STATISTICAL NOISE REMOVAL (SNR) – A NOVEL APPROACH OF REMOVING NOISE FROM THE FULL RANGE FIELD COLLECTED SPECTRA

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STATISTICAL NOISE REMOVAL (SNR) – A NOVEL APPROACH OF REMOVING NOISE FROM THE FULL RANGE FIELD COLLECTED SPECTRA

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Hyperspectral remote sensing (HRS) is an advanced and successful technology in the history of remote sensing field. It was introduced in the early 80's to study the earth's surface spatially and spectrally, in a continuous range from 400 nm to 2500 nm. HRS is also referred to as Imaging Spectroscopy (IS) as it has spectroscopy and imaging in a system together with hundreds of narrow spectral bands dividing the normal broad band from visible and infra – red region to obtain minute information from the remote earth surface materials. The full range spectra detection of the material is mostly dependent upon the spectral resolution and coverage of the spectroradiometer. However signal to noise ratio of the spectroradiometer is also a major factor that can affect the spectrum. The existing research and reports uses smoothing techniques and curve fitting methods for removing the noise in the spectrum as a part of pre-processing techniques. But those techniques are not capable of retaining detailed minute peak and absorption features of the spectra, which helps in discriminating two different species (may be tree species or mineral). In view of above context, in the current study an attempt has been made to remove noise from the field collected spectrum without losing minute details and retaining the original data values to the possible extent. The field survey was carried out in the forests of Araku, part of Eastern Ghats,Andhra Pradesh, India. The spectrum of each tree species is taken using ASD Field spectroradiometer with full-range capacity from 350 nm to 2500 nm data collection through the complete solar irradiance spectrum. For each tree species 5 – 10 spectrum were collected. These spectra were averaged for good accuracy and to remove redundancy of the data. There are many approaches such as Local filters, smoothing, levels of derivatives, baseline correction, Multiplicative Scatter Correction (MSC), Orthogonal Scatter Correction (OSC) applied for the rectification of the errors like maintaining the minute information of the spectrum, retaining the spectral absorptions points (intensity and position). But all of them failed. To combat such kind of problem in the present research a simple and new approach was defined for the field collected hyperspectral data. The collected field spectrum (averaged) contains noise caused by atmospheric instability and interference of soil etc. due to human errors, affecting accuracy of the spectrum. As per literature many researchers prefer to use smoothing techniques to remove noise in the data. Commonly adopted method is Fourier Transformation as it requires less number of model parameters, and is comfortable to implement and control smoothing of high reflectance noise. But this technique has certain drawbacks. To overcome such problem, in this study, temporal moving window was used to remove dropouts, and neighborhood statistics (pre and post correct values) was used to eliminate noise. However, the outliers (high reflectance noise) still remains in the data series which is normally eliminated again by applying the same technique with the corrected dropouts data. The temporal window is not applied on the entire spectrum but only the places where there are unwanted uplift or down – drift due to various reasons described above. The approach was tested on more than 30 species and the results were validated. The validation was based on the seasonal spectrum of the same tree species. Though there may be variation with respect to biochemical composition of species for varied seasons, their absorptions features (either intensity or position is considered) will match. In this way, the accurate spectra of the species can be produced with the minute details. The study gave better results with the proposed approach in comparison with the existing methods. The statistical noise removal had disadvantages also. A bulk process cannot be executed as the approach is not performed on the entire spectrum but only at the local places where errors are found. Practically predicting the error at specific wavelength is impossible. Due to which the process takes much time for each spectrum. On the other side the approach helps to retain the minute information of the spectrum. "Hyperspectral" term is meant for its maximum and clear information obtained and that differentiates it from multispectral spectra. The existing pre-processing approaches tend to lose the identity of the "hyperspectral" spectrum. The details obtained from field are of finer spectral resolution but the pre-processing techniques spoil the reality of the species spectra. This study helps to maintain each and every information of the spectrum as collected from the field using a simple statistical noise removal technique.

Keywords Hyperspectral, Smoothing, Dropouts, Outliers, Neighborhood Statistics