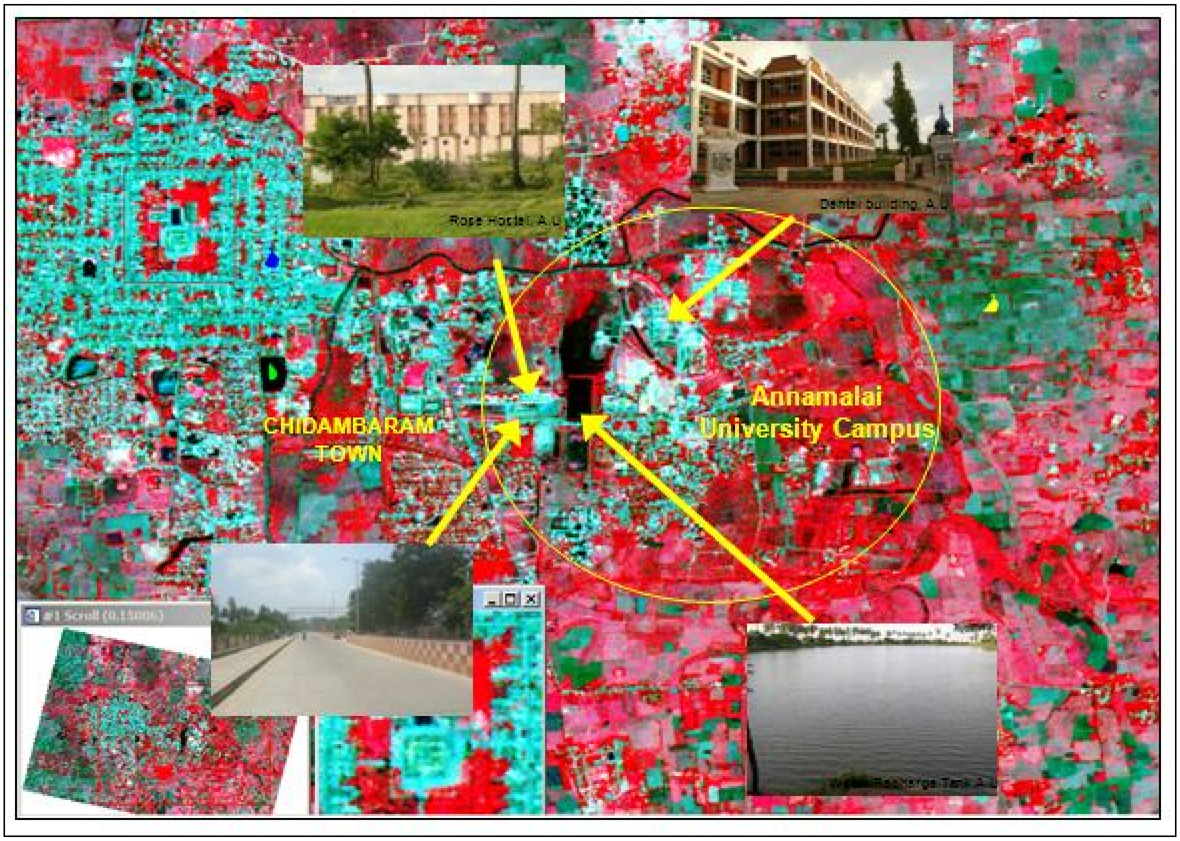


Figure 2: Location map showing study sites In IRS P6 Data (5.8m)

- Cement Road: N 11 23'398'; E 79 42'615'
- Terrace of Buildings
  Rose Hostel: N 11 23'468'; E 79 42'582'
  Dental Building: N 11 23'685'; E 79 42,939'
- Water/Dry Tanks: N 11 23'376'; E 79 42'765'

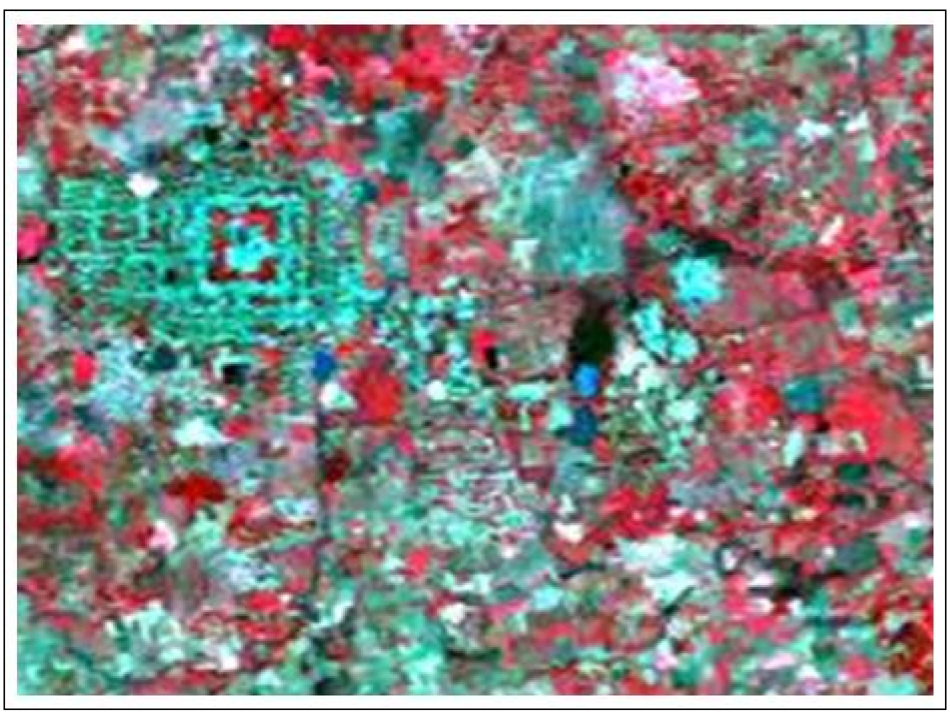


Figure 3: Enhanced IRS P6 Data (5.8m) image showing building structure

3. Methodology

In this field Spectoradiometer is controlled by the spectrum collection using the RS^3 software has been used for the spectrum collection.

RS^3 refers to the third version of this ASD application and is pronounced "RS cubed."

1. To control the operation of an ASD general-purposed RS^3spectoradiometer
   And
2. To receive and store the spectral data transmitted from an ASD
   Spectoradiometer

The ASD general-purpose spectoradiometer are useful in many application areas requiring the measurements of either reflectance or transmittance. The ASD spectoradiometer are highly portable. Yet perform cumulatively in the laboratory as well.

The RS^3 applications come standard with the following ASD

1. Field Spec 2. TerraSpec 3.AgriSpec 4.HandHeld

Figure showing .1. Portable ground truth spectro radiometer, spectrum collection and spectrum processing

4. Results and Discussions

4.1. Laboratory Spectral Reflectance and Absorption of Man Made Material

Clark and Swayze (1990,1992,1995) pointed out mapping of amorphous materials, vegetation and water. Data for spectral characterization of medaled road sample, concrete tiled samples, water were collected during the field work (in-situ) and laboratory analysis carried out, the field spectral examined the spectral reflectance from 400nm to1050nm. Application of AVRIRIS image for spectral classification (Boardman et.a.1995,1998. Measurements were made from a 1.5m high directed at a 45^0 viewing angle, facing the illuminating sun both on the man made materials (concrete road, tiles) and white board. The spectral interval of field spectrometer is 25nm (400 to 675), 50nm (700 to 750) and 100 nm (750 to 1050). However, the spectral reflectance and absorption measured in the laboratory was undertaken at 10nm intervals all over from 400 to 1190 nm.However, the laboratory data were re-organized to a 10, 20, 50 and 100nm bandwidths. Haranyi and Change (1994) discussed the hypespectral image classification and orthogonal projection application In lab-based condition, a new measurement device Spec view field spectoradiometer meters (Figure) was used; it is composed of fiber optic reflectance probe employed for solid samples, which measure sample absorption, transmittance and reflectance. These instruments at a 10nm interval are calibrated to measure over the wavelength range from 400 – 1100nm. The white reflectance standard was used in the instrument with a >97% reflectance. Specular reflectance from manmade materials was minimized using an angle of 45^0 between light beam and normal axis, to the man made material sample surface. Interference light multiple fraction were reduced by setting the measuring probe at 2mm distance from the soil sample.Crucible with a 30nm depth was filled with specimen. Main attention was given to the size of micro-aggregate, where a 2 nm sieve was used to make them homogeneous in dimension

4.2. Collection of Ground Based Spectral Signatures to Camouflage the Selected Objects

The collection of spectral signatures of different manmade objects (building roof, building shadow, road concrete,cement road), land cover features (water bodies, agricultural fields) have been collected with in the Annamalai campus.The field spectrometer has been used for the spectral signature collection.Elevide, 1990 discussed role of visible ans infrared band for identificartion of dry materials. Firstly collected spectral signatures of totally 150 samples were collected for each object on various parts of the Annamalai University. The collected places of Annamalai campus are

1. Rose Hostel, dental college- roof signature
2. Annamalai University main campus road signature
3. Water tank (dry and wet) signature
4. Agriculture college (crop signature collection)

4.3. Field Spectral Characteristics of Spectral Signatures of Building Terrace, ROSE HOSTEL & Dental Hospital Buildings

The field spectrum collection was made on building terraces of Rose Hostel:N11 23'468'; E 79 42' 582 and Dental Building: N11 23'685'; E 79 42, 939 carried out , Annamalai University Campus Spectrum Collected between 10.30am-11.30 am and 2.30 am-3.30 am. Mapping of soil properties using hyperspectral data (Ben-Dor et.al,2000).The spectral signatures of two different objects namely clear tiles and side walls. Totally 150 spectrum was collected on pure red coated tiles and red coated with white mixture tile spectrum also collected. The spectral signatures of the different tiles are shown in Figure (4).

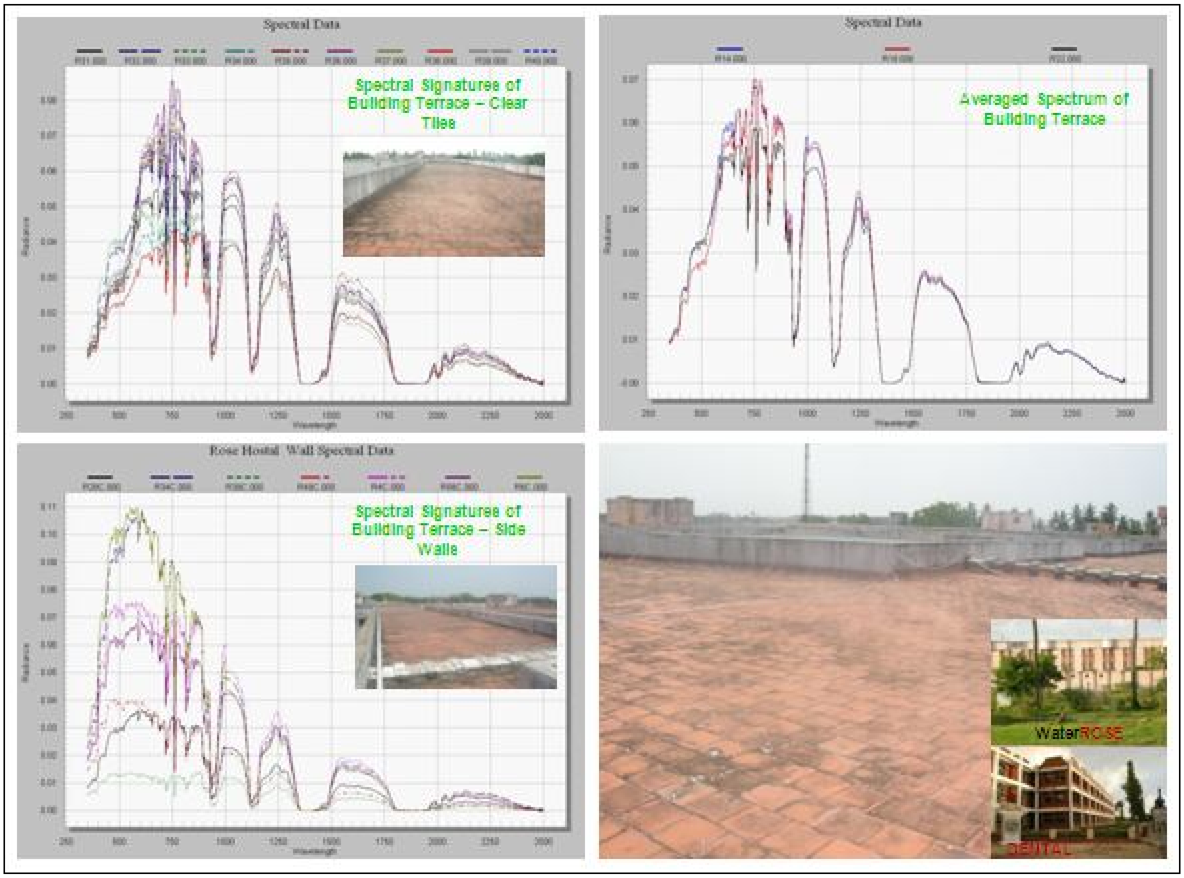


Figure 4: Typical Spectral Signatures of Building Terrace, ROSE HOSTEL & Dental Hospital Buildings, and Annamalai University Campus Spectrum Collected between 10.30-11.30 and 2.30-3.30

The field spectrum collection was made on Typical Spectral Signatures of Cement Road
GPS location 11 23'398';E79 42'615' was carried out, Annamalai University Campus Spectrum Collected between 10.30am-11.30 am and 2.30am-3.30 am. The spectral signatures of cement road samples, totally 150 spectrums were collected. The spectral signatures of the cement road are shown in Figure 5.

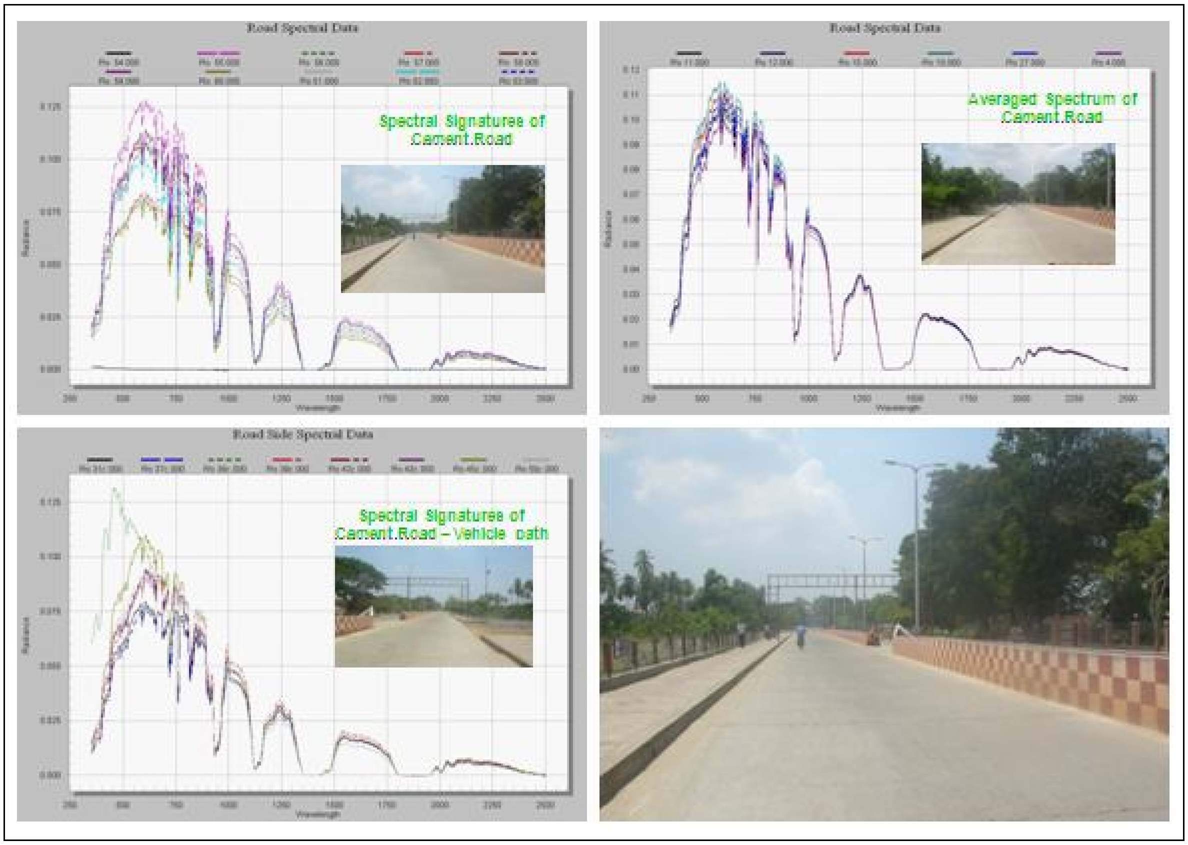


Figure 5: Typical Spectral Signatures of Cement Road, Annamalai University Campus Spectrum Collected between 10.30-11.30 and 2.30-3.30

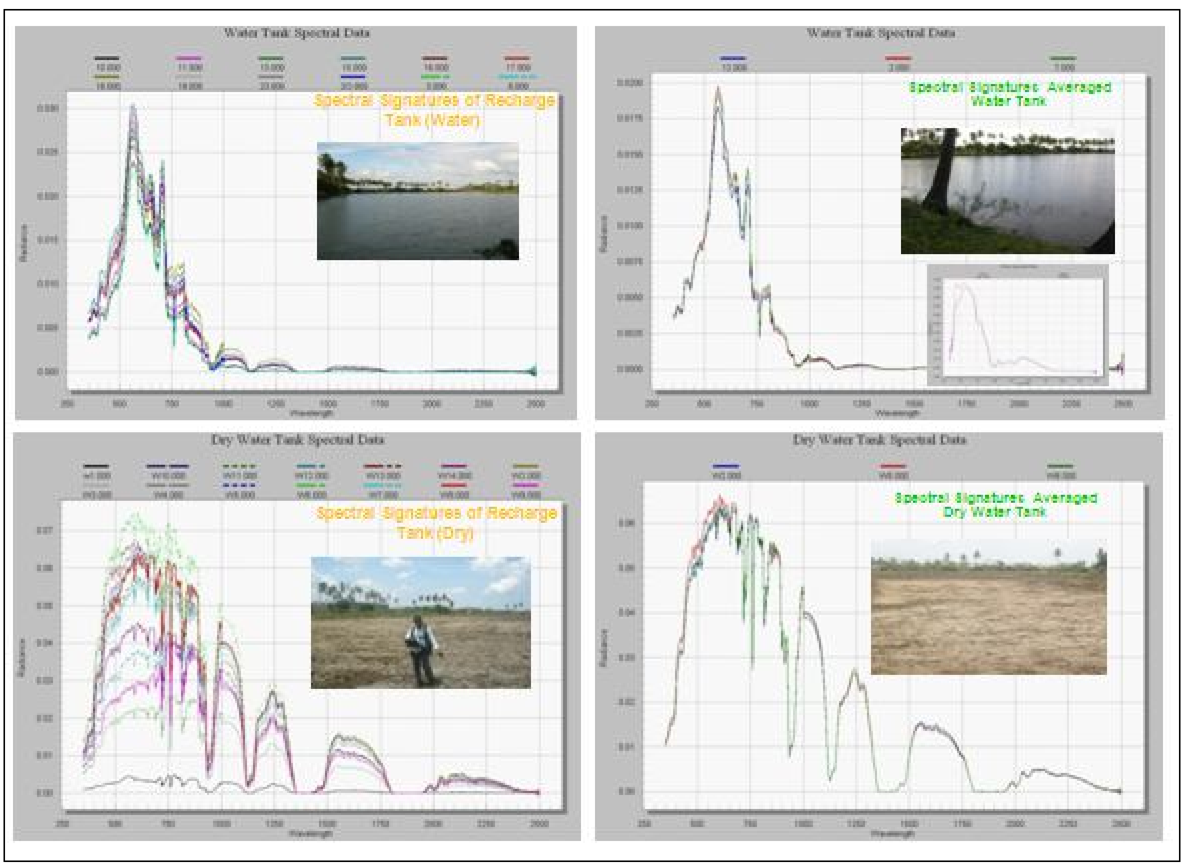


Figure.6: Typical Spectral Signatures of water body, Annamalai University Campus Spectrum Collected between 10.30-11.30 and 2.30-3.30

Figure.6 shows Typical Spectral Signatures of water body, Annamalai University Campus Spectrum Collected between 10.30-11.30 and 2.30-3.30 and. Figures 7 and 8 shows the physical and chemical properties of buildings have been generated in terms of measuring the height, width and type of materials for construction properties.

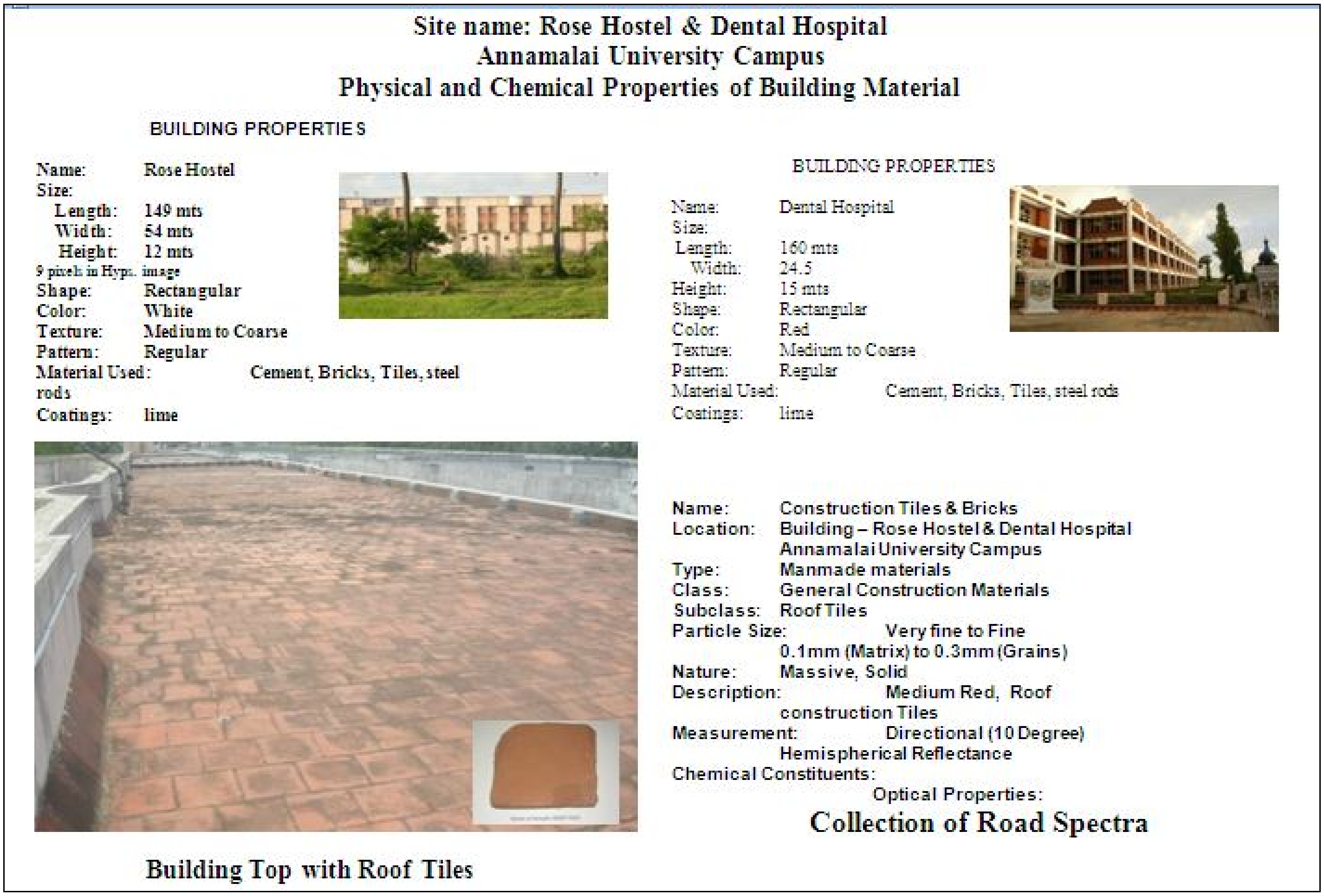


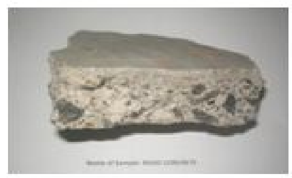
Figure7: Site name: Rose Hostel & Dental Hospital Annamalai University Campus Physical and Chemical Properties of Building Material

Site name: Main Road (Entrance)
Annamalai University Campus
Physical and Chemical Properties of Building Material

ROAD CHARCTERS

Name: Main Road (Entrance)
Type: Cement Road (Two way with Divider)
Length: 580 mts
Width: 18 mts
11 pixels in Hypa. Image
Materials used: Cements and Gravel

Name: Construction Concrete
Location: Building – Main Road (Entrance) Annamalai University Campus
Type: Manmade materials
Class: General Construction Materials
Subclass: Cement Cinderblock
Particle Size: Very fine to Coarse 0.1mm (Matrix) to 4cm (Gravels)
Nature: Massive, Solid
Description: Light brown, cement construction concrete cinderblock.
Measurement: Directional (10 Degree) Hemispherical Reflectance
Chemical Constituents:
Optical Properties:



Name: Clay Soil
Location: Dry Rechargeable Water Tank; Annamalai University Campus
Type: Manmade Structures
Class: Water Resources
Subclass: Rechargeable Tank
Particle Size: Very fine to Coarse 0.1mm to 0.7mm
Nature: Loose, Fragmented
Description: Light Dark brown
Measurement: Directional (25 Degree) Hemispherical Reflectance
Depth: 0-18 cm
Chemical Constituents: Sand : 17.6; Silt: 22.7; Clay: 60.2 ; pH: 6.3 Ec: 0.9;

Exchangeable Cation			
Ca	Mg	Na	K
8.36	2.96	0.22	0.3

Optical Properties:

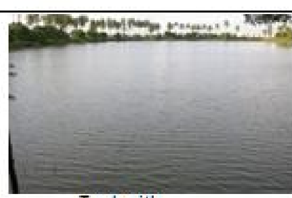
Name: Clay Soil
Location: Rechargeable Water Tank – with Water Annamalai University Campus
Type: Manmade Structures
Class: Water Resources
Subclass: Rechargeable Tank
Particle Size: Very fine to Coarse 0.1mm to 0.5mm
Nature: Loose, Fragmented
Description: Dark brown
Measurement: Directional (25 Degree) Hemispherical Reflectance
Depth: 0-20 cm
Chemical Constituents: Sand : 09.1; Silt: 24.7; Clay: 68.5 ; pH: 6.1 Ec: 0.8;

Exchangeable Cation			
Ca	Mg	Na	K
10.36	3.46	0.43	0.2

Optical Properties:

RECHARGE TANKS

Name: Recharge Tank
Type: Man-made
Length: 240 mts
Width: 102 mts
Depth: 5 mts
27 pixels in Hypa. image



Tank with

Dry Tank

Name: Water
Location: Rechargeable Water Tank – with Water Annamalai University Campus
Type: Rain / Ground Water
Class: Water Resources
Subclass: Drinking Water
Nature: Transparent, Algae at few places
Description: Clear
Measurement: Directional (25 Degree) Hemispherical Reflectance
Depth: 3 m
Chemical Constituents: Ec: 3310; pH:7.8; Ca:72; Mg:115.2; Na:483; K:5; HcO3:189; CO3:0; So4:480; Cl:38; Co3: 0.8; TDS: 1891; TH (CaCO3/mg/l): 660

Optical Properties:

Figure 8: physical and chemical properties of man-made structures

5. Conclusion

Hyperspectral sensors and analyses have provided more information from remotely sensed imagery. As new type of sensors provide more hyperspectral imagery and new image processing algorithms were developed,the positioned hyperspectral imagery become one of the general research,exploration,and monitoring technologies used in a wide variety of fields.Spectroscopy by satellite images brings a new conception in remote sensing that enables the identification of the major scene components.It has a great potential to aid numerous other fields of study.The success of research is very much dependent on the quality of data, correctness of data and the analysis techniques used.The employment of the sequence of MNF, PPI and n-D visualizer in the study area allowed the identification of different mineral and vegetation. This work showed a possible cartography of soil occupation using objects spectral library and a sequential technique in processing image.

6. References

1. Ben-Dor, E., Patin, K., Banin, A. and Karnieli, A., 2000, Mapping of several soil properties using DAIS-7915 hyperspectral scanner data. A case study over clayey soils in Israel. International Journal of Remote Sensing (in press).
2. Boardman J.W., Kruse & F.A.& R.O.,Green; Summaries of the 5nd Annual JPL Airborne Geoscience Workshop, JPL Publication 95-1 Vol.1, pp. 23-26; (1995); " Mapping target signatures via partial unmixing of AVIRIS data".
3. Boardman, J. W., Kruse, F. A., and Green, R. O., 1995, Mapping target signatures via partial unmixing of AVIRIS data. In Summaries of the Fifth JPL Airborne Earth Science Workshop, JPL Publication 95-1, v. 1, pp. 23-26.
4. Boardman JW (1998) Post-ATREM polishing of AVIRIS apparent reflectance data using EFFORT: a lesson in accuracy versus precision. AVIRIS 1998 Proceedings, JPL, California. 1pp. (http://makalu.jpl.nasa.gov/docs/workshops/98_docs/7.pdf)
5. Clark, R. N., and Swayze, G. A., 1995, Mapping minerals, amorphous materials, environmental materials, vegetation, water, ice, and snow, and other materials: The USGS Tricorder Algorithm. In Summaries of the Fifth Annual JPL Airborne Earth Science Workshop, JPL Publication 95-1, v. 1, pp. 39 - 40.
6. Clark, R. N., Swayze, G. A., and Gallagher, A., 1992, Mapping the mineralogy and lithology of Canyonlands, Utah with imaging spectrometer data and the multiple spectral feature mapping algorithm. In Summaries of the Third Annual JPL Airborne Geoscience Workshop, JPL Publication 92-14, v 1, pp. 11-13.
7. Clark RN, Gallagher AJ,Swayze GA(1990)Material absorption band depth mapping of imaging spectrometer data using the complete band shape least-squares algorithm simultaneously fit to multiple spectral features from multiple materials. Proceedings of the 3rd Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) Workshop, JPL Publication 90-54, pp 176–186
8. Crowley JK, Clark RN (1992) AVIRIS study of Death Valley evaporite deposits using leastsquares band-fitting methods. Summaries of the 3rd Annual JPL Airborne Geoscience Workshop, JPL Publication 92-14, v 1, p 29–31
9. Elvidge, C. D., 1990, Visible and infrared reflectance characteristics of dry plant materials. International Journal of Remote Sensing, v. 11(10), pp. 1775 - 1795. Grove, C. I., Hook, S. J., and Paylor, E. D., 1992, Laboratory reflectance spectra for 160 minerals 0.4 - 2.5 micrometers.JPL Publication 92-2.
10. Harsanyi JC, Chang CI(1994)Hyperspectral image classification and dimensionality reduction: An orthogonal subspace projection approach. IEEE Transactions on Geoscience and Remote Sensing 32:779–785
11. Korb, A. R.,Dybwad, P.,Wadsworth, W., and Salisbury,J.W.,1996,Portable FTIR spectrometer for field measurements of radiance and emissivity.Applied Optics,v.35, pp. 1679-1692.
12. Kruse FA, Lefkoff AB, Dietz JB (1993) Expert System-based mineral mapping in northern Death Valley, California/Nevada using the Airborne Visible/Infrared Imaging Spectrometer (AVIRIS). Remote Sensing of the Environment, 44:309–336
13. Kruse, F.A., Boardman, J.W., Huntington, J.F., Mason, P., and Quigley, M.A. (2002), Evaluation and validation of EO-1 Hyperion for geologic mapping. IEEE International Geoscience and Remote Sensing Symposium 1:593-595.
14. Salisbury, J. W., Wald, A., and D'Aria, D. M., 1994, Thermal-infrared remote sensing and Kirchhoff's law 1. Laboratory measurements. Journal of Geophysical Research, v. 99, pp. 11,897-11,911.
15. Yuhas, R.H., Goetz, A. F. H., and Boardman, J.W.,1992, Discrimination among semiarid landscape endmembers using the spectral angle mapper (SAM) algorithm. In Summaries of the Third Annual JPL Airborne Geoscience Workshop, JPL Publication 92-14, vol. 1, pp. 147-149.