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Extraction and validation of contiguous spectra generated from Sentinel-2 data –– A case Study from Araku forest of Eastern Ghats, India

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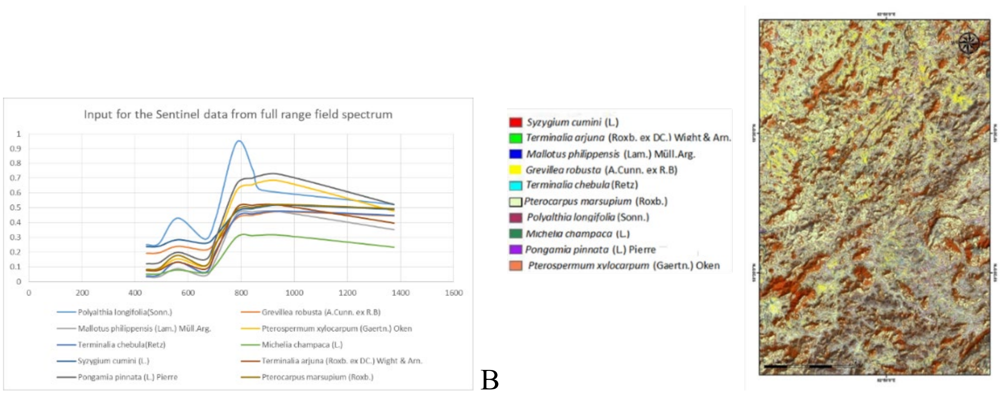
ABSTRACT

In the recent past significant research has been done in the field of hyperspectral remote sensing with respect to data acquisition, processing and its application (Liang, 2003). Further, the availability of high spatial resolution Sentinel-2 multispectral data aided in extracting information at detail level. Researchers has seen much interest in integrating hyperspectral data with high resolution Sentinel data for better understanding the phenomenon or detailed mapping of objects under study. Hyperspectral data can be collected either by space borne or airborne remote sensing methods. The data acquisition, processing and analysing of hyperspectral images is itself challenge. Even the mode of data acquisition by space methods are currently not available, but still data is acquired using airborne methods like AVIRIS, CHRIS, etc. The availability of this kind of data is sufficient for researchers, but having a wide panel of data availability is appreciable to involve larger group of community to take up research in hyperspectral domain. Alternatively hyperspectral data can be collected from the field inventory using spectroradiometer. Keeping in view of the limited hyperspectral data, currently researchers are focusing on substitutive methods of getting data by fusing hyperspectral with multi-spectral data to increase the spatial resolution. However this will not solve the problem of getting hyperspectral data. At this juncture, the research should focus on developing algorithms to extend multispectral data to hyperspectral as to increase repository of hyperspectral data. In view of this, in the current study an attempt has been made to decompose bands obtained from Sentinel-2 data using the spectra collected from field inventory related to canopy tree species of Araku forest of Eastern Ghats, India. The study is divided into two parts. 1) Converting the full range continuous spectra (obtained from Field spec spectroradiometer) of selected tree species into discrete wavelength (as per the Sentinel – 2 band). The field collected spectra range from 350-2500 nm with continuous one nm interval. But to implement step 1, the contiguous spectra was made into discrete bands to match with sentinel bands. The study considered only those wavelengths of field spectra that correspond to Sentinel-2 bands. The field collected spectra is matched point to point with the Sentinel image. The sentinel image is obtained in digital number while the study is done using reflectance values.

A



B

Fig 1: (A) Sentinel data spectrum from full range field spectrum (B). SAM classification

So as a first step, DN values are converted to radiance using gain and bias values and then spectral radiance scaling method is used to convert radiance to reflectance. Using GPS points, the spectra of the tree species collected from the field (discrete wavelength) was matched with the image (of same time). This step is carried out to check the feasibility of upgrading Sentinel-2 data to hyperspectral data. As this step proved the discrete level matching, so further processing is done to make them into narrow contiguous bands, which is done in second step as follows. 2) After matching the discrete wavelength the next step is to extrapolate the sentinel-2 bands to full range continuous spectra from 350 to 1300 nm using Gaussian resampling technique. Later simple spline technique is applied to obtain well-mannered spectra. Then these spectra were compared with the field collected full range spectra upto 1300 nm. However, point to point matching may not be possible with these spectra but spectra can be matched with their strong absorption dips at specified wavelengths. The spectral pattern obtained from Sentinel image for a particular tree species is reasonably matched with the spectra collected from field inventory. This study is an experiment to know if the sentinel-2 can be upgraded as a hyperspectral data. The validation of the study is done using the field data carried out in the same region. The study proves that the process 1 *i.e* down scale of the spectrum matches with the sentinel data when the values are discrete. But the process 2 may vary from place to place and season to season. As the sentinel data is exaggerated and the values may false fit the field data. In the current study, spline smoothening technique was used to match with the field spectra but not necessary the same can give good results if the data and target is different. Thus the study elucidated the process of alternative creation of hyperspectral data from multispectral data. A GUI (tool) related to the technique described in the study was also created for other researchers as substitute for real-time hyperspectral data. The tool takes the input from folder that consists of all the bands of Sentinel data primarily the bands with resolution of 10m and 20m, ignoring the 60m resolution bands. The user can give the expected number of bands in the output, if not then the default is 100 bands. The output is saved in the prescribed folder and separate files are created, which can be visualized. The study is trail version for the compatibility of hyperspectral sensors and Sentinel-2 systems in order to increase the panel of hyperspectral uses.

References

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N. N. Salghuna is a research scholar at Lab for Spatial Informatics, IIIT-Hyderabad. She has pursued her Master's in Birla Institute of Technology, Ranchi. Her research interest includes solving of social issues (land record management, drought management, storm mitigation) using geospatial tools. Currently she works on forest species identification and assessing their health conditions using field-collected biochemical parameters and hyperspectral data, towards her Ph.D.

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