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AVIRIS Starting Guide (“AVIRIS for Dummies”)

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When first working with AVIRIS, I was overwhelmed with the variety of new and different opportunities. Obstacles started when I tried to first look at the data; ENVI prompted me to input 10 (!) different parameters. The following work is intended to get you started immediately and keep the learning period as short as possible. It introduces you on how to open an AVIRIS image, how to georeference and correct for atmosphere. We had low resolution AVIRIS data (20m, summer 2000), and we used ENVI 3.4. / ENVI 3.5. Have fun! For questions and comments send an email:

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0. Day of AVIRIS Over flight

Take spectral readings from a bright area (parking lot, sand quarrel etc.)

Consider measuring precipitable water (water vapor)

1. Getting Started

1.1. Getting AVIRIS from Tapes

`tar -xvf /path to tape device &` ; Unix command to unpack data from tapes (‘&’ means the process runs in the back ground)

1.2. ENVI Parameters to Open AVIRIS .img:

Samples: 614

Lines: 512 (beware; last scene in each row has less lines, check .log file for number of lines)

Bands: 224

data type: integer

byte order: Network (IEEE)

Interleave: BIP

File type: <external> <unknown>

Suggestion to Display an AVIRIS image

ENVI RGB display	Red	G	Blue
AVIRIS band	50	20	10

2. ACORN – Front End of Different Models to Correct Atmosphere

2.1. General

We used Mode 1 and Mode 2. Mode 1 provides you with a reflectance image, that you can enter into Mode 1. Then get calibration in Mode 2 (using bright input spectra from calibration site). The input data for Mode 1 and Mode 2 can be changed using ACORN or in a text editor (e.g. [r04_sc02_mod1.in](#) and [r04_sc02_mod2.in](#)).

You need the following input parameters in advance:

- approx scene center location
- approx elevation (from DEMs or elevation maps)
- water vapor (precipitable water)
- visibility (on a clear day about 80km-100km)
- day and time of image acquisition (from

3 files for Mode1:

Image Spectral Calibration File: (e.g. [input_spec.txt](#))

Gain File (e.g. [input_gain.txt](#))

Offset File (e.g. [input_off.txt](#))

Additional 2 files for Mode 2:

Image Target reflectance: (e.g. [input_m2_target_AVIRrefl.txt](#))

Measured Target: (e.g. [input_m2_meas_target.txt](#))

2.2. Input Parameters

- Approximate scene center location

We georeferenced before we corrected for atmosphere. We saved 3 bands of every AVIRIS scene as a '.bil' file and opened it in ArcGIS. From the approximate center of the image, we took latitude/longitude (not in decimal).

- Approximate elevation

Needs to be in meters. We got took the average from a DEM (Digital Elevation Map) in ArcGIS. One can also use elevation maps

- Water Vapor (or precipitable water)

This is the hardest parameter to obtain. One can use a water vapor measuring device, such as "Microtops". Measurements must be from the day and time of the over-flight. Precipitable water needs to come from an atmospheric sounding. One can calculate precipitable water (check atmospheric physics texts). The parameter will need an atmospheric profile which is available at <http://raob.fsl.noaa.gov/>

- Visibility

Visibility is between 80km and 100km on a clear day.

- Day and time of data acquisition

Check the ".avhdr file" in your AVIRIS data and take an average. This is already in Greenwich-standard time (do not adjust for your local time)

Prepare files for Mode 1:

Image Spectral Calibration File: (e.g. [input_spec.txt](#))

Same as AVIRIS .spc file

Gain File (e.g. [input_gain.txt](#))

This file is based on the AVIRIS file. You have to recalculate your AVIRIS file.

$\text{Input_gain} = 10/\text{gain}_{\text{AVIRIS}}$ (e.g. $10/500 = 0.02$ or $10/1000 = 0.01$)

Offset File (e.g. [input_off.txt](#))

Normally, there should be no offset. The file contains a column with Zeros. If you have 512 lines, you should have 512 Zeros.

Prepare Files for Mode 2

- **Image Target reflectance:** (e.g. [input_m2_target_AVIRrefl.txt](#))

After running Mode 1 get average AVIRIS spectrum of the calibration site.

- **Image Spectral Calibration:** same as in mode 1
- **Measured Target:** (e.g. [input_m2_meas_target.txt](#))

taken from spectrometer

measured spectrum must be adjusted with a correction spectrum (provided with the spectrometer)

$$\text{spec}_{\text{meas}} * \text{spec}_{\text{correct}}$$

make an average of your spectrometer file and your AVIRIS .spec file and compare. If the difference is too big apply a scaling factor to your AVIRIS .spec file.

First column spectrometer wavelength, second column: adjusted spectrometer reflectance

2.3. In ENVI:

Make sure AVIRIS scene is in BIP (or BIL not BSQ):

<file> <edit ENVI header>

Change to BIP in ENVI: <basic tools> <convert data>

2.4. In ACORN

The files, that must be changed or checked every time you work on a new AVIRIS scenes are in **BOLD**. When the input parameters can be taken from the first scene, the parameter is just in *italic*.

Select processing mode 1

In “Edit Control File”:

Input Image File Name: e.g. r02sc03

Choose Output file : e.g. atm_r02sc03

Input File Format : (e.g. bip)

Integer format: host (Intel)

Image Dimensions: 224 bands

lines : 512

samples 614

offset: 0

Image Spectral Calibration File: enter path and prepared file (e.g.

C:\ACORN_BH\data_input\input_spec.txt)

Gain File: enter path and prepared file (e.g. C:\ACORN_BH\data_input\input_gain.txt

Offset File: enter path and prepared file (e.g. C:\ACORN_BH\working_directory\file.off)

Image latitude: of scene center (e.g. 44, 22, 55) check ArcGIS project

Image latitude (e.g. -104, 1, 35)

Image Mean elevation : (e.g. 1800 m) check DEM or map

Image Acquisition Altitude : 20 km

Image Date: (e.g. 6 Day

7 month

2000 year)

Image time: from “.avhdr file” (take average, do not adjust for mountain time)

Derive Water Vapor: both

Fixed water vapor : (e.g. 28 mm)

Image atmosphere visibility: (e.g. 90 km)

Artifact Suppression: Type 1 (Type 2 smoothes and Type 3 takes out entire bands that have high atmospheric influence)

ACORN Estimated Visibility: do not select

Click ok and save

Mode 2:

open file name: e.g. “ro4_sc02_m2.in” (or new mode2)

input image file : output file from mode 1 (e.g. atm_rot310_r04_sc)

output image file : e.g. atm2_rot310_r04_sc

Input file format: Integer format

Image dimension : same as in Mode 1

Image Target reflectance: enter path and prepared file

Image Spectral Calibration: enter path and prepared file

Measured Target: enter path and prepared file

2.5. Problem Solving:

The Model process takes more than a minute

If it finishes early, check your input data and “.eco output file”

Check your ACORN input file (.in) in wordpad

3. Georeferencing:

Before georeferencing, we first rotated the scene to have North on the top of the scene. This makes it easier to find ground control points (GSPs). We georeferenced AVIRIS data with DOQs (digital orthoquads), which can be downloaded from the web or purchased from governmental agencies, such as the National Forest Service. In order to save computer space we saved the results on CDs. We saved three bands of the georeferenced AVIRIS scene as an ArcView “.bil” file. In ArcGIS or ArcView, we put the all the georeferenced scenes together to get an overview of the area.

3.1. Mosaic ALL the DOQs to cover the ENTIRE area of the AVIRIS scene

DOQs have a resolution of 2m. Their high resolution provides easy target finding when georeferencing. They are about the size of an AVIRIS scene. So, in order to use them for georeferencing one needs to mosaic the DOQs to cover the ENTIRE AVIRIS scene.

In ENVI: <Basic Tools> <Mosaicing> <georeferenced mosaic
<import file without feathering>

In <options> Background value to ignore: 0

<File> <apply>

3.2. Rotate AVIRIS scene

By trial and error find the angle, which brings you closest to the true orientation. (Every second flight line should be rotated by an additional 180 degrees, since the AVIRIS airplane flies back))

ENVI <basic tools> <rotate/flip data>

3.3. General Georeferencing

Pick about 40 GCPs (ground control points) per AVIRIS scene

it is best to pick them at the very outer edges of the image (first 4 points should be taken from the corners)

try to pick the next point opposite of the last one

it is better to have the points equally distributed, even though it may mean less points (keep them equally distributed already in the process of picking them)

pick GCP's

<Map> <registration> <select GCP's from Image to image>

save GCP's as .pts file

keep an eye on the errors

Georeference

don't go from the main menu

open GCPs <Map> <registration> <select GCP's from Image to image>

in "Ground Control Point selection

<File> <Restore GCPs from ASCII>

!!!! in <Options> <Warp File (as image to map)>

choose input warp file

click <ok>

in "Registration parameters" enter:

Warp method: polynomial

Degree: 3 (2 and 4 may also work, 4 can lead to distortions, if 2 works, it is better than using 3rd degree)

Resampling: nearest neighbor

Click on <change Output parameters>

x and y pixel size 20(!) meter (or what ever your resolution is)

4. Problem solving:

When ENVI freezes, type the magic word "retail" in IDL window

Check ".readme" files you get along with the AVIRIS data to find out the meaning of all the different files

5. Links

[AVIRIS main page](#)