Optical and Atmospheric Correction

OPTICAL

The Optical package contains algorithms specifically designed to work with optical satellite data. This includes functionality for AVHRR correction and processing, advanced image classification and atmospheric correction for flat terrain areas (ATCOR2).

ATMOSPHERIC CORRECTION

The Atmospheric Correction package includes functionality for atmospheric correction in rugged terrain areas.

MODULE PREREQUISITES

Optical is an add-on to Geomatica Core. Atmospheric Correction (ATCOR3) is available as an add-on to the Optical package.

AVHRR CORRECTION & PROCESSING

Generate geo-corrected AVHRR images, perform radiometric correction and calibration, and extract Normalized Differential Vegetation Index (NDVI) and Sea Surface Temperature (SST) information from visible and thermal bands.

Supported Formats

- NOAA 11-14 supported
  - Level 1b 10-bit/16-bit HRPT/LAC
  - Level 1b 8-bit/10-bit/16-bit GAC
  - Dartcom 16-bit HRPT
  - Satlantic 16-bit HRPT

- Read all ephemeris orbital elements (Keplerian elements) including:
  - Satellite ID
  - Orbit ID
  - Date, upper left/lower right LONG/LAT coordinates
  - GCP corresponding to exact center of middle pixel of first line in image
  - Epoch
  - Inclination
  - Right ascension
  - Argument of perigee
  - Eccentricity
  - Mean motion
  - Mean anomaly
  - Ascending/descending orbit flag
  - Platinum resistance temperatures
- Read GCP data from tape or disk header for Level 1b LAC/HRPT and GAC formats (up to 255 GCPs)

Geometric Correction

- Use ephemeris information to locate a corresponding TLE (Two Line Element) file (TLE files included)
- Extract required orbital element value from TLE file
- Compute transformation between input image coordinates and output image georeferencing system
- Resample input image using nearest neighbor, bilinear interpolation, cubic convolution, or sin(x)/x mode
- Perform a panoramic geometric correction, which can then be subsequently corrected using standard polynomial techniques

Radiometric Correction and Calibration

- Perform satellite zenith, solar zenith and relative azimuth angle correction and visible or thermal channel calibration of a raw AVHRR image
- One GCP, an approximate starting scan date/time, and a set of orbital element values are required

Information Extraction

- Compute Normalized Differential Vegetation Index (NDVI) from visible channels of an AVHRR scene
- Calculate Sea Surface Temperature (SST) using three AVHRR thermal bands, and sensor calibration information

Algorithms Available

- AVHMLIN – skipped missing line insertion
- AVHRCOR – automated geometric correction
- AVHRPANO – panoramic correction
- AVHRRAD – radiometric correction and calibration
- SST – calculate sea surface temperature

ADVANCED IMAGE CLASSIFICATION

The Optical package includes the following advanced image classification and transformation functionality:

- Contextual/Fuzzy Classifiers:
  - Perform frequency-based contextual classification of multispectral imagery based on training sites and a user selected pixel window size
  - Unsupervised fuzzy clustering
- Neural Network Classifiers:
  - Classify multispectral imagery using back-propagation neural network trained for pattern recognition of sample data from training sites
  - The neural network segment defines the trained back-propagation neural network to use. This segment contains the following control information: dimension of the neural network, input sampling information, momentum rate and learning rate
  - Print a report of the parameters in a back-propagation neural network segment
- Spectral Unmixing:
  - Creates fraction images for a set of class signatures
- Segmentation:
  - Unsupervised texture segmentation analyzes both multispectral and texture information to determine the amount of aggregation at a given level and image location
- Wavelet Transform:
  - Mallat's discrete two-dimensional wavelet transform creates multi-scale texture maps from one image channel.

Algorithms Available

- AVG – unsupervised texture segmentation
- CONTEXT – contextual classification
- FUZ – unsupervised fuzzy classification
- IMGFUSE – image fusion
- MAL – Mallat wavelet transformation
- NEWGCP – update gcp's with transformation
- NNCLASS – neural network classification
- NNCREAT – neural network creation
- NNREP – neural network report
- NNTRAIN – neural network training
- REDUCE – image channel reduction
- RSFUSE – resample and fuse image using coefficients
- UNMIX – linear spectral unmixing

ATMOSHERIC CORRECTION

Variations in the earth's atmosphere and terrain modify the spectral characteristics of satellite imagery. The objective of atmospheric correction is the elimination of atmospheric and terrain effects to retrieve physical parameters of the earth's surface, including surface reflectance, emmisivity and temperature. Such correction is especially important in cases where multi-temporal, multi-sensor or multi-condition images are to be compared and analyzed.

Atmospheric Correction functionality includes:

- Elimination of atmospheric and illumination effects
- Retrieve physical parameters of the Earth's surface, such as:
  - Surface reflectance
  - Emmisivity
  - Temperature

Technical Specifications

- View spectra Viewing using set parameters
- Perform constant atmospheric correction
- Apply spatially varying correction
- Automatically generate Haze/ and Cloud masks Generation
- Manually generate and edit Haze and Cloud masks Generation/Editing
- Edit the Visibility Index Editing
- Generate Value-added products:
  - Soil Adjusted Vegetation Index
  - Leaf Area Index
  - Fraction of Absorbed Radiation
  - Surface Albedo
  - Absorbed Solar Radiation
  - Thermal Flux Difference
  - Ground Heat Flux
  - Latent Heat
  - Sensible Heat
  - Net Radiation

ATCOR2 and ATCOR3

ATCOR2 is a spatially-adaptive fast atmospheric correction algorithm for flat terrain, while ATCOR3 is designed to work with rugged terrain, utilizing a Digital Elevation Model.

ATCOR Sensor Support

Supported Sensors:

- Landsat-4/5 TM, MSS
- Landsat-7 ET+, panchromatic band
- SPOT 1-3 HRV
- SPOT 4-5
- IRS-1A/-1B LISS-2
- IRS-1C/-1D LISS-3 and panchromatic
- IRS-1C/-1D WiFS
- IKONOS
- QuickBird
- MOS-B
- MOMS-02
- Resurs MSU-E
- ASTER
- Hyperion
- SAC-C/MMRS

Algorithms Available

- ATCOR2 – atmospheric correction for flat areas
- ATCOR2_T – calculation of surface temperature for flat area
- ATCOR3 – atmospheric correction using elevation data
- ATCOR3_T – calculation of surface temperature map
- MASKING – automatic calculation of haze/cloud mask
- FPAR – calculates fraction of absorbed photosynthetically active radiation
- LAI – calculates leaf area index model value
- SAVI – calculates Soil Adjusted Vegetation Index

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