ASDtoolkit User Guide

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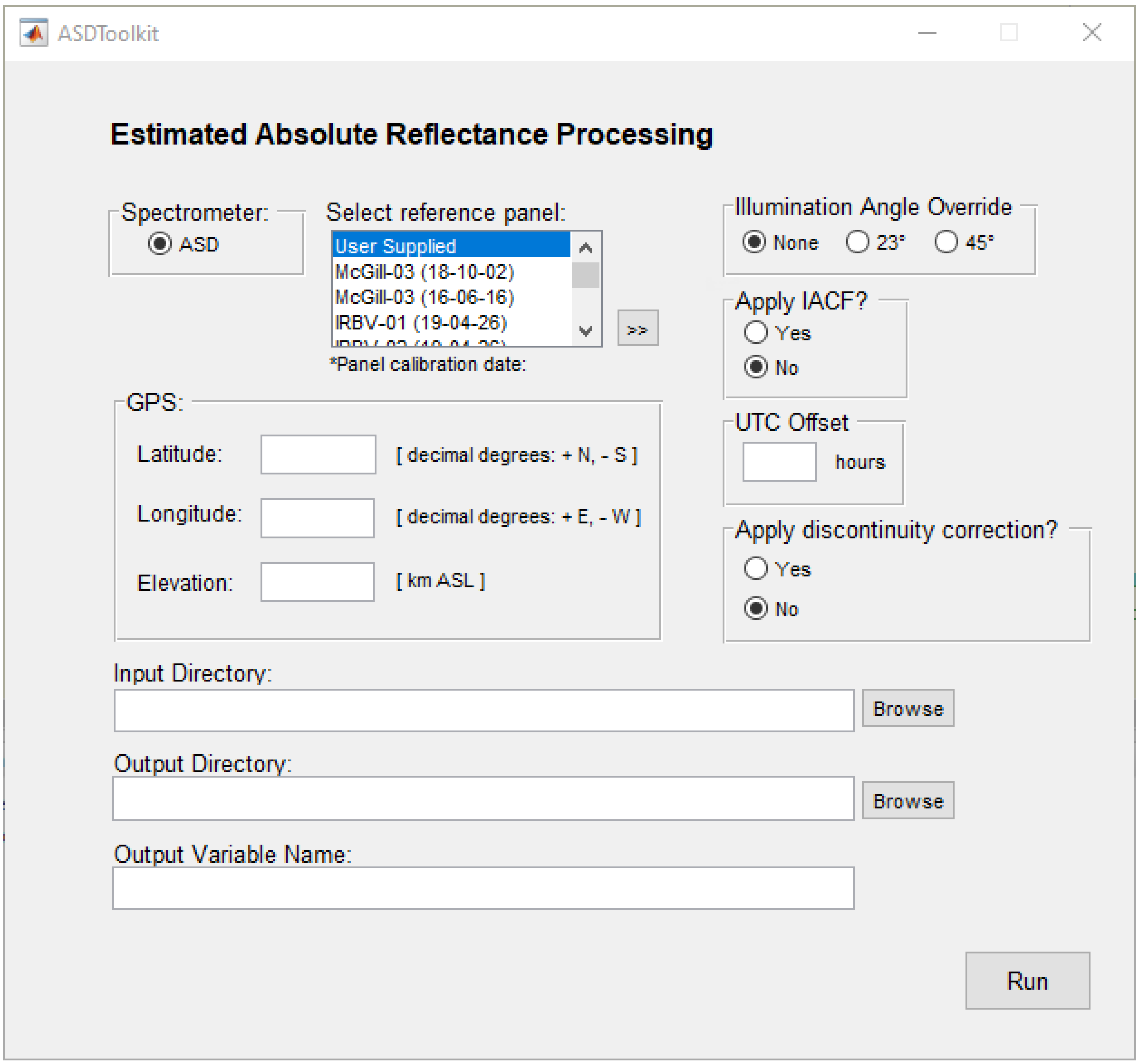
The purpose of this interface is to take original ASD datafiles and calculate the corrected reflectance based upon the Solar Zenith Angle (SZA) and reference panel used.

Interface Overview



Using the Interface:

Step 1: Spectrometer

The spectrometer type used: for this application, only the ASD is currently supported. It cannot be unselected.

Step 2: Select Reference Panel Used

Choose the name of the reference panel that was used during field measurements in order to calculate the corrected reflectance. The latest calibration date for the panel is given in parenthesis (yy-mm-dd).

- If you have a custom defined panel characteristic file (see **Appendix A** below on the proper format for a custom panel file as required by the ASDToolkit), choose the first item in the list, “User Supplied”

Step 3: Select the Working Directory

Click the [>>] icon next to the panel selection list. Select the working directory where the application files are located. **When running the standalone application, leave the directory as the default otherwise the application will not be able to run.**

Step 4: Illumination Angle Override

Choose whether or not to override the illumination angle of the data files to 45° or 23°. This option is included for processing of ASD files that were collected under lab conditions with artificial illumination where the solar angle and latitude/longitude/time would not be relevant for the collected data files. For data files collected in the field under solar illumination conditions, select the “None” option to use the calculated solar angles.

Step 5: Apply IACF?

Choose whether or not to apply an Incident Angle Correction Factor. This accounts for the difference in solar angle between the time that the measurement of the reference panel was taken and the time that the target measurement(s) are taken. If the reference and target measurements are taken close together in time, the correction will be minimal. However, if the reference and target measurements are far away from each other in time, the correction will be more useful.

Step 6: Enter UTC Offset

Enter the number of hours of offset between local time and UTC. If it is hours behind UTC, include a negative sign “-“ before the number of hours. For example, Vancouver is 7 hours behind UTC. Therefore, the entry would be “-7”.

Step 7: Apply Discontinuity Correction

The ASD has known spectral discontinuities and may exhibit spectral “steps” at the joints of the three detectors that make up the full-range spectroradiometer. Certain conditions may cause these discontinuities to become more pronounced. By applying jump correction, the toolkit will provide an additive and multiplicative solution in order to account for the discontinuities, in addition to the original unaltered spectra.

Step 8: Enter the GPS Coordinates

Enter the longitude, latitude, and elevation values for the set of target files. The code assumes a constant lat/lon for every file within the selected input directory, so ensure that all files are correctly organized into individual folders based on target GPS coordinates. If incorrect values are entered, there will be an error message. Click "Ok" on the error message and reenter the incorrect values.

Step 9: Select the Input Directory

Browse to the folder containing the reference (ratio) files generated from ViewSpecPro for the ASD spectrometer. These files should have the extension '.asd.txt' for the ASD. Do NOT choose folders containing the raw or DN files, as the code relies upon the ratio values for correct computation of corrected reflectance. The function automatically appends a "\" to the end of the path, so the user does NOT need to do this.

Step 10: Choose the Output Directory

Browse to the location where you would like to save the output variable. The function automatically appends a "\" to the end of the path, so the user does NOT need to do this.

Step 11: Choose the Output Variable Name

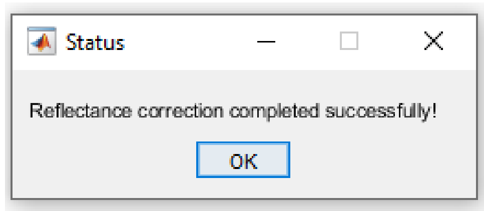
Choose the name that you would like the save the output variable as. The function automatically adds the necessary extension ('.mat'), so the user only needs to choose the name of the variable.

Step 12: Run the Function

Click on the "Run" button at the very bottom right corner of the GUI window. The user will see a progress bar run for the importation of the files. When the calculations are finished, a pop-up window will appear stating that the calculations were done successfully. Click "Ok" or close the pop-up window. If the user is done with importing files, it is ok to close the interface window, or the user can change the values in the fields and click "Run" again to import files using the new inputs. A progress bar will appear and track the process. Once the progress bar disappears, the user MUST wait until they see a message box pop-up stating that the reflectance correction was completed successfully. The user may then click "OK" and navigate away from the GUI.

- If the option to use a "User Supplied" panel characteristic file was chosen in **Step 2**, after completing the necessary fields and clicking "Run" on the interface, a new "Select a File" window will open. Using this window, navigate to the correct file location and select the correct custom panel characteristic file (*.csv)* and click "Open". The window will then close and the toolkit will continue processing the data files as normal.

- Note: there is a small time lag between when the progress bar disappears and the final completed message pop up appears (seen in the image below). This is due to the time needed to write all the results out to their respective files in the specified directory. The user MUST wait for this final pop-up stating that the correction has been completed, otherwise the files may not be finished writing.



Interface Outputs:

Files Always Generated:

variablename.mat

Matlab variable file: contains all of the output data and header information. Can be opened directly into Matlab for further data manipulation.

variablename_estimatedAbsoluteReflectance.csv

Excel file (.csv) that contains the estimated absolute reflectance output values. Each column represents a single data file, with the name of the file as the first row in the column.

variablename_headerInfo.csv

Excel file (.csv) that contains the header information for each processed file. Each column represents a single data file.

Optional Files:

If IACF option is chosen to be applied:

variablename_estimatedAbsoluteReflectance _IACF.csv

Excel file (.csv) that contains the estimated absolute reflectance output values. Each column represents a single data file, with the name of the file as the first row in the column.

If Jump Correction is chosen to be applied:

variablename_DC_additive.csv

variablename_DC_multiplicative.csv

Two Excel files (.csv) that contain the estimated absolute reflectance values for both the additive and multiplicative solutions for the ASD jump correction. Each column represents a single data file, with the name of the file as the first row in the column.

Note on the Matlab Data File (.mat):

The function generates an output variable of the name given by the user in the interface. The variable is of type '.mat'. The user will need to load the variable into the Matlab workspace themselves if they wish. This can be done using the command in Matlab:

```
>> load('outputVariableName.mat');
```

where "outputVariableName" is the name chosen in **Step 10**. Importing the variable this way loads the data structure under the name "estimatedAbsoluteReflectance". If the user wishes to import the variable to the workspace with a different name, the variable should be loaded using the command:

```
>> dataStructure = load('outputVariableName.mat');
```

where "dataStructure" will be the name of the variable in the Matlab workspace. It is advised to load the variable with a unique name in the workspace when processing multiple sets of files as each variable has an automatic name of "estimatedAbsoluteReflectance" in the workspace, which can become confusing as more output variables are added.

The data structure contains 18 fields if all options are enabled. These fields and their associated data types are shown in the example image below.

Path: shows the directory path of the input files

Name: shows the name of the imported file

Header: contains the original header information from the imported file

Datetime: shows the date and time information for the imported file

Panel: displays the name of the panel characteristic file used to process the data

Latitude: displays the entered latitude value

Longitude: displays the entered longitude value

Elevation: displays the entered elevation value

Reference_zenith: shows the calculated solar zenith angle for the reference measurement, using the date/time information

Reference azimuth: shows the calculated solar azimuth angle for the reference measurement, using the date/time information

Target_zenith: shows the calculated solar zenith angle for the target measurement, using the date/time information

Target azimuth: shows the calculated solar azimuth angle for the target measurement, using the date/time information

Wavelength: contains the wavelength information

Reflectance: contains the estimated absolute reflectance for the imported file

IACF: value of the calculated Incident Angle Correction factor

IACF_reflectance: contains the corrected reflectance with the IACF applied to it

DC_additive: the additive solution if the ASD jump correction option is applied

DC_multiplicative: the multiplicative solution if the ASD jump correction option is applied

estimatedAbsoluteReflectance

1x10 struct with 16 fields

Fields	path	name	header	datetime	panel	latitude	longitude	elevation	reference_zenith	reference_azimuth	target_zenith	target_azimuth	wavelength	reflectance	IACF	IACF_reflectance
1	'D:\Kathryn...	'180619_MB...	1x1 struct	'19-Jun-201...	'McGill-03_...	45.4092	-75.5185	0.0100	42.8249	105.1522	42.3120	105.8470	2151x1 double	2151x1 double	0.9918	2151x1 double
2	'D:\Kathryn...	'180619_MB...	1x1 struct	'19-Jun-201...	'McGill-03_...	45.4092	-75.5185	0.0100	42.8249	105.1522	42.3035	105.8585	2151x1 double	2151x1 double	0.9917	2151x1 double
3	'D:\Kathryn...	'180619_MB...	1x1 struct	'19-Jun-201...	'McGill-03_...	45.4092	-75.5185	0.0100	42.8249	105.1522	42.2923	105.8739	2151x1 double	2151x1 double	0.9915	2151x1 double
4	'D:\Kathryn...	'180619_MB...	1x1 struct	'19-Jun-201...	'McGill-03_...	45.4092	-75.5185	0.0100	42.8249	105.1522	42.2810	105.8893	2151x1 double	2151x1 double	0.9913	2151x1 double
5	'D:\Kathryn...	'180619_MB...	1x1 struct	'19-Jun-201...	'McGill-03_...	45.4092	-75.5185	0.0100	42.8249	105.1522	42.2613	105.9162	2151x1 double	2151x1 double	0.9910	2151x1 double
6	'D:\Kathryn...	'180619_MB...	1x1 struct	'19-Jun-201...	'McGill-03_...	45.4092	-75.5185	0.0100	42.8249	105.1522	42.2444	105.9393	2151x1 double	2151x1 double	0.9907	2151x1 double
7	'D:\Kathryn...	'180619_MB...	1x1 struct	'19-Jun-201...	'McGill-03_...	45.4092	-75.5185	0.0100	42.8249	105.1522	42.2360	105.9509	2151x1 double	2151x1 double	0.9906	2151x1 double
8	'D:\Kathryn...	'180619_MB...	1x1 struct	'19-Jun-201...	'McGill-03_...	45.4092	-75.5185	0.0100	42.8249	105.1522	42.2248	105.9663	2151x1 double	2151x1 double	0.9904	2151x1 double
9	'D:\Kathryn...	'180619_MB...	1x1 struct	'19-Jun-201...	'McGill-03_...	45.4092	-75.5185	0.0100	42.8249	105.1522	42.1966	106.0048	2151x1 double	2151x1 double	0.9900	2151x1 double
10	'D:\Kathryn...	'180619_MB...	1x1 struct	'19-Jun-201...	'McGill-03_...	45.4092	-75.5185	0.0100	42.8249	105.1522	42.1882	106.0164	2151x1 double	2151x1 double	0.9899	2151x1 double

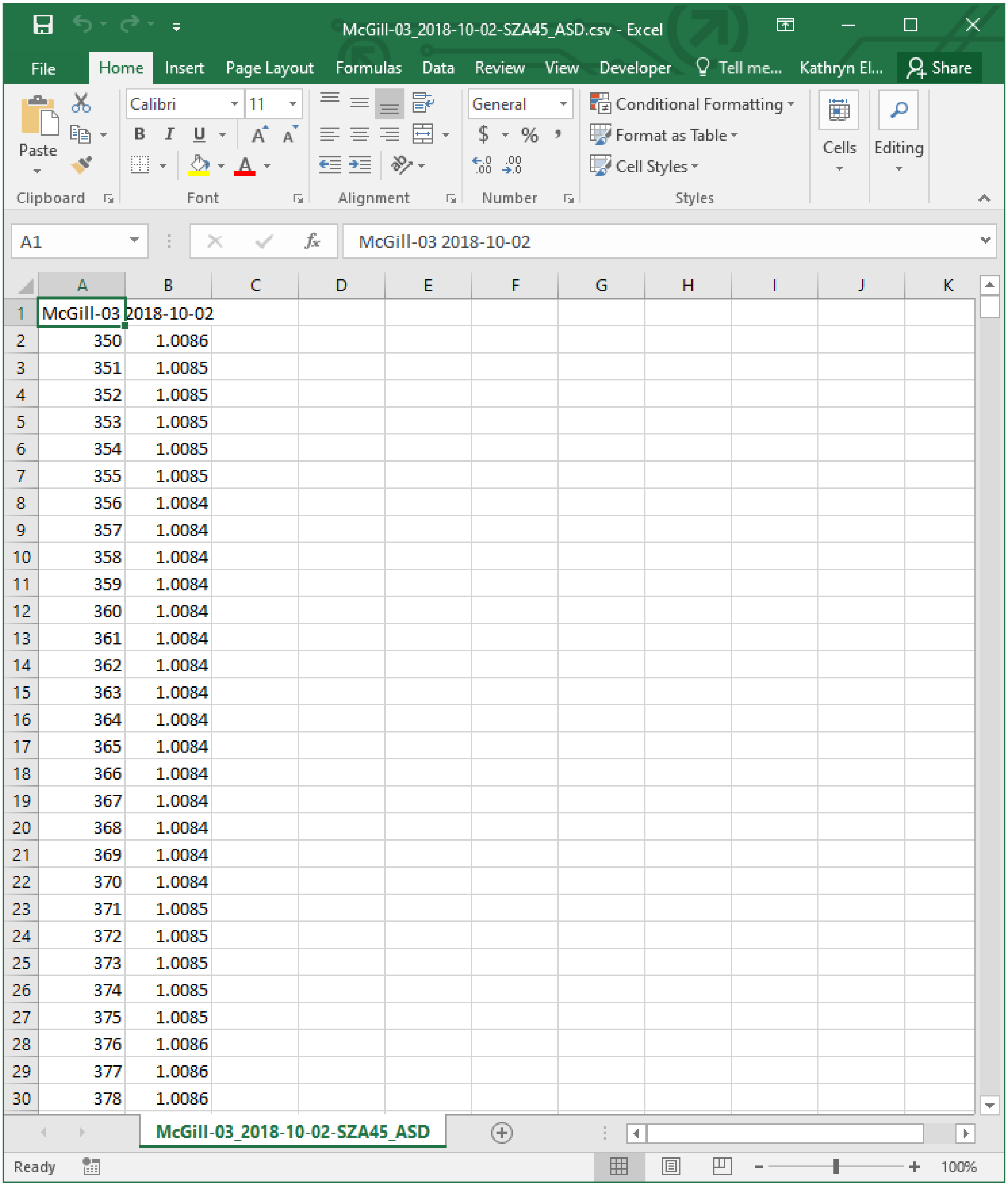
The appearance of the output data structure when opened in Matlab

Appendix A: Creating a Custom Panel Characteristic File

If you have your own Spectralon panel that you would like to use to process ASD files, the option to do so is available within the ASDToolkit. However, the format of the character file MUST be in a specific format. **If the format is not followed, the toolkit will not be able to properly read the custom characteristic file and will fail to process the ASD files**. The criteria are as follows:

1) the file must be a .csv
2) the first row in the first column must contain a panel identifier or panel characteristic file name
3) the wavelengths must only be in the first column, beginning at row two
4) the panel measurement data must only be in the second column, beginning at row two
5) the panel measurements must be provided at the same wavelength intervals as the R_{ratio} files.

An example of a panel characteristic file is shown here for reference:



	A	B
1	McGill-03 2018-10-02	
2	350	1.0086
3	351	1.0085
4	352	1.0085
5	353	1.0085
6	354	1.0085
7	355	1.0085
8	356	1.0084
9	357	1.0084
10	358	1.0084
11	359	1.0084
12	360	1.0084
13	361	1.0084
14	362	1.0084
15	363	1.0084
16	364	1.0084
17	365	1.0084
18	366	1.0084
19	367	1.0084
20	368	1.0084
21	369	1.0084
22	370	1.0084
23	371	1.0085
24	372	1.0085
25	373	1.0085
26	374	1.0085
27	375	1.0085
28	376	1.0086
29	377	1.0086
30	378	1.0086

An example of what a panel characteristic file (.csv) should look like in Excel.