SPECTRORADIOMETER DATA ANALYSIS TOOL

TECHNICAL REPORT 1.0

Hyperspectral Techniques Development Division
AMHTDG | EPSA | Space Applications Centre | ISRO

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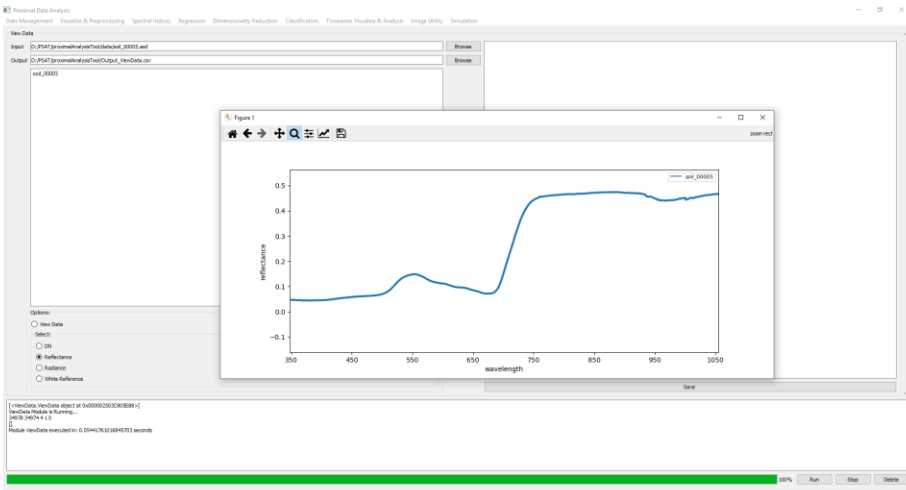
- SVC Spectroradiometer-OLD
- SVC Spectroradiometer-New

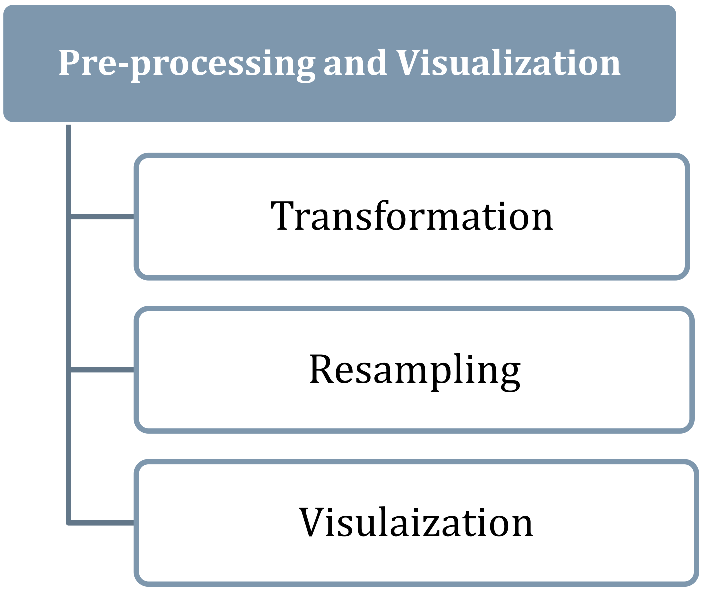
1.1 ASD SPECTRORADIOMETER

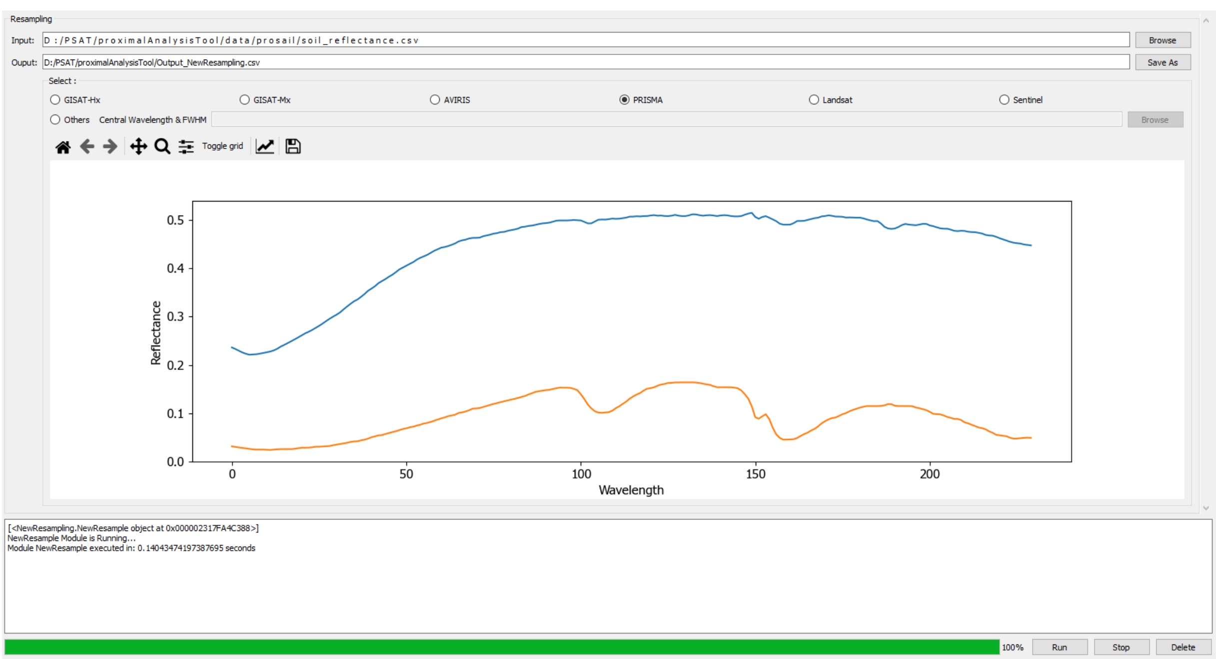
User Interface

1 DATA MANAGEMENT MODULE



2 PRE-PROCESSING AND VISUALIZATION





2 PRE-PROCESSING AND VISUALIZATION

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2.1 TRANSFORMATION

User Interface

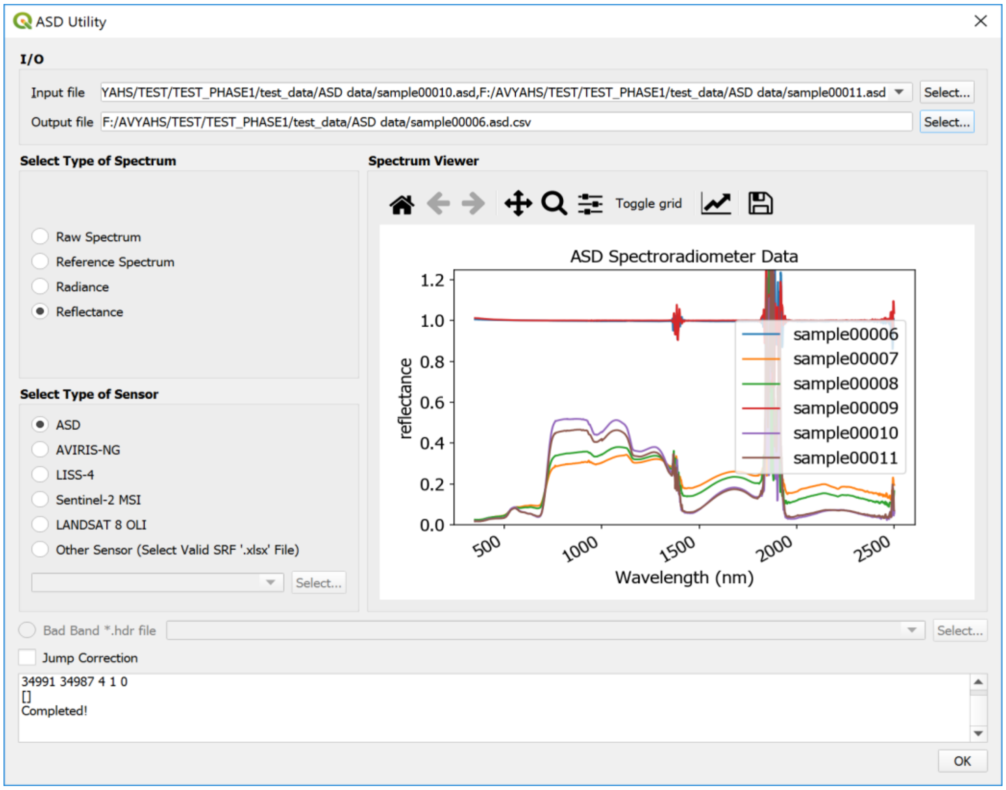

Figure. User-Interface for Spatio-Spectral Segment

Input Arguments

Type of Spectrum: Select type of spectral data stored in .asd file.

Type of Sensor: ASD data will be saved based on the selected sensor types (algorithm employs Spectral-Response Function of the selected Sensor)

Bad-band: Remove the bad band from the resampled version of AVIRIS-NG data using the bad band list available with ".hdr" file.

Jump Correction: Offset error of SWIR1 and SWIR2 sensor arrays of ASD sensor can be corrected by selecting this option.

2 PRE-PROCESSING AND VISUALIZATION

I/O PARAMETERS

TYPE	DATA FORMAT	DATA TYPE	VALUE RANGE	REMARK
Input				
Input File	*.asd			ASD spectroradiometer files
Bad band file	*.hdr file associated with AVIRIS-NG data			
Output				
Output File	*.csv			Save input files to single *.csv file format

OVERVIEW

ASD utility tool is capable of reading the ASD spectroradiometer data (*.asd) and display the associated data types (raw data, Radiance, reflectance and white-reference). It can be used to resample the ASD spectrum based on the spectral-response-function of different sensors (AVIRIS-NG, LISS-4, Senstinel-2 MSI, LANDSAT8-OLI). Bad-band list associated with the AVIRIS-NG data can be used for removing the bad-bands from the resampled-ASD-spectrum.

Jump/Splice Correction: The so-called splice/Jump correction eliminates the gaps in the signal between the domains of the different detector arrays. Critical transitions are located at λ=1000nm and λ=1800nm. The objective of the splice correction is to compensate the difference between the reflectance R1000nm and R1001nm by adapting all values from 1001nm upwards to the level of those to 1000nm.

$$R_{i,splice} = \begin{cases} R_i\,, & i \in [1;1000] \\ R_i - f_{1000}\,, & i \in [1001;1800] \\ R_i - f_{1800}\,, & i \in [1801;2500] \end{cases}$$

$$f_{1000} = R_{1001} - (2 \cdot R_{1000} - R_{999})$$
$$f_{1800} = R_{1801} - (2 \cdot R_{1800} - R_{1799})$$

f_{1000} and f_{1800} represent biases which are added to the original values and – depending on their algebraic sign – either increase or decrease all further reflectances. $R_{i,splice}$ are the corrected new values with smooth splices at the critical transition wavelengths.

2 PRE-PROCESSING AND VISUALIZATION

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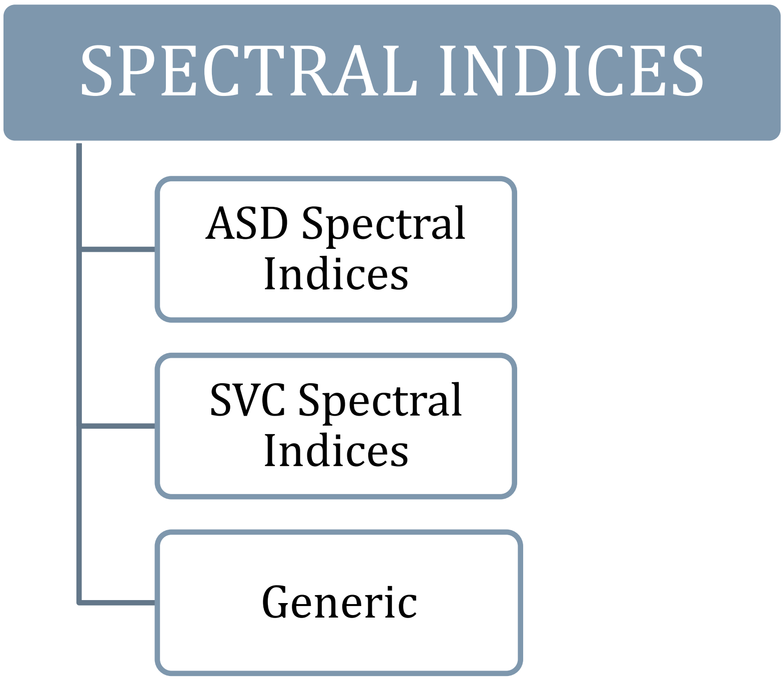
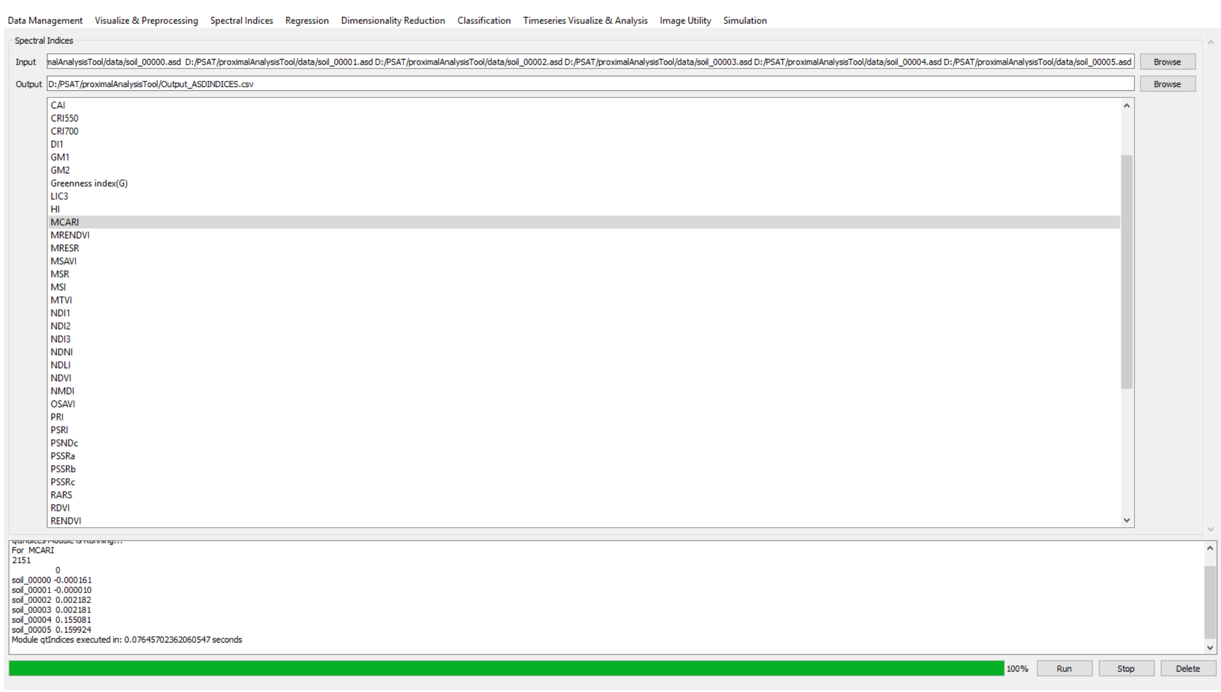
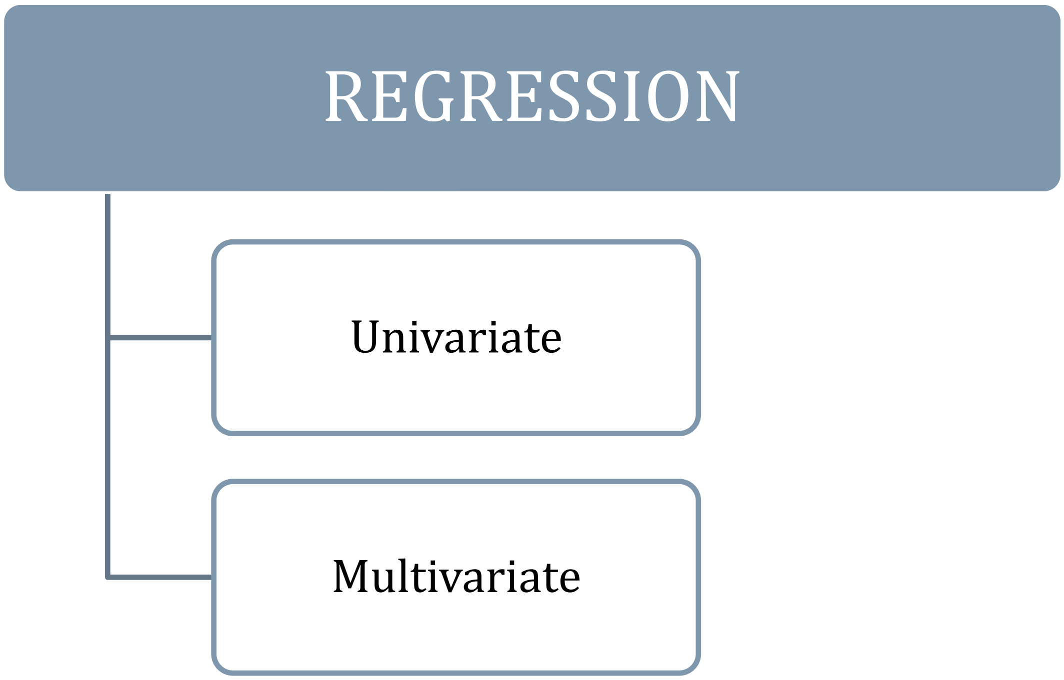
6 SPECTRAL INDICES



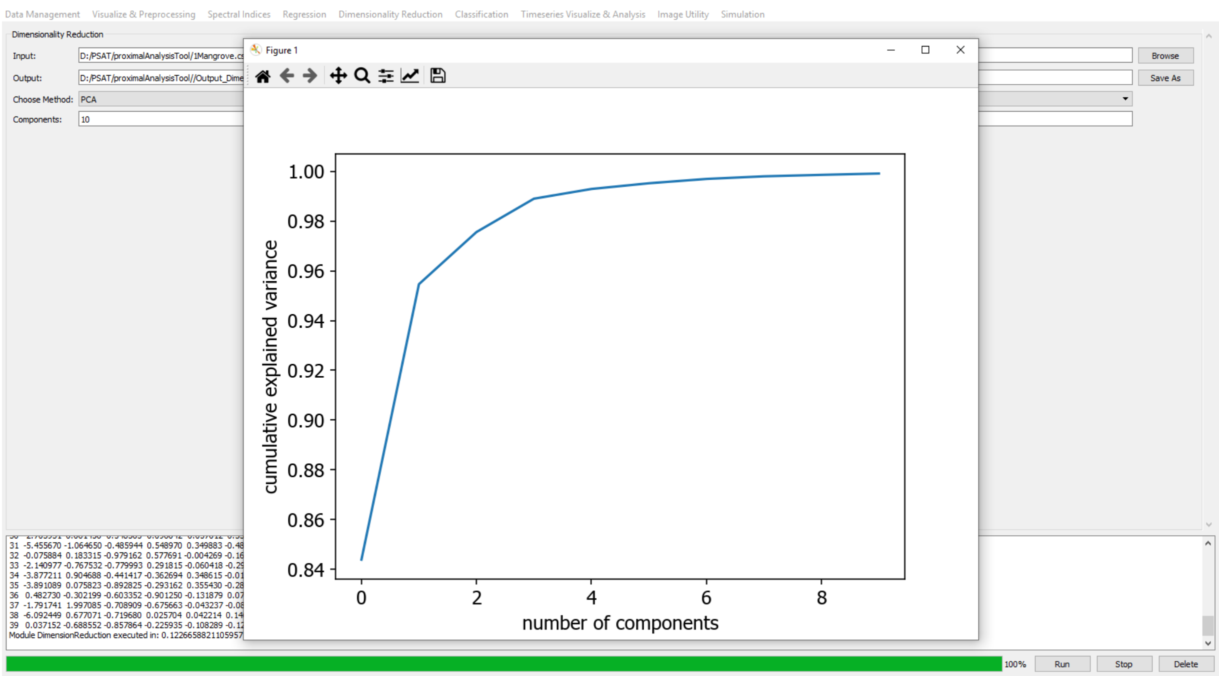


6 SPECTRAL INDICES

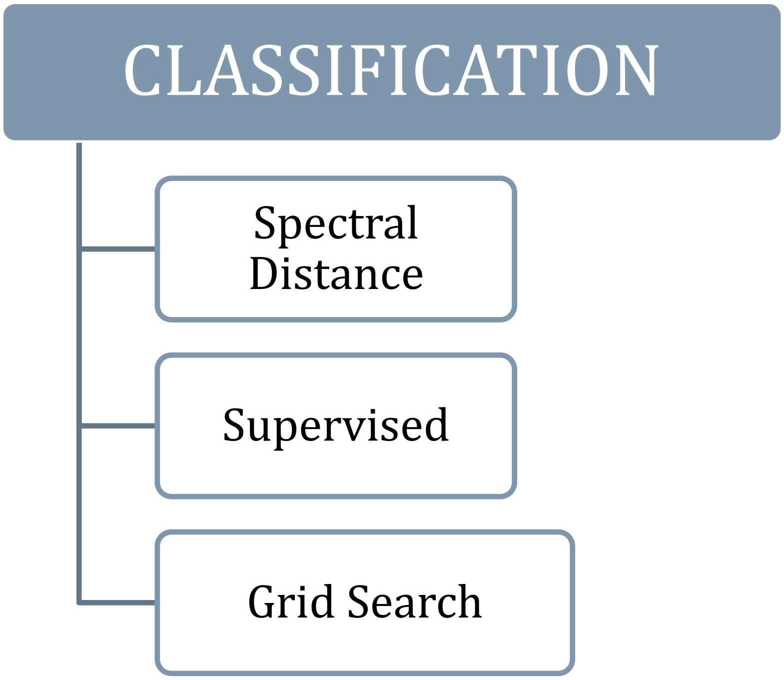
7. REGRESSION

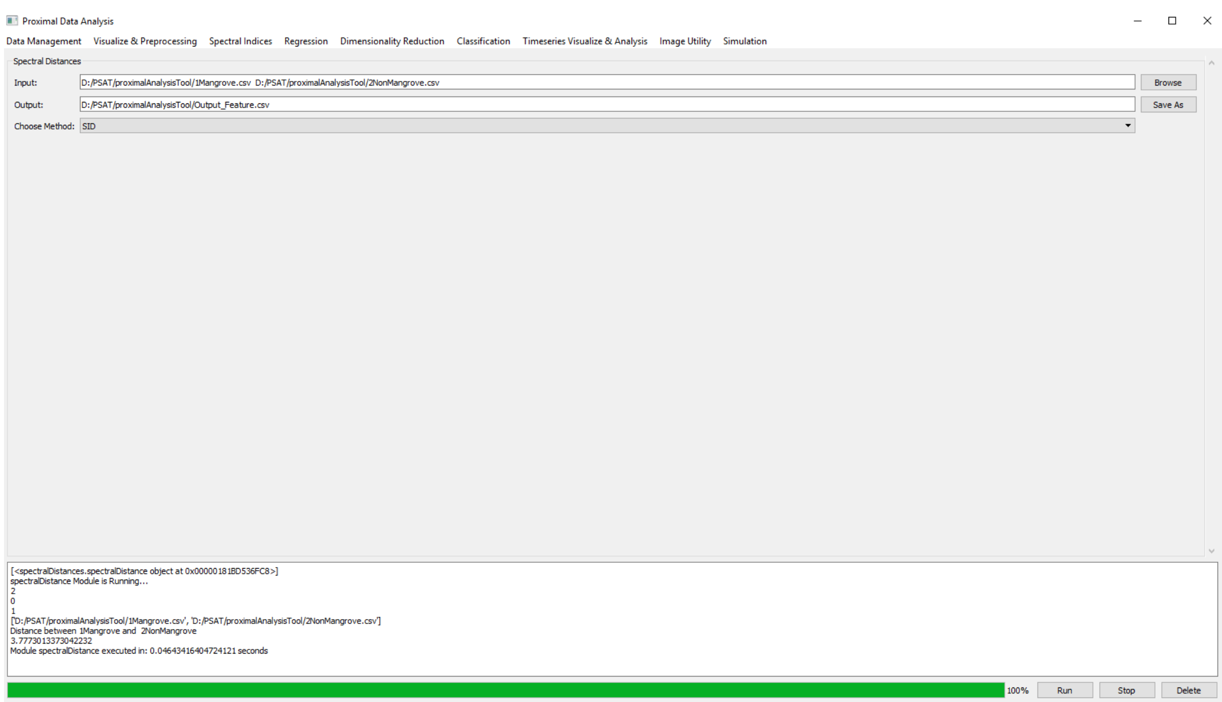


4. DIMENSIONALITY REDUCTION



6. CLASSIFICATION





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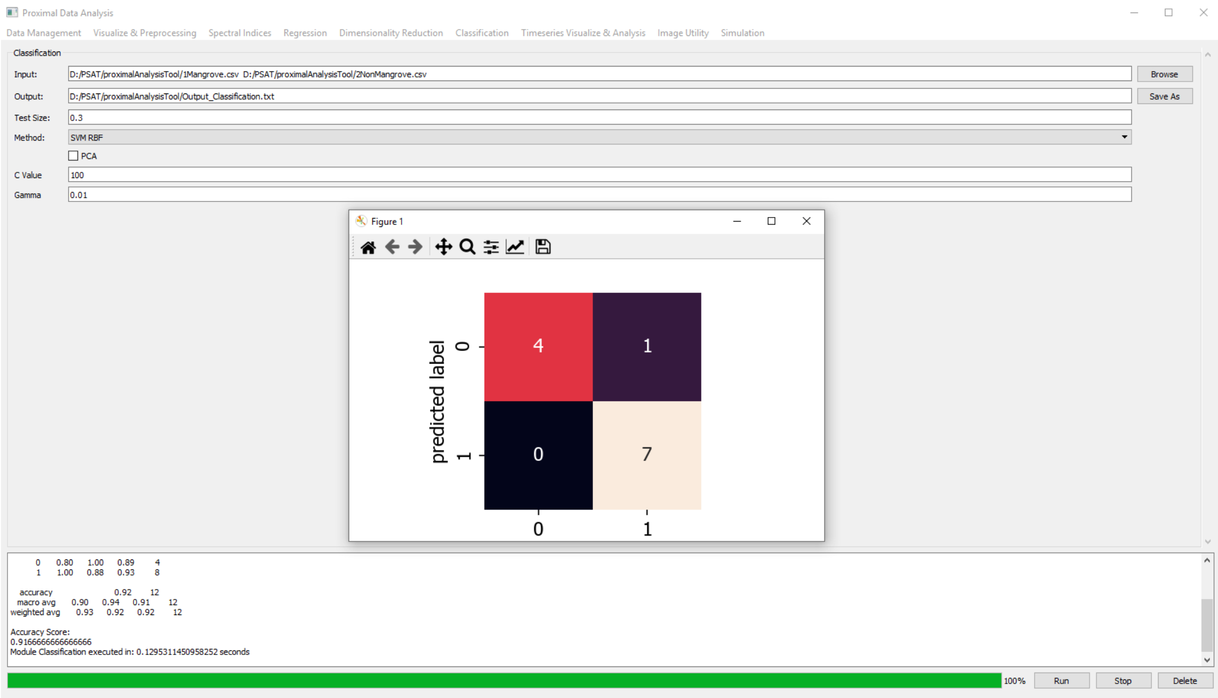

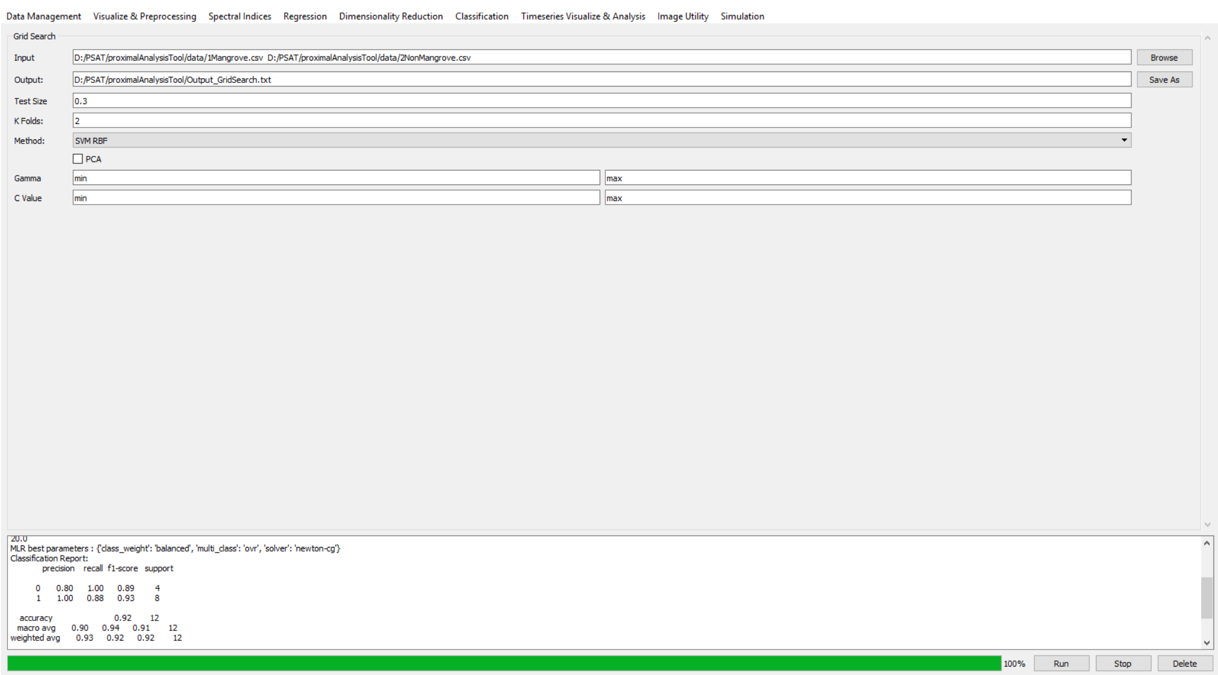

7. TIME-SERIES ANALYSIS

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8. IMAGE UTILITY

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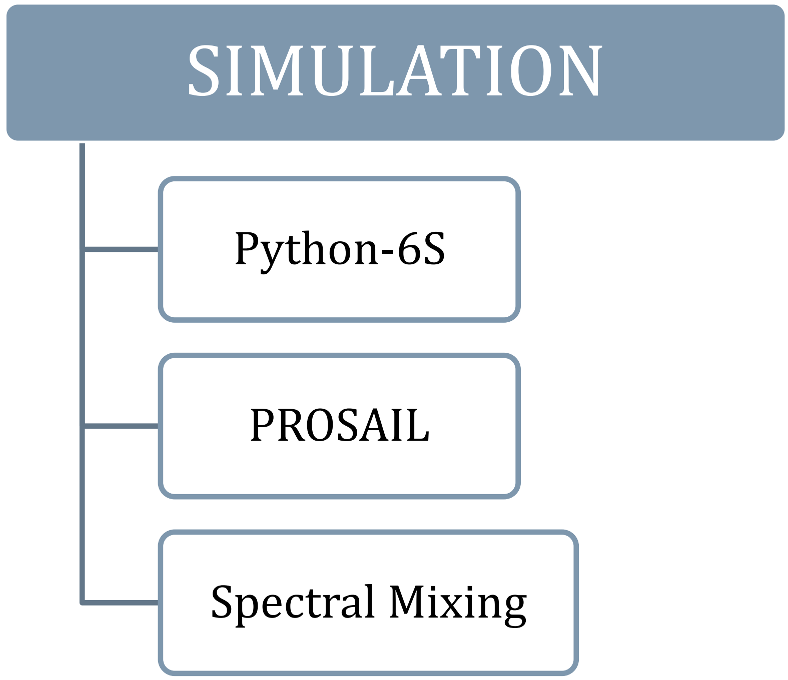
9. SIMULATION



6.3 SEGMENTATION

6.3.1 SPATIO-SPECTRAL SEGMENT TOOL

QGIS 3.XX → Hyperspectral→ Classification → Segmentation → Spatio-Spectral-Segment

User Interface

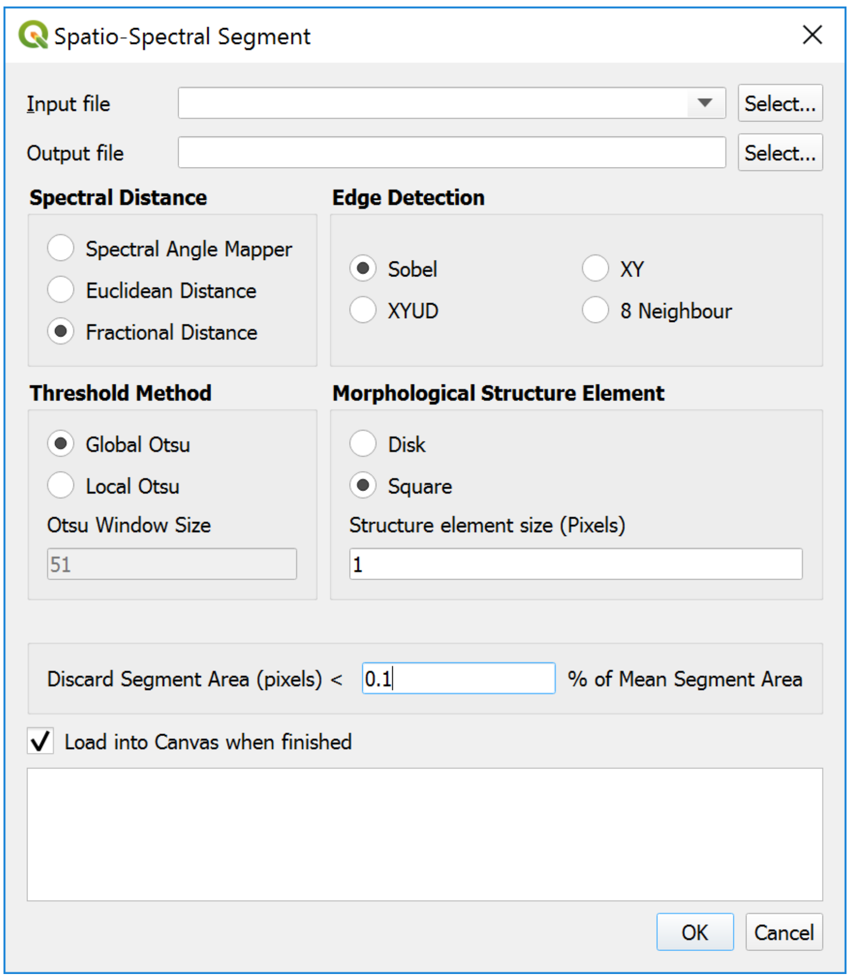


Figure. User-Interface for Spatio-Spectral Segment

I/O PARAMETERS

TYPE	DATA FORMAT	DATA TYPE	VALUE RANGE	REMARK
Input				
Input File	GeoTiff / ENVI			Bad band Removed Data, Radiance/Reflectance
Local Otsu Window Size		Integer	Odd-Number	Maximum value = Min (no. of rows, no. of columns)
Structure element Size		Integer		Default=1
Discard Segments		Integer	0-100%	
Output				
Output File	ENVI			Raster file with integer values for each segment

Input Arguments

Spectral Distance: Select the spectral distance which defines the similarity between two spectrum

Edge Detection: Select from the four different types of Edge detection methods which uses the spectral similarity within the 3x3 neighborhood

Threshold: Global otsu/Local otsu will be used for identifying the threshold for separating edge pixels from homogeneous area pixels.

Otsu Window Size: Defines the Block size of the dynamic thresholding algorithm

Structure element: Decides the morphological structuring element for removing the “salt and pepper” type noise in the outcome of the edge detector.

Discard Segment area: Segments with the area less than the “input” percentage of the mean segment area will be discarded from the final result.

OVERVIEW

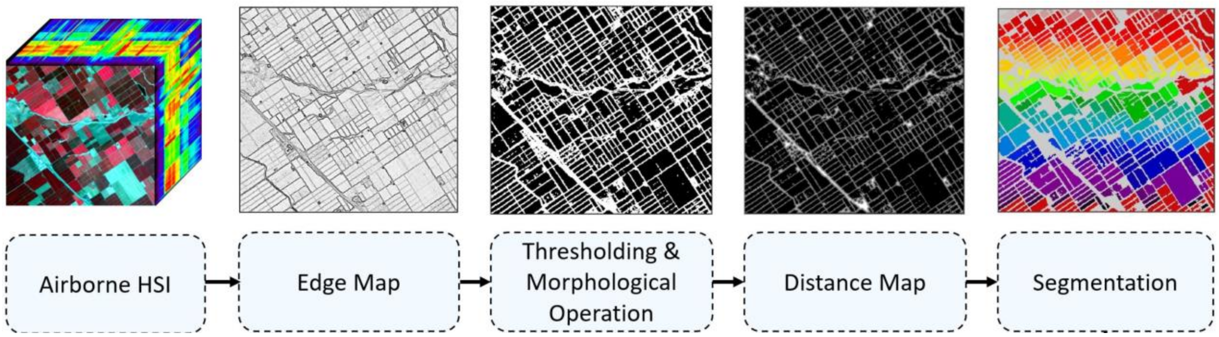
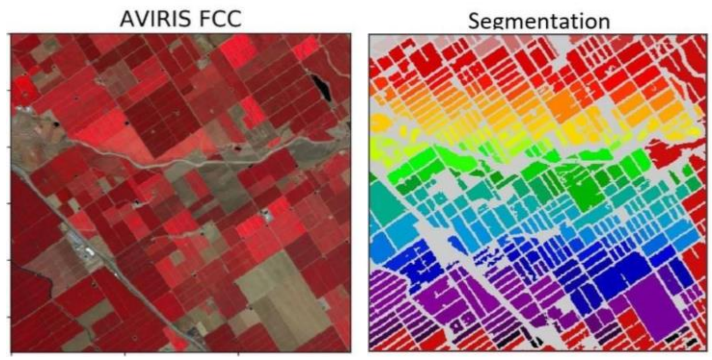


Figure: Data Flow Diagram

Spatio-Spectral segment is an n unsupervised method for extracting the spatial-spectral homogeneous areas in HSIs. Methodology is illustrated in the Figure above this paragraph. Edge map has been derived using Spectral Distance Method as mentioned in Bakker and Schmidt (Bakker and K. Schmidt, 2002). Otsu thresholding has been implemented to extract boundaries. Morphological opening and closing has been implemented sequentially for removing “salt and pepper” like noise in the edge map. Two pixels are connected when they are neighbors and have the same value. Based on this, connected regions were labeled based on their neighbors in 8-neighborhood pixels. These connected regions have been employed to find centroids for the segmentation algorithm. We consider watershed segmentation (WS) (Tarabalka et. al., 2010) method to segment the image. WS algorithm allocates pixels into marked basins. Here, marker is determined automatically using the local-maxima of the distance transform to the background for separating overlapping objects. Distance transform uses Euclidean distance to assign a value (distance) to the pixel which is the distance between the non-background pixels and the nearest background pixel. Segments which are small in size has been filter out using the minimum area threshold. Small segments (area less than specified

threshold) can be removed from the final segmentation result using the area property of the segments.

Result



Reference

W. Bakker and K. Schmidt, “Hyperspectral edge filtering for measuring homogeneity of surface cover types,” ISPRS Journal of Photogrammetry and Remote Sensing, vol. 56, no. 4, pp. 246–256, 2002.

Y. Tarabalka, J. Chanussot, and J. A. Benediktsson, “Segmentation and classification of hyperspectral images using watershed transformation,” Pattern Recognition, vol. 43, no. 7, pp. 2367–2379, 2010.