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Building Spectral Library of Soil Samples using Spectroscopic Device and ENVI Software

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Abstract— Spectroscopic devices are useful for getting Spectral Signatures of various materials. Spectral signature is the specific combination of emitted, reflected or absorbed electromagnetic radiation at varying wavelength which can uniquely identify an object. The spectral signature can give the idea about distinguish between the materials. Spectral reflectance is the efficiency by which a material reflects energy as a function of wavelength. In this research for collecting Spectral Signatures of Soil Samples we used the ASD FieldSpec4 Standard Spectroradiometer device that having the spectral range 350-2500 nanometer and its supporting software's are used. For building a Spectral Library from Spectral Signatures of soil samples collected by Spectroradiometer the ENVI 5.5 application software is used.

Keywords— Spectral library, ENVI, ASD FieldSpec4, Soil, Remote Sensing, Spectral Signature.

I. INTRODUCTION

ENVI is an acronym for "Environment for Visualizing Images" is a software application developed by Harris Geospatial Solution. ENVI Solutions combine the latest spectral image processing and image analysis technology with an intuitive, user friendly interface to help get meaningful information from imagery [1]. ENVI combines advanced spectral image processing and proven geospatial analysis technology with a modern, user friendly interface. Whether you use panchromatic, LiDAR, SAR, Multispectral or hyperspectral imagery, ENVI has the latest processing and analysis tools to help you extract meaningful information to make better decisions. ENVI application is used to process and analyze geospatial imagery. It is commonly used by remote sensing and image analytics. Remote Sensing is the acquisition of information about an object or phenomenon without making physical contact with the object and thus in contrast to on-site observation, especially the earth. Remote Sensing is used in various fields, including geography, land surveying and most earth science disciplines for example hydrology, ecology, meteorology, oenology, geology [2]. It also has military, intelligence, commercial, economic, planning, and humanitarian applications. ENVI supports imagery from today's newest and most popular satellite and airborne sensors, including multispectral, hyper spectral,

panchromatic, LiDAR, Infrared, Thermal, Radar, HDF5, full motion video, LAZ, ASCII and NET CDF-4. ENVI is a flexible solution that can be customized to meet specific project need and can be deployed and accessed from the desktop, in the cloud, and on mobile device [3]. In ENVI, the Spectral Library Builder is used to create ENVI Spectral libraries from a variety of spectra sources and spectral signature database [4]. Spectra source include ASCII file, spectral files produced by ASD Spectroradiometer, other Spectral libraries, ROI means, and spectral profiles and plots [5]. When we collect the all spectra, the collected spectra's automatically resample to an input wavelength space using Full width at half maximum (FWHM) information, if it is available [5]. We can develop the spectral library for various materials like, vegetation's, soil, food etc. By using ASD FieldSpec4 spectroradiometer [7, 8] and its supporting software first we have to collect the spectral database of various samples and by the use of ENVI application software we can create the spectral library. Spectral library can be used for identifying objects from imaging and non-imaging data, and also used for storing the numerous samples spectral signature in once package. Spectral Signature is the variation of reflectance or emittance of a material with respect to wavelength. On the earth the electromagnetic energy special digital sensors have been developed to measure all types of electromagnetic energy as it interacts with object [9]. By using Spectral Library Viewer function from ENVI we can visualize spectral data from ENVI standard spectral library (sli) files. ENVI Software includes several groups of laboratory spectra from the NASA Jet Propulsion Laboratory (JPL), Johns Hopkins University (JHU), and the U.S. Geological Survey (UCGS). The available spectral libraries in ENVI, the Aster Folder contains the ASTER spectral library (version 2) which includes thousands of laboratory spectra from natural and manmade materials covering 400 to 1540 nm. This folder contains the JPL and JHU spectra..

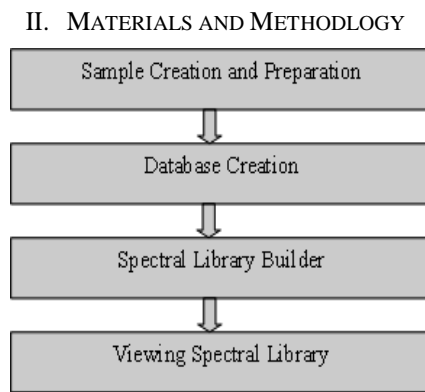


Fig. 1. Steps for Building Spectral Library

A. Study Area and Soil Samples Collections and Preparations

According to the Fig.1, the first step is Creation and Preparation of Samples. For this, We have selected Aurangabad and Jalna region which are located in Maharashtra as our study area. Most of the soil samples collected from Aurangabad region. For building a spectral library we created soil database. Which consist of 10 samples of soil from different farms. The samples include top soil (0-20 cm depth of land surface). Soil samples were collected from the Aurangabad and Jalna City of India during January to March 2017 between 10:00 am to 1:00 pm on a sunny day. Dr. Babasaheb Ambedkar Marathwada University, Chikalthana, Himayat bag are the places of Aurangabad City. Sashta-Pimpalgaon, Apegaon, Ambad these are the locations of Jalna City.

B. Database Creation

According to the Fig.1, the second steps we created the database. For this the ASD FieldSpec4 Spectroradiometer was used for measurement of soil samples in the Multispectral Lab, Department of Computer Science and IT, Dr. B.A.M.Univeristy, Aurangabad, and Maharashtra, India. To avoid the disturbance of external light, the Spectral database creation procedure was carried out in a dark room. The sample scanning was done within the wavelength starting from 350 to 2500 nanometer using RS3 Spectral acquisition software [10]. Toungasteon halogen light source matched with Spectroradiometer was used with a 45 incident angle. Side length of about 40 cm of square piece black paper was used to hold the soil samples. About 200 gm of soil samples panning a diameter of approximately 25 cm was scanned by the spectroradiometer at a distance of 30 cm from spectroscopy. The distance between gun and the light source was 60 cm. A standardized white spectralon panel has 100 % reflectance and was used to optimize signal and calibration accuracy and detector responses. ViewSpec Pro software is used for conversion of spectral data. RS3

software will give data in .ASD binary file format. For further processing on ASD binary file, the ViewSpec Pro software is used.

C. Building Spectral Library

According to the Fig.1, the third steps we developed the Spectral Library. For this In ENVI, the Spectral Library Builder is used to create ENVI Spectral libraries from a variety of spectra sources. Spectra source include ASCII file, spectral files produced by ASD Spectroradiometer, other Spectral libraries, ROI means, and spectral profiles and plots. When we collect the all spectra, the collected spectra's automatically resample to an input wavelength space using FWHM information, if it is available.

D. Viewing Spectral Library

According to the Fig.1, the fourth steps shows that after building the Spectral library we can view the created spectral library By using Spectral Library Viewer function form ENVI. We can visualize spectral data from ENVI standard spectral library (sli) files. ENVI Software includes several groups of laboratory spectra from the NASA Jet propulsion laboratory (JPL), Johns Hopkins University (JHU), and the U.S. Geographical Survey (USGS). The aster folder contains the ASTER Spectral Library (Version 2) which includes thousands of laboratory spectra from natural and manmade materials covering 400 to 1540 nm. This folder contains the JPL and JHU Spectra.

III. RESULT AND DISCUSSION

In Fig.1, you can see we applied basically four steps. Sample Collection, Database Creation, Building a Spectral Library using ENVI Software and lastly we can view the created spectral library by using ENVI. First we collected the soil samples from different regions and by using the ASD FieldSpec4 Spectroradiometer that having the wavelength starting from 350-2500 nanometer and by using its supporting software and its accessories we create the spectral database of soil samples. And for further conversion of spectral database we used ViewSpec Pro software that having capability for some statistical analysis and data format conversion. Lastly we developed and view the spectral library. In ENVI to build spectral library the following steps are performed. From Toolbox select Spectral-> select Spectral Library->select Spectral Library Builder options. By using the Spectral Library Builder option we can import Spectral database of various soil samples collected from ASD FieldSpec4 Spectroradiometer and its supporting software RS3 in ASCII, ASD, and CSV etc. file format.

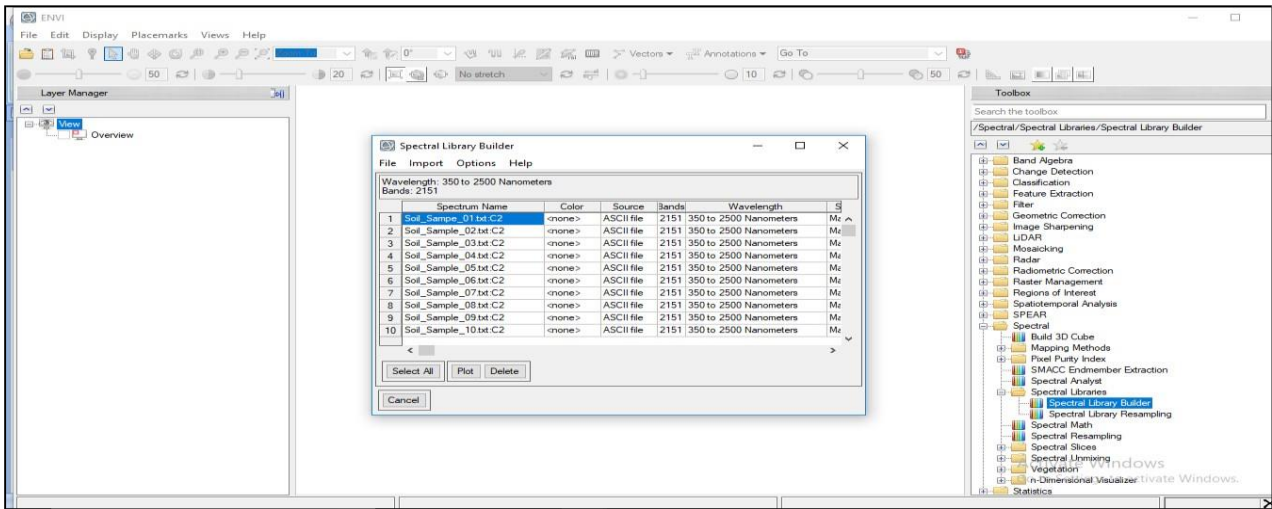


Fig. 2. Sample Selection in ASCII Format

Fig.2 shows after selecting the soil samples in ASCII format by using Spectral library builder option in ENVI. Click on Select All option then the all samples will be selected and click on plot button.

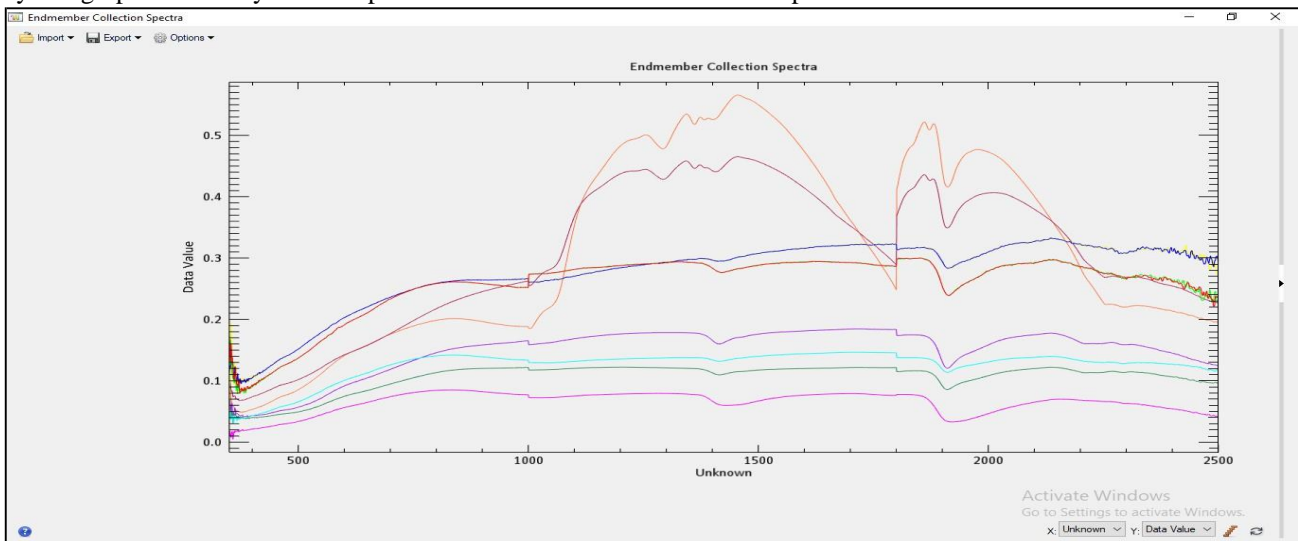


Fig. 3. Selected samples plot

Fig. 3 shows the selected samples in plot format. We can see the all soil sample spectral signature is different according to its chemical properties. After the plotting we have export all signatures in one package means in the format of spectral library. Click on Export and select

Spectral library. After Exporting the file in Spectral library format we can view this spectral library using ENVI Spectral Library viewer option, Figure 4 shows the spectral library in spectral library viewer.

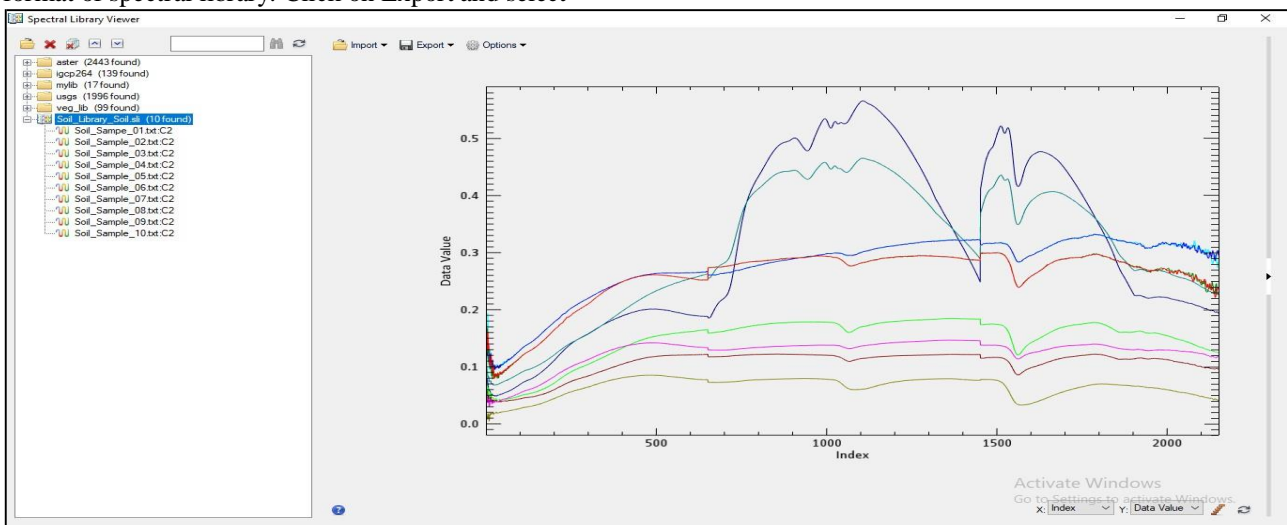


Fig. 4. Spectral Library Viewer

In fig. 4, we can see soil spectral library in spectral library viewer in ENVI. The ENVI automatically categorized each signature in a different color for separation. We can customize this library according to our use and simplification. In figure 4 in the left side you can available spectral libraries provided by ENVI software. And also user created libraries.

IV. CONCLUSION

In this research work, we have built the spectral library of samples those were collected from different regions from Aurangabad and Jalna city, Maharashtra, India. We used ASD FieldSpec4 Spectroscopic device and ENVI 5.5 application software. It can be concluded that the spectroscopic device and ENVI software is useful in Remote sensing applications based on imaging and non imaging data analysis which is collected using Spectroscopic devices and it is also useful for developing a spectral library for various materials. And the developed Spectral library can be useful for further and different types of research work.

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