

Hyperspectral Analysis ProPack

HYPERSPECTRAL ANALYSIS PROPACK

Extend the functionality of the PCI ProSDK through the Hyperspectral Analysis ProPack, which enables flexible use and automation of PCI Geomatics' robust, hyperspectral processing and analysis technology.

The Hyperspectral Analysis ProPack includes robust PCI Pluggable Functions (PPFs) which operate on hyperspectral image data from both airborne and satellite-borne imaging spectrometers.

IMAGE METADATA SUPPORT

Included within the Hyperspectral Analysis ProPack is support for image metadata, which has been designed to accommodate the needs of hyperspectral processing and analysis.

Importing Metadata

- METAIN – Reads global and channel-specific image metadata, including metadata required for hyperspectral analysis, from an XML document and reformats and stores them in a PCIDSK file.
- If the data and metadata are provided in an ENVI-format data and header file pair, then Geomatica programs can read the metadata directly from the header file

Exporting Metadata

- METAOUT – Writes image metadata from a PCIDSK file to an XML document

DATA PREPROCESSING

Preprocessing tasks, which prepare data for visual interpretation, removal of atmospheric effects, or automated analysis can be divided into sensor-

related calibration, geometric correction, and noise removal.

Sensor-Related Calibration

- DRSUB – Dark Reference subtraction:
 - Obtains band-image values that are more closely proportional to at-sensor radiance
- SHFTCW – Shift-center wavelength value:
 - Directly changes the center wavelength values in band-response profiles

Geometric Correction

- ROLLCOR – Pushbroom scanner image roll correction:
 - Removes roll distortion without ancillary data
 - Shifts image lines by an integer number of pixels

Noise Removal

- STRPCOR – Remove periodic striping:
 - Corrects for periodic striping in raster images that is caused by differences in signal response between different detectors.
- BRDFCOR – Reduce cross-swath brightness variation:
 - Reduces along-scanline tone variation without knowing the instantaneous view direction
- PCLT – Generate a principal components linear transformation:
 - Generates a linear transformation matrix (and its inverse) for transforming selected image channels of an input image into principal components channels.
- MNFLT – Generate a maximum noise fraction linear transformation:

- Generates a linear transformation matrix (and its inverse) for transforming selected image channels of an input image into channels that show steadily decreasing image quality with increasing channel number.
- Accepts explicit noise image or approximation for certain kinds of noise (salt-and-pepper, image striping)
- LINTRN – Linearly transform image channels:
 - Computes and applies parameters of band-wise linear data transformations and their inverse values
 - Transforms an image using the parameters read from a transformation parameters file
 - Applies either the forward or inverse transformation
- MNFNR – Maximum noise fraction noise removal:
 - Attempts to remove noise in a single image band using a procedure based on the maximum noise fraction transform.
 - Is used when an image band has significantly more noise than the other image bands
 - Transforms an image band so that its noise content is close to that of the other bands
- Relies on ground or lab reflectance spectrum for surface types that can be localized in an image
- Does not account for the effect of variations in atmospheric conditions over the full extent of image

Flat Field Correction

- FTLOC – Locate spectrally flat targets:
 - Generates reference spectrum by finding image locations where image spectra are best approximated by a polynomial function of wavelength, of a user-specified order
- SP2RT – Convert a spectrum to a radiometric transformation:
 - Converts reference spectrum into a radiometric transformation
 - Stores transformation in the image file
 - Can be applied on-the-fly
- APPLRT – Apply radiometric transformation:
 - Applies a sequence of one or more radiometric transformations to an image dataset and outputs the transformed image data to a disk file.

SIMPLE ATMOSPHERIC CORRECTION

The Hyperspectral Analysis ProPack includes the following PPFs that implement simple atmospheric correction operations.

Empirical Line Calibration

- EMPLINE – Empirical line calibration:
 - Computes parameters of band-specific radiometric transformations to transform multi-band image values to estimates of scene reflectance

LOCAL ANALYSIS

The Hyperspectral Analysis ProPack provides the following local analysis operations.

Endmember Selection

- ENDMEMB – Select Endmembers:
 - Estimates a set of Endmember spectra for a specified image region using iterative error analysis (IEA)
 - Outputs endmembers to a file so that they can be used as input for the SPUNMIX PPF.

Spectral Unmixing

- SPUNMIX – Spectral Linear Unmixing:
 - Linearly unmixes a hyperspectral image, resulting in an estimated fractional contribution of each reference spectrum to the image spectrum at each pixel
 - Includes an RMS-error for each endmember in an output report

Spectral Angle Mapper Image Classification

- SAM – Perform a spectral angle mapper classification
 - Classifies the pixel vector in a hyperspectral image dataset based on a set of reference spectra that define the classes
 - The classification is based on the angle between each band vector and each reference spectrum
 - Each pixel is assigned the class of the reference spectrum that makes the smallest angle with the pixel's band vector

SPECTRA HANDLING

The Hyperspectral Analysis ProPack includes PPFs that implement the following spectra handling operations.

- I2SP – Derive spectra from an image
- SPCONVP – Concolve spectra with band response profiles
- SP2SP – Reformat a set of spectra

DATA COMPRESSION

The Hyperspectral Analysis ProPack includes a PPF that compresses a hyperspectral dataset.
VQHSOC – Hierarchical self-organizing cluster vector quantization:

- Provides lossy image compression
- Transforms an N-band image into a set of N-dimensional "codevectors," called a "codebook," plus an "index map"

MODEL-BASED HYPERSPECTRAL ATMOSPHERIC CORRECTION

The Hyperspectral Analysis ProPack includes PPFs that implement an atmospheric correction technique that employs the MODTRAN4 atmospheric radiative transfer model. PPFs derive an atmospheric water vapor content map from the image data, and that correct spectral line curvature and correction are included.

PCI Geomatics customers can obtain the MODTRAN4 executable and data files directly from PCI Geomatics. We have been licensed by the United States Department of the Air Force to provide this service. These new capabilities provide end-users with the capability to better analyze and view their hyperspectral data.

- GENTP5 – Generate a MODTRAN4 'tape5' files (Note: this is not a general 'tape 5' file generation utility, but rather is limited to the parameters relevant to the atmospheric correction method)
- GENRLUT – Generate an at-sensor radiance look up table from a MODTRAN4 'tape7' output file
- RESRLUT – Resample at-sensor radiance to surface reflectance dataset
- ATRLUT – Transform at-sensor radiance to surface reflectance dataset
- GENAWC – Generate a water vapor column map
- GENCLUT – Detect spectral line curvature correction
- SLCCOR – Apply a spectral line curvature correction

- SMSPEC – Smooth the dataset in the along-band dimension
- RLUTSP – Extract radiance spectra from a radiance look up table
- VIEWAZ – Evaluate the view zenith angle and azimuth
- SOLARAZ – Evaluate the solar zenith angle and azimuth

SOME OF THE INCLUDED COMPLEMENTARY PPFs

Image Management

- IMERGE
 - Merges multiple geocoded rasters into a single file.
- REPROJ
 - Reprojects images, bitmap segments and vector layers to a specified projection.
- CLIP
 - Clips layers based on a user defined clip region.
- TILE
 - Creates multiple subset tiles from a single file.
- PYRAMID
 - Build an image pyramid for one or more image layers in a data file.

For more information, contact

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