ASTER Preprocessing Toolkit (APTK) Installation and User Guide
Version 1.0.2

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Installation

For use in ENVI Classic, place the APTK folder in your save_add directory. The next time Classic is started, you should see a button for APTK in the File->Open External File->EOS menu. For use in ENVI 5.0 or later, place the APTK folder in your extensions directory. The next time ENVI is started, you should see a button for APTK in your Extensions menu. APTK is not guaranteed to work with versions of ENVI older than 4.8.

Usage

APTK is designed to mitigate multiple issues with how ASTER data are stored, processed, and used by geospatial software packages. The output from an APTK processing run is a new set of ENVI-formatted files, which is consistent with other third party EOS plugins for ENVI (MCTK, EPOC, VCTK, and Hyperion Tools).

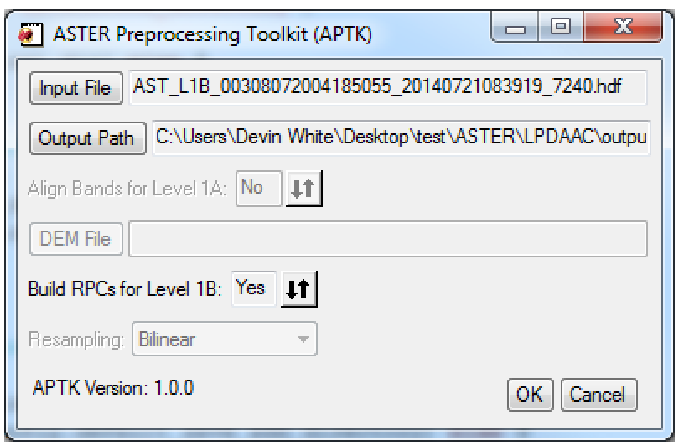

Figure 1. The APTK graphical user interface.

Level 1A Processing

For Level 1A, calibration coefficients are applied to individual bands within a swath (VNIR Nadir, VNIR Backward, SWIR, and TIR), the results are combined into a single cube, and that cube is written out to an ENVI file. That file contains correct band names, wavelengths, and a Rational Polynomial Coefficient (RPC) sensor model to enable orthorectification and, for Band 3N/3B, stereo DEM extraction. For a full L1A dataset, you should end up with four files, all of which are automatically loaded into ENVI.

Individual bands within an L1A swath are not aligned with one another, but are geopositionally correct. The impact of this misalignment is most noticeable in the SWIR swath, where the interband offsets can exceed six pixels. ENVI's solution to this issue is to allow you to orthorectify each band individually and then stack them together (done automatically), but this (1) forces you to orthorectify your data and (2) makes you dependent on ENVI's internal orthorectification module, which is not very robust compared to others like C-3PO. APTK includes a band alignment option, but it does require you to supply a DEM. The first band within a swath is used as the baseline and all others are transferred into its coordinate space using the DEM and their individual sensor models. This does require some interpolation, so you have the option of which method to use. The end result is a single cube with well-aligned bands, in the original viewing geometry, suitable for analysis and visualization. The alignment procedure is computationally expensive, so you will likely have to wait a few minutes for the process to complete. NOTE: It is not recommended to use a DEM with finer spatial resolution than 15m—you won't gain anything since that is the high end of ASTER's spatial resolution. The ASTER 30m global DEM (GDEM) works well.

Without band alignment, the RPC model generated by APTK is only accurate for the first band in a swath. For VNIR Nadir, VNIR Backward, and TIR, the offsets are small enough that you might be willing to ignore them, but it makes a big difference for SWIR. Band alignment should always be performed, but the choice is yours.

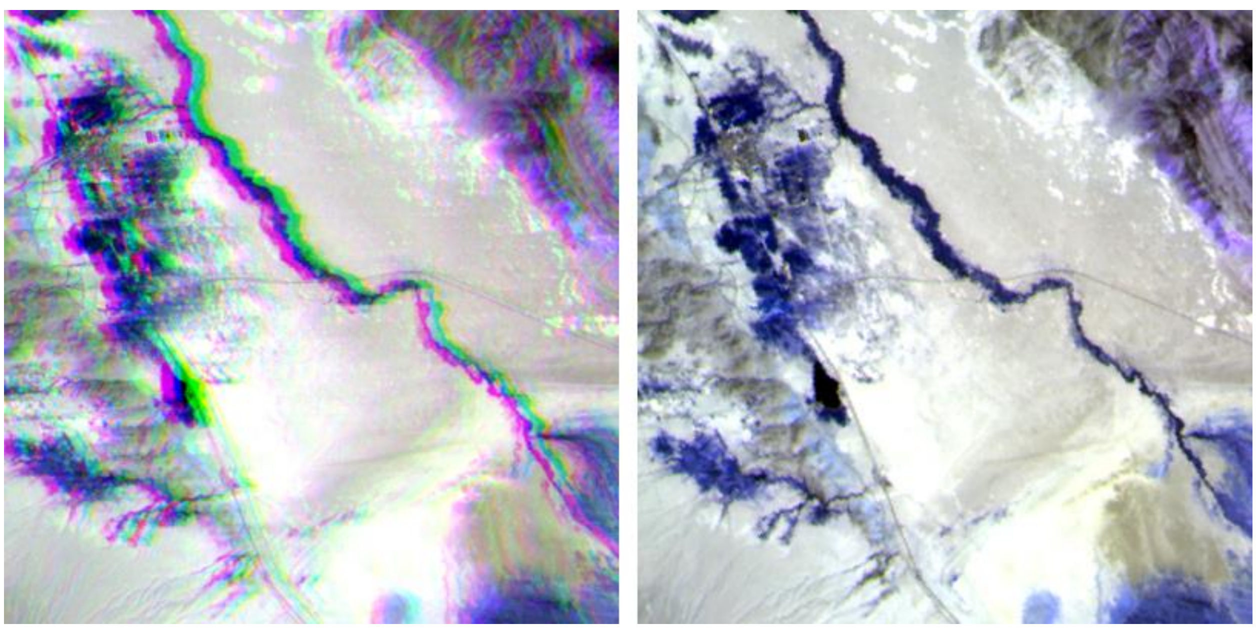

Figure 2. An example of APTK's Level 1A SWIR band alignment capability. Raw bands are displayed on the left in a false color composite, aligned bands are displayed on the right.

Level 1B Processing

Level 1B datasets are notoriously difficult to work with. First and foremost, the scene is projected onto the WGS-84 ellipsoid, which means that the projection was done under the assumption that the Earth is perfectly flat with a height of 0m above the ellipsoid. In mountainous areas, you can see positional errors on the order of 500m when compared to orthorectified Landsat data or Google Earth. Second, the projected scene is rotated such that it mimics the sensor's orbital scan path, which most geospatial software packages do not like. Third, ENVI is the only software package that offers the option to build RPCs to enable orthorectification and stereo DEM extraction for L1B, but their approach is incomplete and as such requires the user to supply ground control points to bring the data closer to where it is supposed to be on the ground. It in essence reproduces the ellipsoid projection effect unless you force it to consider a different solution via ground control, which puts a significant burden on the user. APTK mitigates all of these issues.

At a minimum, APTK processes each L1B swath in a similar fashion to L1A, producing a calibrated cube with correct band names and wavelengths. Band realignment is not required. Unless you elect to build RPCs, each cube is automatically “unrotated” in its native UTM projection so that North is up, which is what most geospatial software packages prefer. This does require some interpolation, so you have the option of which method to use. If you do elect to build RPCs, swaths are left in their rotated state, but you can then perform orthorectification or, for Band 3N/3B, stereo DEM extraction.

The L1B RPCs built by APTK are far more accurate than those built natively by ENVI. Both use a reverse-engineering approach, piecing together required sensor model information scattered across the supplied file and filling in the rest with reasonable photogrammetric tradecraft. Where they differ is that ENVI assumes the sensor is looking straight down, which is generally not the case. That can lead to significant positioning errors unless you supply ground control points. Without ground control, APTK’s method can position an L1B swath within a half pixel of its L1A counterpart after orthorectification, which means that ground control is not required. The method is still being refined, so accuracy should continue to improve.

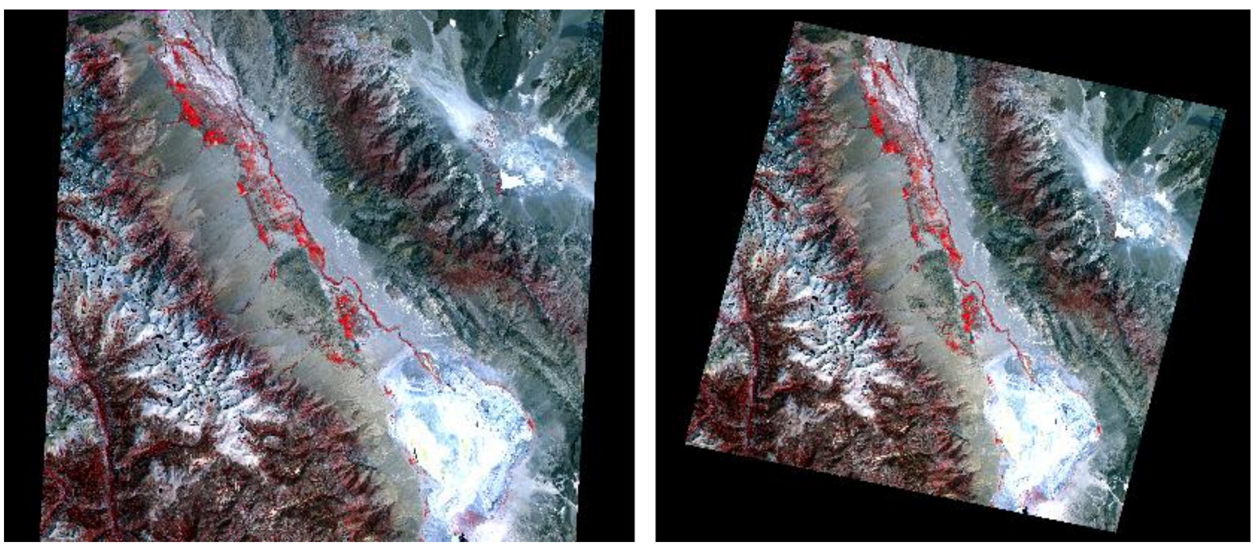

Figure 3. The original scan-path-aligned L1B swath and APTK’s unrotated, north-is-up output for the same swath. The scale for each image is different.

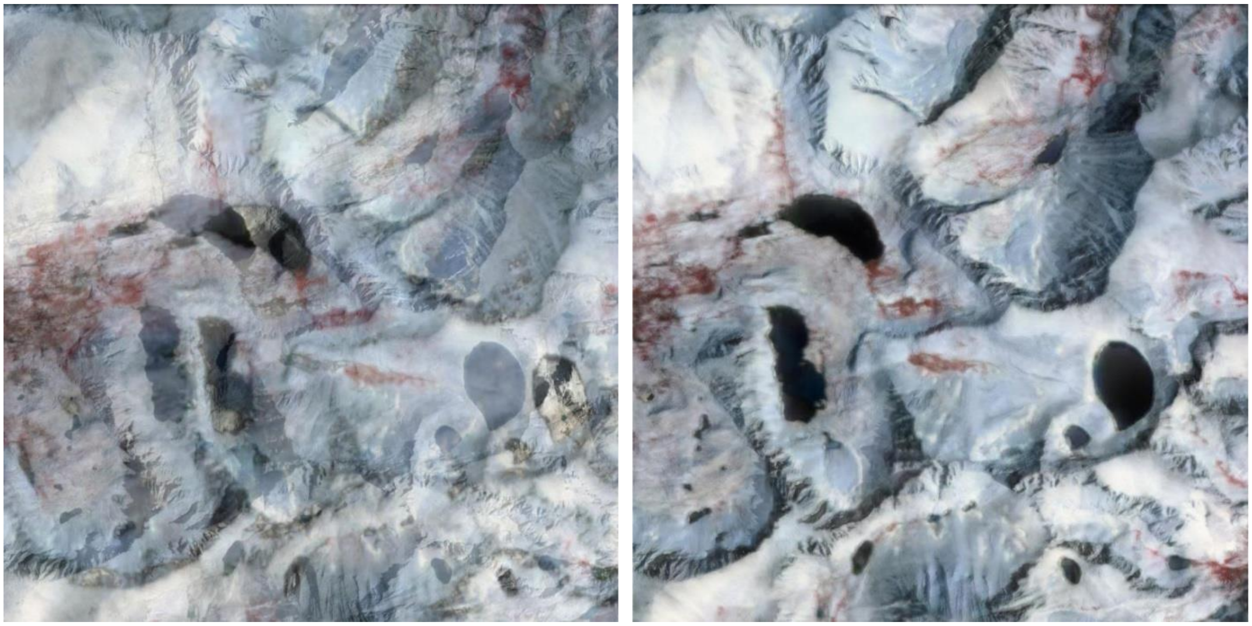

Figure 4. Comparison of no-ground-control orthorectification output for ENVI vs. APTK in a mountainous region. ENVI output is on the left, APTK output is on the right. Both outputs are overlaid, with transparency, on commercial high resolution satellite imagery as presented in Google Earth. Residual displacement for APTK is well within documented platform positional uncertainty (50m).

Application Programming Interface

The following pages contain documentation for IDL routines that enable you to process L1A and L1B datasets programmatically. The available options exactly mirror those present in the GUI.

Acknowledgements

I would like to thank the NASA/USGS Land Processes Distributed Active Archive Center (LP DAAC) for providing technical assistance and challenging sample data during the development of APTK.

CONVERT_ASTER_L1A, FILE, OUT_DIR [,R_FNAMES=R_FNAMES] [,R_FIDS=R_FIDS] [,/MSG] [,/PROGRESS] [,/ALIGN] [,DEM_FID=DEM_FID] [,DEM_POS=DEM_POS] [,INTERP={0|1|2}]

FILE

Set this parameter to the fully qualified path on your system for the Level 1A file that you want to process.

OUT_DIR

Set this parameter to the fully qualified path on your system for a directory where you want to place output files.

R_FNAMES (optional)

The routine will populate a user-supplied variable with an array of fully qualified paths for outputted files.

R_FIDS (optional)

The routine will populate a user-supplied variable with an array of ENVI File IDs (FIDs) for the outputted files, which are opened in ENVI automatically.

MSG (optional)

The routine will populate a user-supplied variable with a string error message if processing does not complete successfully. The default return value is a null string ('').

PROGRESS (optional)

Set this keyword to indicate that you want to see a progress bar during processing.

ALIGN (optional)

Set this keyword to force band alignment within each swath. This requires the use of a DEM, whose FID and band position must be supplied via the DEM_FID and DEM_POS keywords. The interpolation method used can also be indicated using the INTERP keyword (default is bilinear).

DEM_FID (optional)

Use this keyword to supply the FID for the DEM you want to use during band alignment. DEM_POS must also be used.

DEM_POS (optional)

Use this keyword to supply the zero-based band number of the elevation data you want to use during alignment. DEM_FID must also be used.

INTERP (optional)

Use this keyword to indicate which interpolation method to use during band alignment. 0 = Nearest Neighbor, 1 = Bilinear, 2 = Cubic Convolution.

CONVERT_ASTER_L1B, FILE, OUT_DIR [,R_FNAMES=R_FNAMES] [,R_FIDS=R_FIDS] [,/MSG] [,/PROGRESS] [,INTERP={0|1|2}] [,/BUILD_RPCS]

FILE

Set this parameter to the fully qualified path on your system for the Level 1B file that you want to process.

OUT_DIR

Set this parameter to the fully qualified path on your system for a directory where you want to place output files.

R_FNAMES (optional)

The routine will populate a user-supplied variable with an array of fully qualified paths for outputted files.

R_FIDS (optional)

The routine will populate a user-supplied variable with an array of ENVI File IDs (FIDs) for the outputted files, which are opened in ENVI automatically.

MSG (optional)

The routine will populate a user-supplied variable with a string error message if processing does not complete successfully. The default return value is a null string ('').

PROGRESS (optional)

Set this keyword to indicate that you want to see a progress bar during processing.

INTERP (optional)

Use this keyword to indicate which interpolation method to use during the “unrotation” process. 0 = Nearest Neighbor, 1 = Bilinear, 2 = Cubic Convolution.

BUILD_RPCS (optional)

Set this keyword to indicate that you want to build RPCs instead of unrotating the data.