



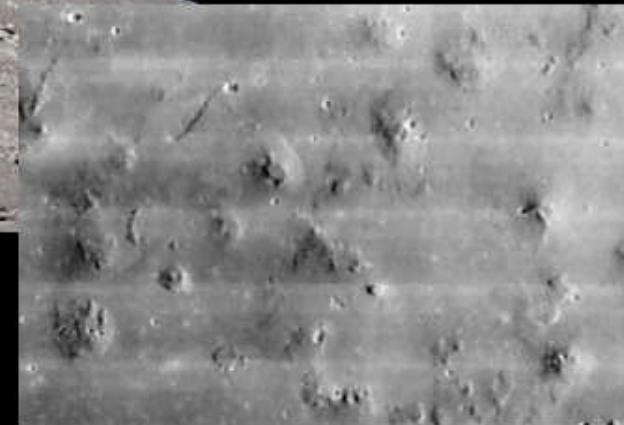
Katima, Alaska

Simple Shape-from-shading (SfS) with Carlotto's method and MS-Excel

Part 3: Convert source images to text data and import



Mons Rumker - Apollo 15 AS15-97-13252

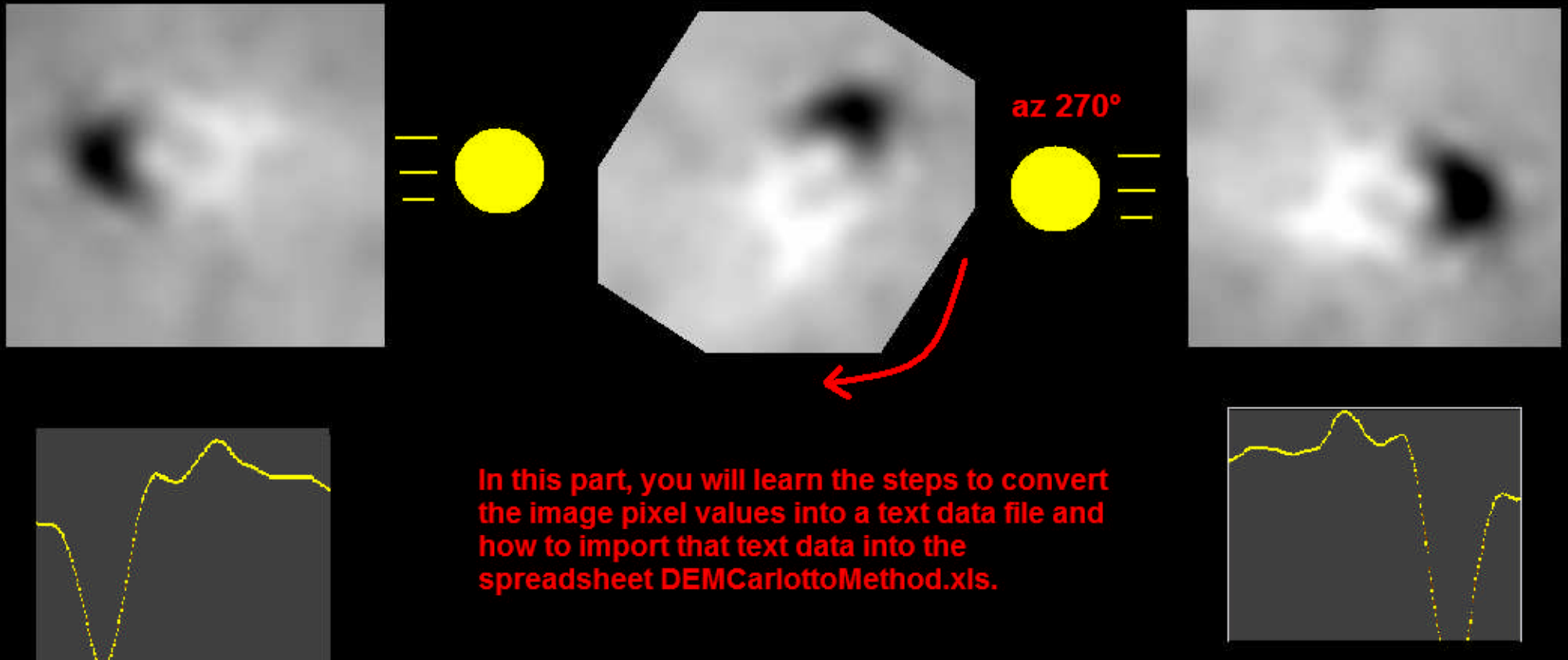


Marius Hills - Lunar Orbiter IV - IV-15-H2

K. Fisher fisherka@csolutions.net Org. 3/2007

In Part 1, we discussed how Carlotto's method simplifies computation by rotating all lunar features images so the apparent azimuth of the Sun is 270° .

fits -> Astronomical Image Processing for Windows (AIP4WIN) -> fits

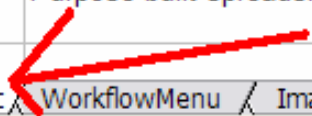


In this part, you will learn the steps to convert the image pixel values into a text data file and how to import that text data into the spreadsheet DEMCarlottoMethod.xls.

Converting and importing lunar feature images

Image Processing Checklist

Item	Software	Software type	Task type	Task
1	AIP4WIN	Image processing	Pre-process image - rectify	Convert color source fits to color jpg
2	LTVT	Lunar observing	Pre-process image - rectify	Two-point register and rectify image
3	LTVT	Lunar observing	Pre-process image - rectify	Export rectified color jpg to file
4	AIP4WIN	Image processing	Pre-process image - make greyscale levels	Convert color source jpg to 8-bit or 16-bit
5	AIP4WIN	Image processing	Pre-process image - rotate and crop to rectangular	Rotate the image so the apparent shape is rectangular
6	AIP4WIN	Image processing	Pre-process image - rotate and crop to rectangular	Crop the image
7	AIP4WIN	Image processing	Pre-process image - rotate and crop to rectangular	Resave the image as an 8 bit or 16-bit greyscale image
8	FV Tool	Digitize pixel values	Convert image to csv text data	Export the greyscale image to an N x M matrix
9	Microsoft Excel	General spreadsheet	Convert csv text data to Excel worksheet	Import the csv data as an Excel worksheet
10	DEMCarlottoMethod.xls	Purpose-built spreadsheet	Import NxM matrix to DEM spreadsheet	Copy/move the NxM matrix in the Excel worksheet in DEMCarlottoMethod.xls
11	DEMCarlottoMethod.xls	Purpose-built spreadsheet	Store info on image	Update worksheet StoreIPM_Info worksheet
12	DEMCarlottoMethod.xls	Purpose-built spreadsheet	Generate DEM - enter data	Generate the DEM using DEMCarlottoMethod.xls
13	DEMCarlottoMethod.xls	Purpose-built spreadsheet	Generate DEM - enter data	Copy the stored image pixel data to worksheet ImagePixelValueMap
14	DEMCarlottoMethod.xls	Purpose-built spreadsheet	Generate DEM - enter data	Update the image characteristics to WorkflowMenu
15	DEMCarlottoMethod.xls	Purpose-built spreadsheet	Generate DEM - enter data	Identify/name the working image pixel data
16	DEMCarlottoMethod.xls	Purpose-built spreadsheet	Generate DEM - housekeeping	Delete any preexisting DEM or Gradient



You will be covering the first eleven steps in the image processing checklist. The checklist is embedded inside DEMCarlottoMethod.xls and is included separately in the reference materials.

Converting and importing images

This section uses a variety of software and freeware to convert your lunar image into text data. Recommended software discussed on the project website and used in this presentation are:

- 1) An astronomical image processing package - AIP4WIN or the package of your choosing.
- 2) Mosher and Bondo's Lunar Terminator Visualization Toolkit (LTVT) for image rectification (freeware).
- 3) NASA HEARSAC's FV Tools (freeware).

Converting and importing images



If you do not have a lunar dome image to work with a sample image of Cauchy Omega is available at the project website, provided courtesy of Paolo Lazzorotti.

Convert and import images

Learning goals for Part 3

- 1) Proper rotation of a feature image to an apparent solar azimuth of 270° .**
- 2) Rectification of an image to offset the effect of foreshortening.**
- 3) Conversion of your fits or jpg image to 8-bit greyscale.**
- 4) Conversion of your greyscale rotated image to text data.**
- 5) Importing and storing your image's text data into DEMCarlottoMethod.xls.**

Convert and import images

Process overview

Convert color source fits to color jpg

Two-point register and rectify image in LTVT

Export rectified color jpg to file

Gather ephemeris data

Convert color source jpg to 8-bit or 16-bit greyscale fits

Rotate the image so the apparent solar azimuth is 270°

Crop the image

Convert and import images

Process overview - continued

Export the greyscale image to an NxM csv matrix

Import the csv data as an Excel worksheet

Copy/move the NxM matrix in the Excel worksheet to a storage worksheet in DEMCarlottoMethod.xls

Update worksheet StoreIPM_Info worksheet with image characteristics.

Convert and import image

Convert color source fits to color jpg

For the first step of the process - rectification of the image to reduce the impact of foreshortening - Mosher and Bondo's LTVT will be used.

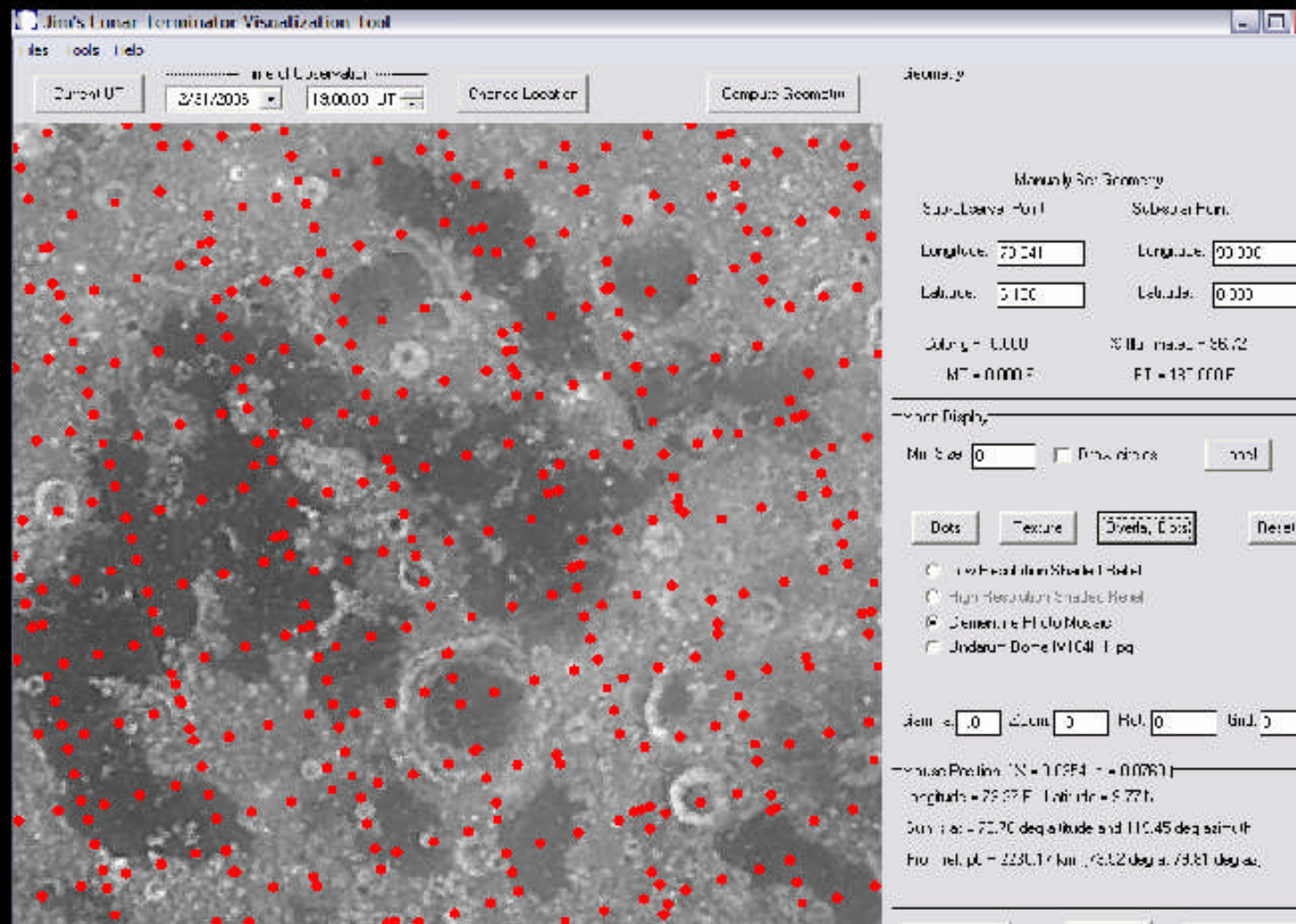
LTVT imports jpg or bmp images, but not FITS. Use your astronomical imaging processing software to convert your greyscale or color fits to *.jpg.

Convert and import image

Two-point register and rectify image in LTVT

Mosher and Bondo's Lunar Terminator Visualization Tool (LTVT) uses two-point registration to rectify an image. Here, we will briefly overview the process.

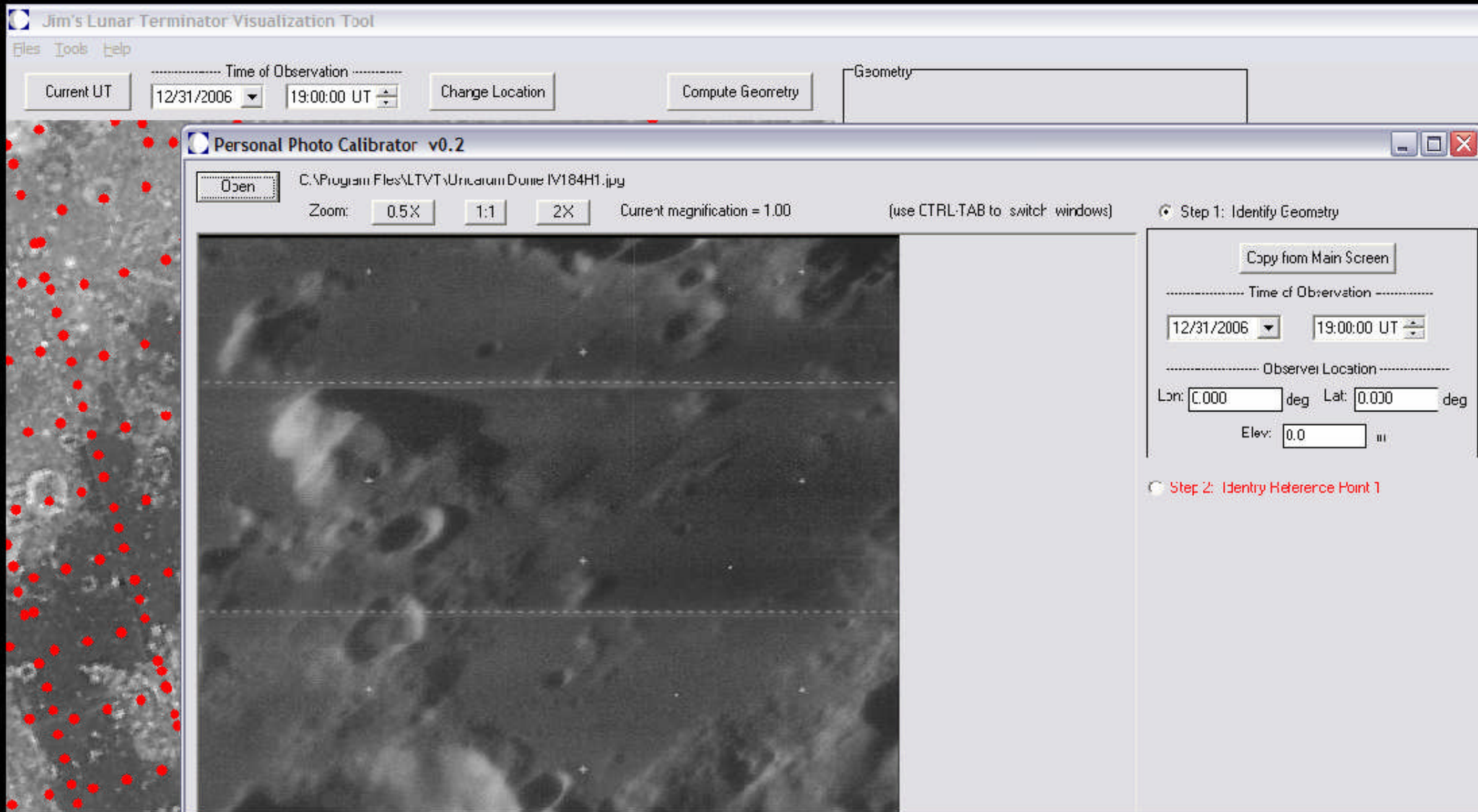
Begin by overlaying ULCN 2005 control points over a high resolution Clementine image (provided as part of the LTVT distribution).



Convert and import image

Two-point register and rectify image in LTVT

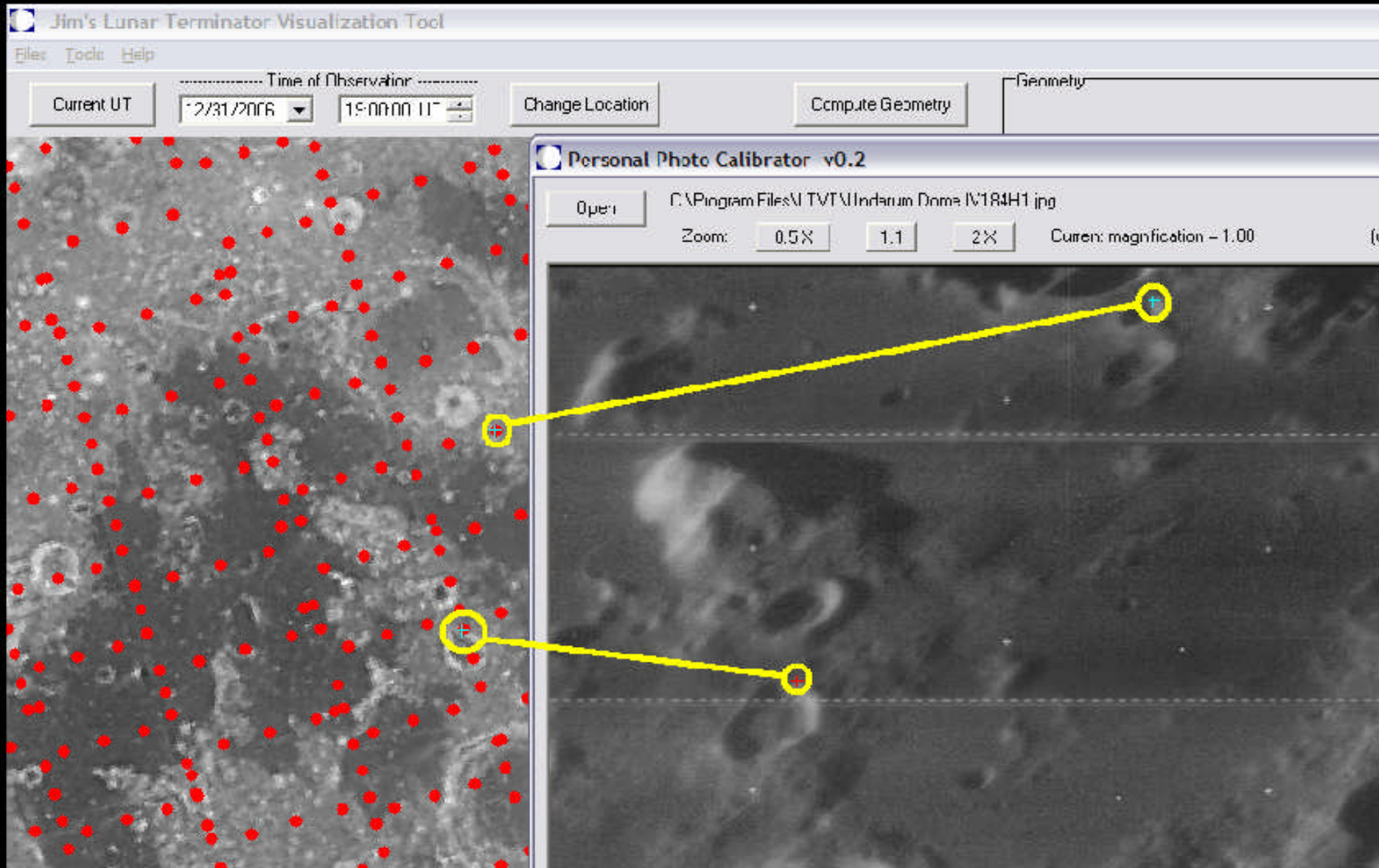
The registration or calibration process is begun by opening your user image in a second window.



Convert and import image

Two-point register and rectify image in LTVT

An association is built between two points on each image. This provides a transformation function for the rotation and scaling of the user's image.



Convert and import image Two-point register and rectify image in LTVT

Establishing the association includes pairing pixels on the user's image with estimated lunar coordinates.

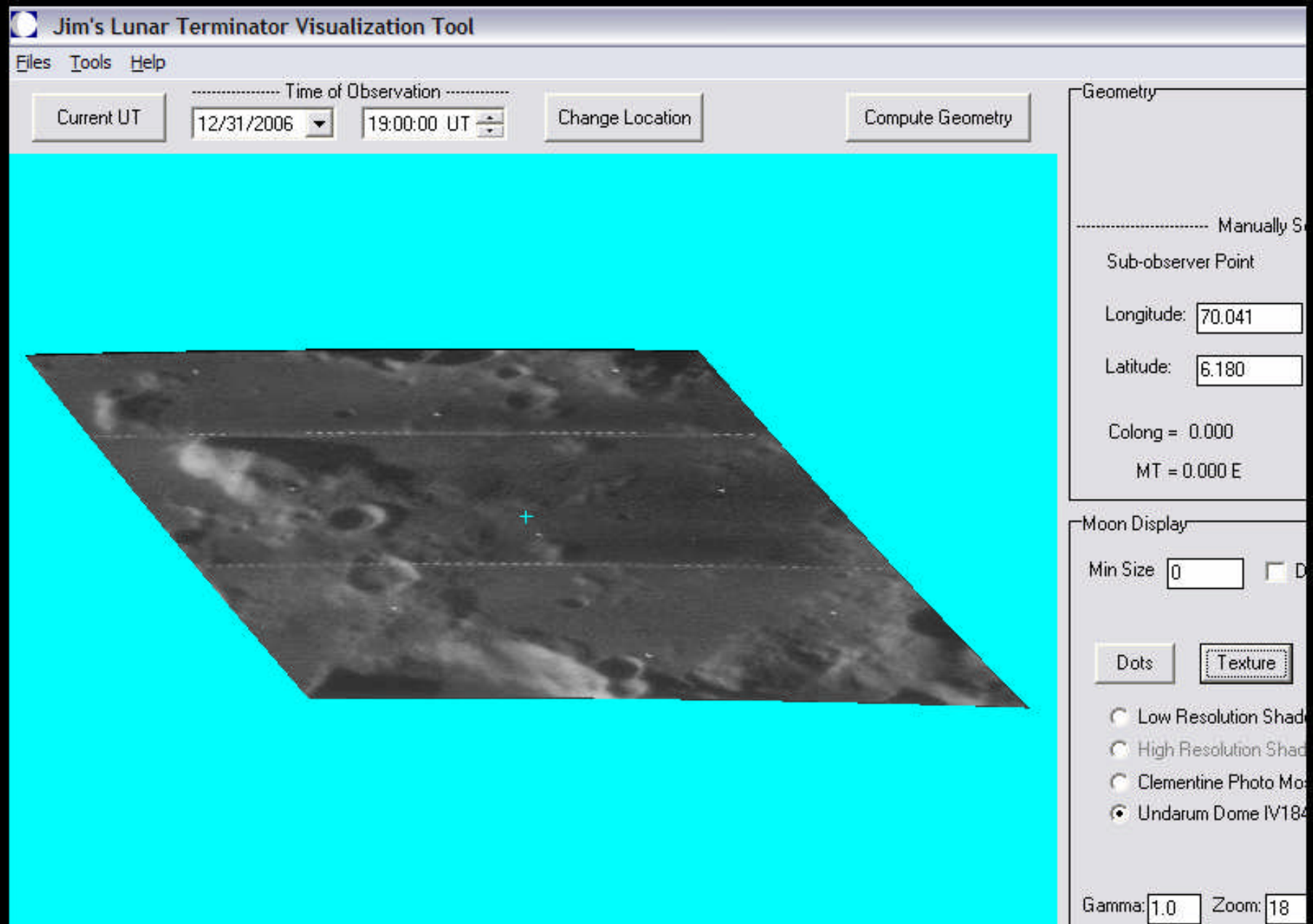
The screenshot displays the 'Personal Photo Calibrator v0.7' software interface. The main window shows a grayscale image of the Moon with two yellow circles marking specific points. A yellow line connects these two points. The right-hand panel contains the following information:

- Step 1: Identify Reference Point**
 - Copy from Main Screen
 - Time of Observation: 12/31/2005 19:00:00 UT
 - Observer Location: Lat: 41.8 deg, Lon: 41.8 deg, Elev: 4700 m
- Step 2: Identify Reference Point**
 - Copy from Main Screen
 - Set with mouse
 - Longitude: 62.367 X: 180
 - Latitude: 611 Y: 381
- Step 3: Identify Reference Point**
 - Copy from Main Screen
 - Set with mouse
 - Longitude: 72.478 X: 382
 - Latitude: 7829 Y: 4
- Step 4: Check**
 - if this is a minor image
 - Direction: -37.701 deg, Zoom: 30.555
 - When finished, click SAVE to store in database

At the bottom of the window, the status bar reads: 'Moon is at pixel (437, 48) Note: take up your coordinates: X=0-5, Y=0-73 and Z=(71,105,7,900)'

Convert and import image Two-point register and rectify image in LTVT

With this positional information, LTVT performs two-point rotation to rectify the image.



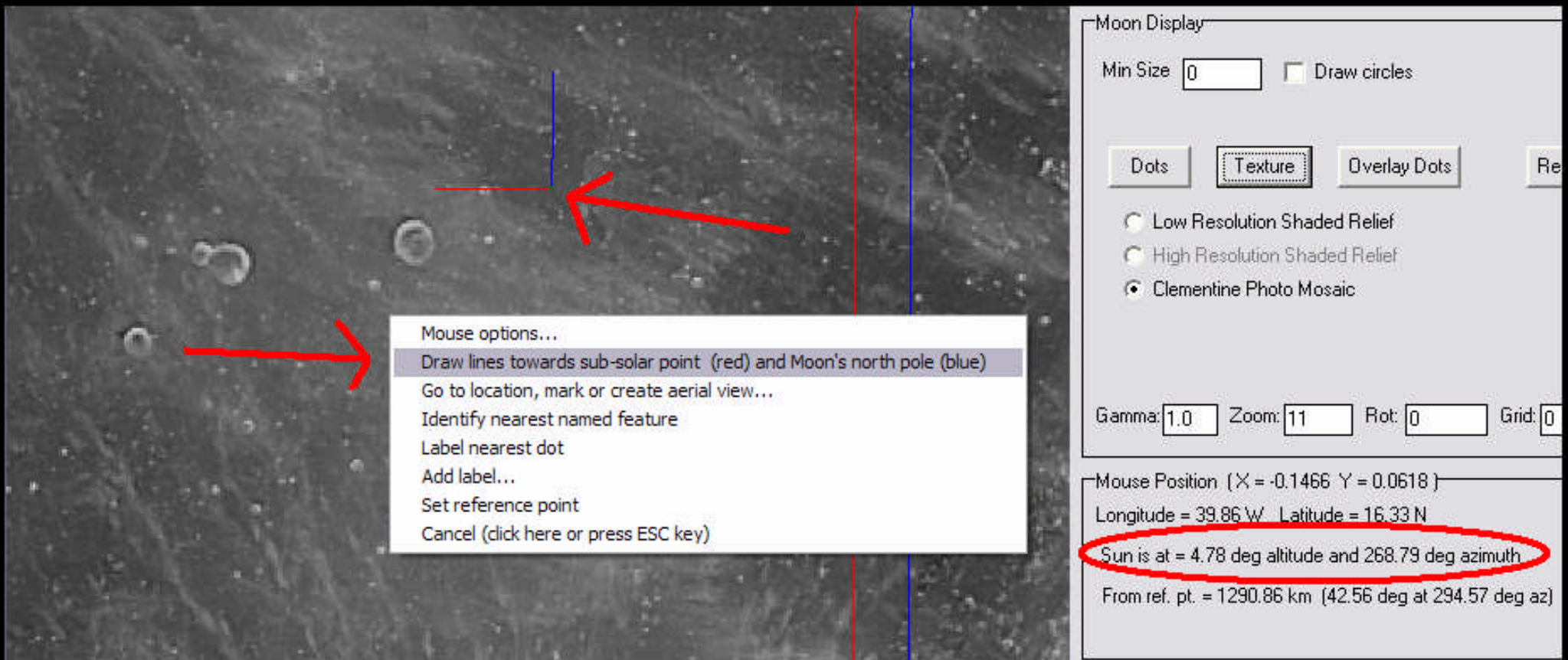
Convert and import image

Two-point register and rectify image in LTVT

Once rectified, the jpg image can be exported and saved as a jpg.

Convert and import image Collect ephemeris data

LTVT also include ephemeris information, based on high accuracy ephemeris files downloaded from JPL. The information window provides information on the solar altitude and azimuth at the current cursor position. Right-clicking provides an option to plot the relative direction of the Sun and lunar north pole.



The screenshot displays the LTVT software interface. On the left, a grayscale image of the Moon's surface is shown with a context menu open. A red arrow points to the menu option "Draw lines towards sub-solar point (red) and Moon's north pole (blue)", which is currently selected. Another red arrow points to the "Mouse options..." option. On the right, the "Moon Display" control panel is visible. It includes a "Min Size" input field set to 0, a "Draw circles" checkbox, and buttons for "Dots", "Texture", "Overlay Dots", and "Re". Below these are radio buttons for "Low Resolution Shaded Relief", "High Resolution Shaded Relief", and "Clementine Photo Mosaic". At the bottom of the panel, there are input fields for "Gamma: 1.0", "Zoom: 11", "Rot: 0", and "Grid: 0". Below the panel, a status window displays the "Mouse Position (X = -0.1466 Y = 0.0618)" and provides coordinates: "Longitude = 39.86 W Latitude = 16.33 N". The line "Sun is at = 4.78 deg altitude and 268.79 deg azimuth" is circled in red. Below this, it shows "From ref. pt. = 1290.86 km (42.56 deg at 294.57 deg az)".

Mouse options...

- Draw lines towards sub-solar point (red) and Moon's north pole (blue)
- Go to location, mark or create aerial view...
- Identify nearest named feature
- Label nearest dot
- Add label...
- Set reference point
- Cancel (click here or press ESC key)

Moon Display

Min Size: 0 Draw circles

Dots Texture Overlay Dots Re

Low Resolution Shaded Relief
 High Resolution Shaded Relief
 Clementine Photo Mosaic

Gamma: 1.0 Zoom: 11 Rot: 0 Grid: 0

Mouse Position (X = -0.1466 Y = 0.0618)

Longitude = 39.86 W Latitude = 16.33 N

Sun is at = 4.78 deg altitude and 268.79 deg azimuth

From ref. pt. = 1290.86 km (42.56 deg at 294.57 deg az)

Convert and import image

Collect ephemeris data

The training directory contains a checklist of image and ephemeris data to be gathered. This data is used later in the SfS process.

What was the feature imaged:

Lunar lat and long.

Where it was taken from:

Earth lat and long., city name

When it was taken:

UTC Date and Time.

Image data:

Resolution pixels/meter of the uncropped image.

Gamma.

Number of pixel rows in the cropped image.

Number of pixel columns in the cropped image.

Ephemeris data:

Solar altitude and az on Moon when image was taken.

observer's sub-Earth lunar latitude and longitude.

Catalogue data:

Feature coordinates

Related UCLN control points near the feature.

Feature surface composition. (False ratio Clementine image)

Partial list of data to be gathered.

Convert and import image Collect ephemeris data

There are many sources for ephemeris data. Traditionally, Jamieson's Lunar Tool Kit 1997 has been used. Other options include LTVT and the USNO's Multi-Year Interactive Computer Almanac.

```

Moon
Apparent Topocentric Positions
Local Zenith and True North

Dubai
Location: E 55°17'00.0", N25°13'00.0",      Om
(Longitude referred to Greenwich meridian)

Moon
Topocentric Physical Ephemeris: Rotation Parameters
Distance
to Object
km
Dubai
Location: E 55°17'00.0", N25°13'00.0",      Om
(Longitude referred to Greenwich meridian)
394757.580
395432.899
396324.609
397363.436
398471.261

Selenographic Coordinates      Position Angles
Earth      Sun      Axis      Bright
Date      Time      Lat.  Long.  Lat.  Long.  .      Limb
(UT1)      h  m  s
2007 Mar 11 03:41:02.0      7.547  -6.705  0.11  275.33  9.310  100.80
2007 Mar 11 04:41:02.0      7.517  -6.913  0.11  274.82  9.177  100.62
2007 Mar 11 05:41:02.0      7.462  -7.083  0.11  274.31  9.028  100.41
2007 Mar 11 06:41:02.0      7.387  -7.207  0.12  273.81  8.858  100.17
2007 Mar 11 07:41:02.0      7.298  -7.278  0.12  273.30  8.667  99.91

```

The MICA quickly reports an observer's selenographic subEarth latitude and longitude for anywhere on the globe. Lunar distance is used to reduce the image's scale.

Convert and import image

Collect ephemeris data

E) Find your image scale						
1) Find the tilt factor at the feature						
Parameter	Value	Units				
Lunar longitude of object	60.0	deg				
Lunar latitude of object	30.0	deg				
Tilt factor	2.31	scalar				
2) Find the pixel scale of your lunar astrophotograph, adjusting for tilt factor						
	Name	Pixels fro	Altas size	Tilt factor	Pixels per km	
Object1	C. One	100	50.0	2.31	0.87	
Object2	C. Two	50	30.0	2.31	0.72	
Object3	C. Three	200	80.0	2.31	1.08	
Pixel/km conversion factor			0.89	scalar (average)		
Standard deviation			0.18			

▶ ▶ \ Calculators \
StoreImage_InfoLog \
StoreIPM_CauchyOmega_Evans2I | <

The Calculators tab in DEMCarlottoMethod.xls has convenience utility calculators that can aid in some reductions, but an authoritative source like Jamieson's Lunar Tools are a better option.

Convert and import image

Convert color source jpg to 8-bit or 16-bit greyscale fits

Most astronomical processing image packages have features to convert a fits or jpg image into an 8-bit greyscale image. The process shown here uses AIP4WIN.

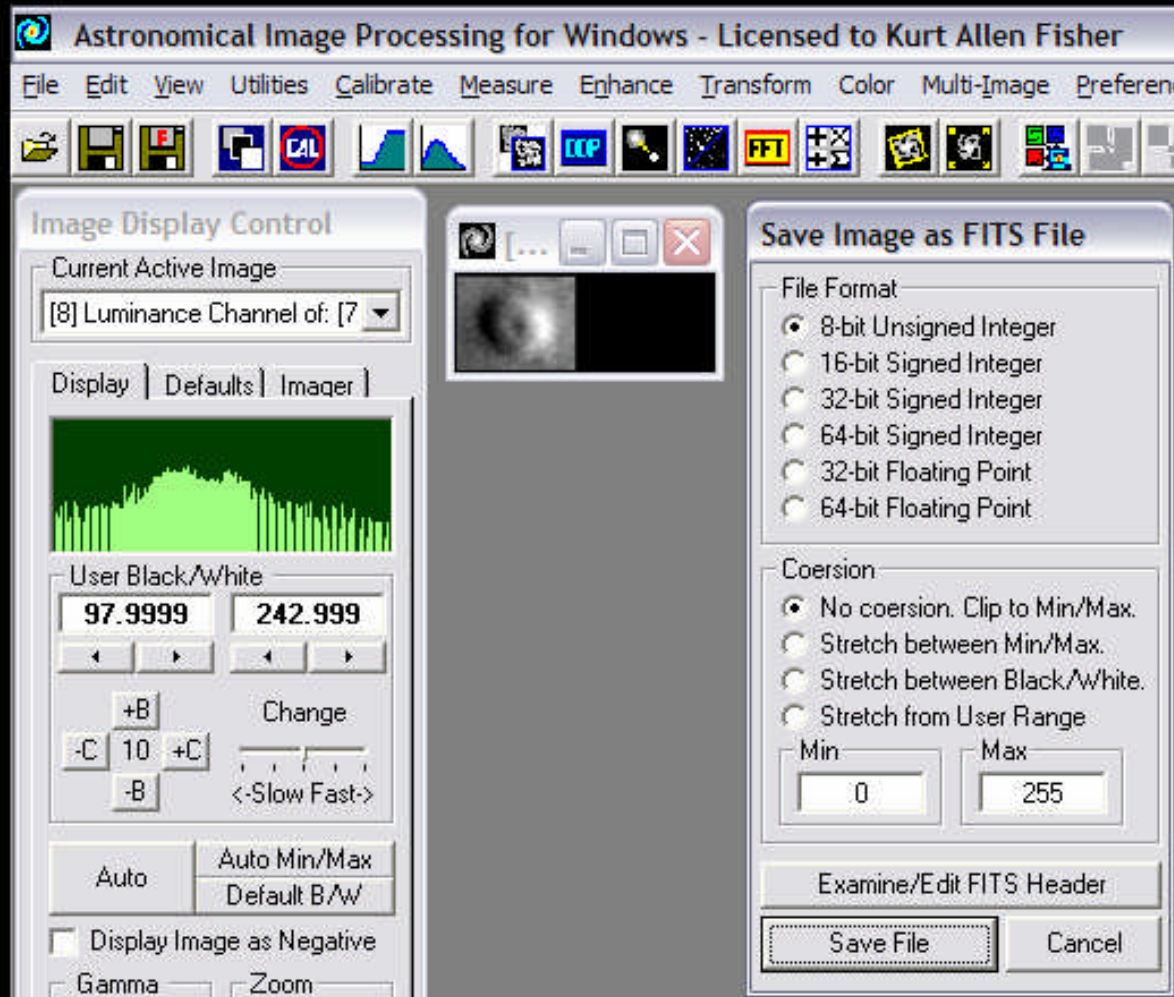


Converting a color jpg to greyscale in AIP4WIN.

Convert and import image

Convert color source jpg to 8-bit or 16-bit greyscale fits

Saving a color fits or jpg as an 8-bit greyscale using AIP4WIN.

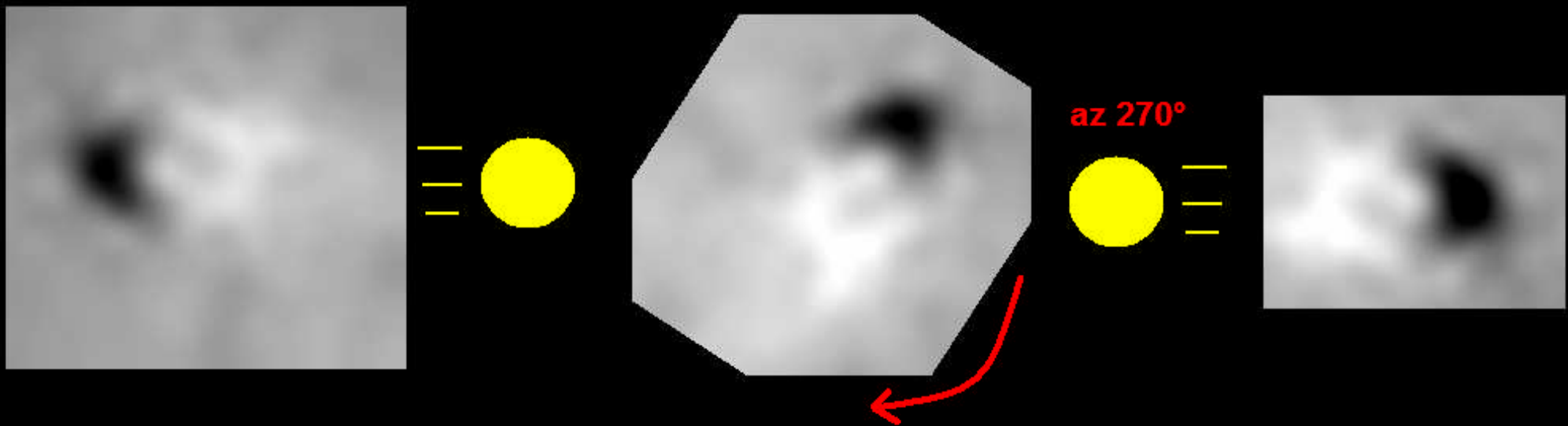


There is no advantage to a 16-bit as opposed to an 8-bit image for a 1000 meter high dome. If the image horizontal resolution is 300 meters, the extra brightness levels in a 16-bit image will not resolve in the DEM.

Convert and import image

Rotate the image so the apparent solar azimuth is 270°

Crop the image

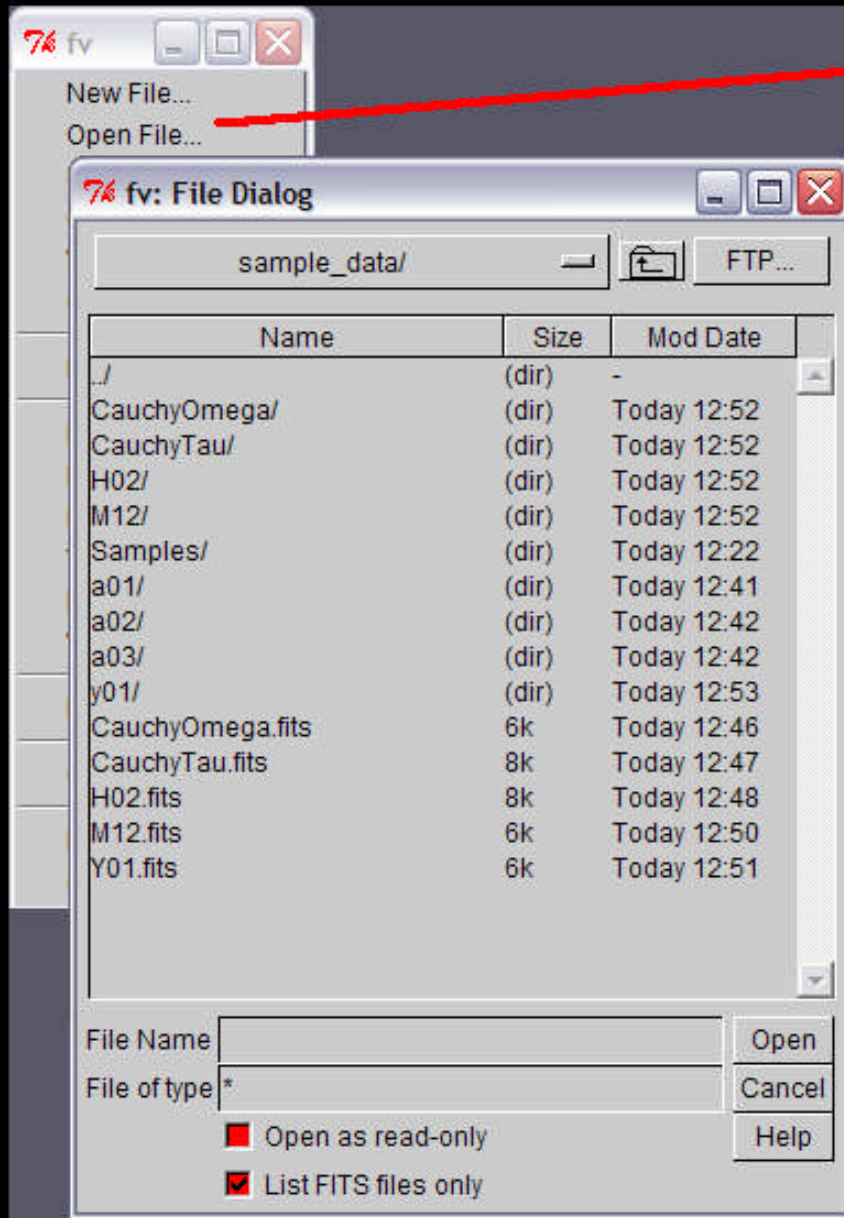


Convert and import image

Export the greyscale image to an NxM csv matrix

The working example shown here will use

HEARSAC's FV Tools to digitize the image's pixel brightnesses.



Open the image with the FV Tools "File Open" Menu.

Convert and import image

Export the greyscale image to an NxM csv matrix

Once the image is open, use the "Table" option to convert the image's pixel brightnesses to text data.

The screenshot shows the fv software interface. The top window, titled "fv: Summary of CauchyOmega.fits in C:/fv/sample_data/", displays a table with columns for Index, Extension, Type, Dimension, and View. The "Table" button in the View column is highlighted with a red arrow.

The bottom window, titled "fv: Image of CauchyOmega.fits[0] in C:/fv/sample_data/", shows the "Export as Text..." menu option highlighted with a red arrow. The table below displays the pixel brightness data.

Index	Extension	Type	Dimension	View
0	Primary	Image	53 X 42	Header Image Table

Index	Extension	Type	Dimension	View
2				
3				

42	1.4300000000E+002	1.4700000000E+002	1.5000000000E+002
41	1.4600000000E+002	1.5000000000E+002	1.5200000000E+002
40	1.4700000000E+002	1.4600000000E+002	1.4400000000E+002
39	1.4800000000E+002	1.4800000000E+002	1.4800000000E+002
38	1.4300000000E+002	1.4500000000E+002	1.4700000000E+002
37	1.3900000000E+002	1.4400000000E+002	1.4700000000E+002
36	1.4300000000E+002	1.4700000000E+002	1.5000000000E+002
35	1.4400000000E+002	1.4600000000E+002	1.4800000000E+002
34	1.4500000000E+002	1.4500000000E+002	1.4400000000E+002
33	1.5100000000E+002	1.4800000000E+002	1.4600000000E+002

Convert and import image

Export the greyscale image to an NxM csv matrix

The "Export to Text" option initiates conversion to a csv text file.
You can select a range of pixel rows and columns to export.

The screenshot shows the 'fv' software interface. A window titled 'fv: Summary of CauchyOmega.fits' displays a table with columns: Index, Extension, Type, Dimension, and View. The table shows a single entry with Index 0, Extension Primary, Type Image, and Dimension 53 X 42. Below this, a window titled 'fv: Image of CauchyOmega.fits[0]' shows a grid of image data. A dialog box titled 'fv: Export to file options' is open, showing the following settings:

- Rows:**
 - All
 - From: 1 To: 42
 - Selection
- Columns:**
 - All
 - From: 1 To: 53
 - Print Row Numbers
- Output Format:**
 - CSV format (7*8*...format)
 - User-defined separator (specify below)
- Column Separator (for example: , or |... default is **):** [Empty field]
- Save** button is highlighted.

Convert and import image

Import the csv data as an Excel worksheet

HEARSAC FV Tools has now created a csv file that contains the rows and columns of pixels digitized as brightness integers between 0 and 255.

In the following step, you will importing this csv file into a temporary Excel spreadsheet. In a later final step, this temporary Excel worksheet will be copied into DEMCarlottoMethod.xls.

Convert and import image

Import the csv data as an Excel worksheet

Use Excel's "File | Open" option to open your csv text file. Opening the csv file start's Excel's text import wizard.

Microsoft Excel - Book1

File Edit View Insert Format Tools Data Window Help PDF Create!

Text Import Wizard - Step 1 of 3

The Text Wizard has determined that your data is Delimited.
If this is correct, choose Next, or choose the data type that best describes your data.

Original data type

Choose the file type that best describes your data:

- Delimited - Characters such as commas or tabs separate each field.
- Fixed width - Fields are aligned in columns with spaces between each field.

Start import at row: 1 File origin: 437 : OEM United States

Preview of file C:\fv\sample_data\CauchyOmega_t0.txt.

1	"1.4300000000E+002"	"1.4700000000E+002"	"1.5000000000E+002"	"1.5300000000E+002"
2	"1.4600000000E+002"	"1.5000000000E+002"	"1.5200000000E+002"	"1.5500000000E+002"
3	"1.4700000000E+002"	"1.4600000000E+002"	"1.4400000000E+002"	"1.4300000000E+002"
4	"1.4800000000E+002"	"1.4800000000E+002"	"1.4800000000E+002"	"1.4800000000E+002"
5	"1.4300000000E+002"	"1.4500000000E+002"	"1.4700000000E+002"	"1.4900000000E+002"

Cancel < Back Next > Finish

Convert and import image

Import the csv data as an Excel worksheet

Set the option to separate fields using a comma character.

Microsoft Excel - Book1

File Edit View Insert Format Tools Data Window Help PDF Create!

A1 fx

A B C D E F G H I

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

Text Import Wizard - Step 2 of 3

This screen lets you set the delimiters your data contains. You can see how your text is affected in the preview below.

Delimiters

Tab Semicolon Comma Treat consecutive delimiters as one

Space Other: Text qualifier: "

Data preview

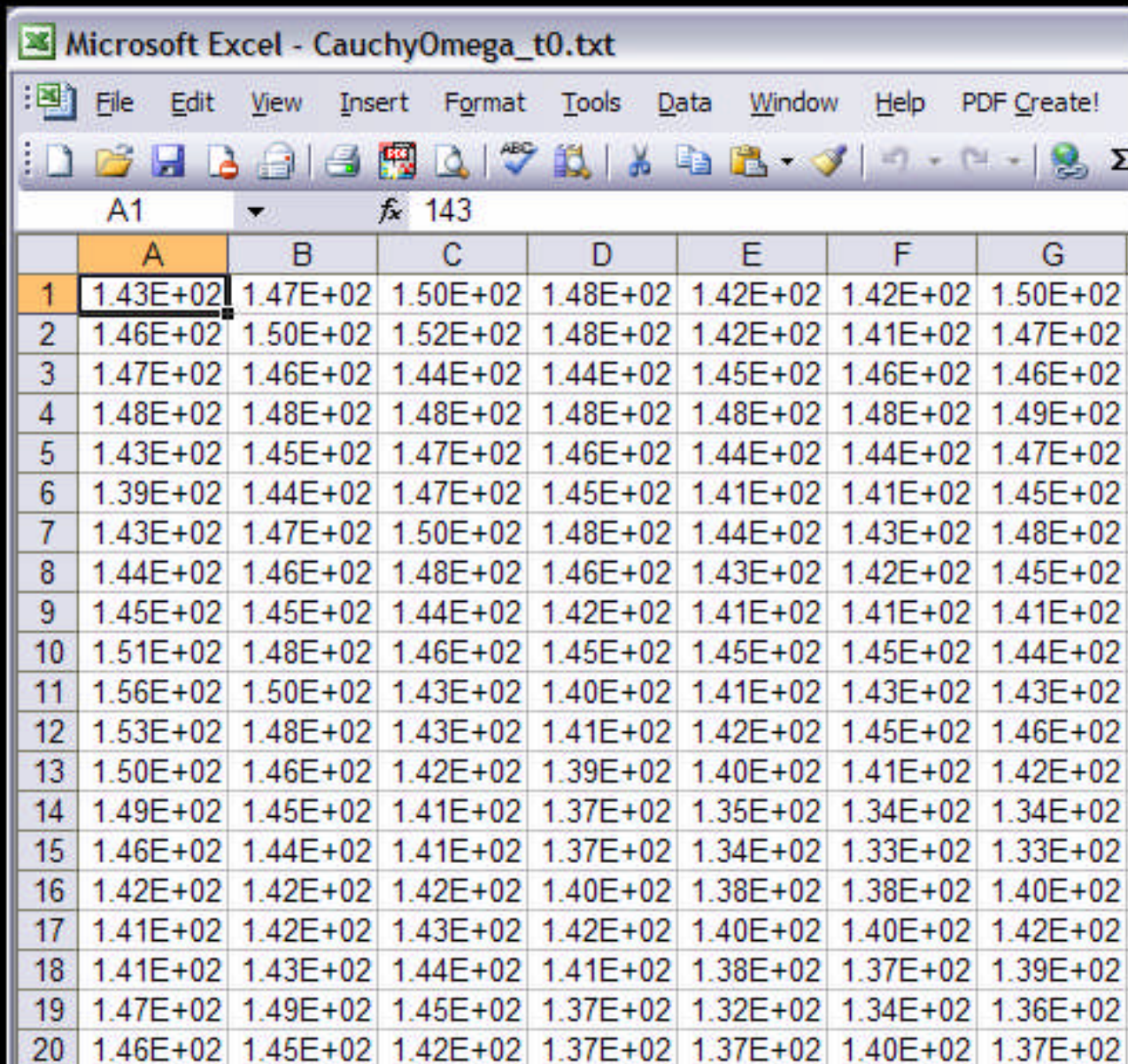
1.4300000000E+002	1.4700000000E+002	1.5000000000E+002	1.4800000000
1.4600000000E+002	1.5000000000E+002	1.5200000000E+002	1.4800000000
1.4700000000E+002	1.4600000000E+002	1.4400000000E+002	1.4400000000
1.4800000000E+002	1.4800000000E+002	1.4800000000E+002	1.4800000000
1.4300000000E+002	1.4500000000E+002	1.4700000000E+002	1.4600000000

Cancel < Back Next > Finish

Convert and import image

Import the csv data as an Excel worksheet

The import wizard will import the text in scientific notation.



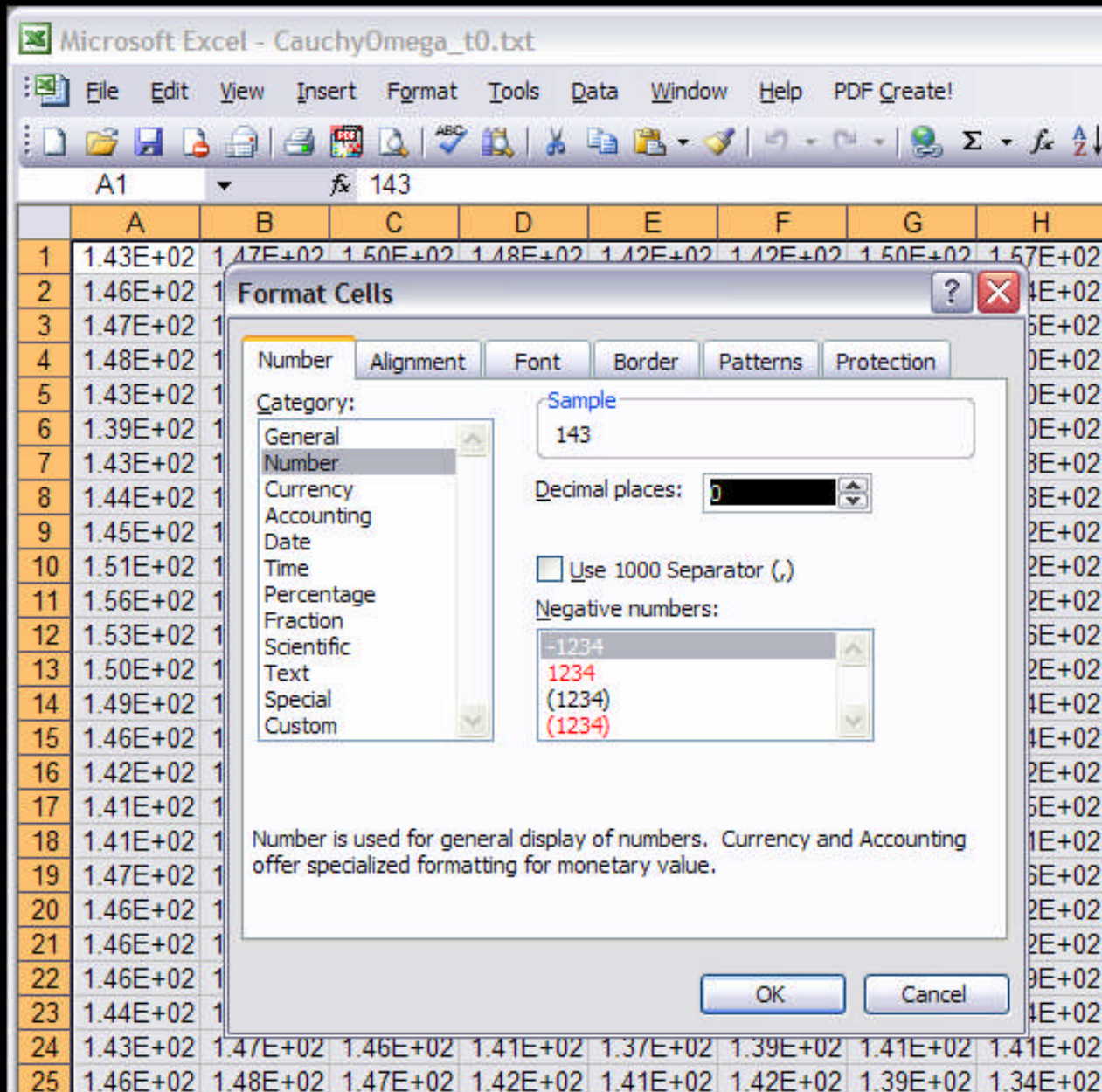
The screenshot shows a Microsoft Excel window titled "Microsoft Excel - CauchyOmega_t0.txt". The menu bar includes File, Edit, View, Insert, Format, Tools, Data, Window, Help, and PDF Create!. The toolbar contains various icons for file operations and editing. The active cell is A1, containing the value 143. The worksheet displays a grid of data from row 1 to 20 and column A to G. All values are in scientific notation (E+02).

	A	B	C	D	E	F	G
1	1.43E+02	1.47E+02	1.50E+02	1.48E+02	1.42E+02	1.42E+02	1.50E+02
2	1.46E+02	1.50E+02	1.52E+02	1.48E+02	1.42E+02	1.41E+02	1.47E+02
3	1.47E+02	1.46E+02	1.44E+02	1.44E+02	1.45E+02	1.46E+02	1.46E+02
4	1.48E+02	1.48E+02	1.48E+02	1.48E+02	1.48E+02	1.48E+02	1.49E+02
5	1.43E+02	1.45E+02	1.47E+02	1.46E+02	1.44E+02	1.44E+02	1.47E+02
6	1.39E+02	1.44E+02	1.47E+02	1.45E+02	1.41E+02	1.41E+02	1.45E+02
7	1.43E+02	1.47E+02	1.50E+02	1.48E+02	1.44E+02	1.43E+02	1.48E+02
8	1.44E+02	1.46E+02	1.48E+02	1.46E+02	1.43E+02	1.42E+02	1.45E+02
9	1.45E+02	1.45E+02	1.44E+02	1.42E+02	1.41E+02	1.41E+02	1.41E+02
10	1.51E+02	1.48E+02	1.46E+02	1.45E+02	1.45E+02	1.45E+02	1.44E+02
11	1.56E+02	1.50E+02	1.43E+02	1.40E+02	1.41E+02	1.43E+02	1.43E+02
12	1.53E+02	1.48E+02	1.43E+02	1.41E+02	1.42E+02	1.45E+02	1.46E+02
13	1.50E+02	1.46E+02	1.42E+02	1.39E+02	1.40E+02	1.41E+02	1.42E+02
14	1.49E+02	1.45E+02	1.41E+02	1.37E+02	1.35E+02	1.34E+02	1.34E+02
15	1.46E+02	1.44E+02	1.41E+02	1.37E+02	1.34E+02	1.33E+02	1.33E+02
16	1.42E+02	1.42E+02	1.42E+02	1.40E+02	1.38E+02	1.38E+02	1.40E+02
17	1.41E+02	1.42E+02	1.43E+02	1.42E+02	1.40E+02	1.40E+02	1.42E+02
18	1.41E+02	1.43E+02	1.44E+02	1.41E+02	1.38E+02	1.37E+02	1.39E+02
19	1.47E+02	1.49E+02	1.45E+02	1.37E+02	1.32E+02	1.34E+02	1.36E+02
20	1.46E+02	1.45E+02	1.42E+02	1.37E+02	1.37E+02	1.40E+02	1.37E+02

Convert and import image

Import the csv data as an Excel worksheet

Select all the cells and reformat them as integers.



Microsoft Excel - CauchyOmega_t0.txt

File Edit View Insert Format Tools Data Window Help PDF Create!

A1 143

Format Cells

Number Alignment Font Border Patterns Protection

Category: Sample
143

Decimal places: 0

Use 1000 Separator (,)

Negative numbers:
-1234
1234
(1234)
(1234)

Number is used for general display of numbers. Currency and Accounting offer specialized formatting for monetary value.

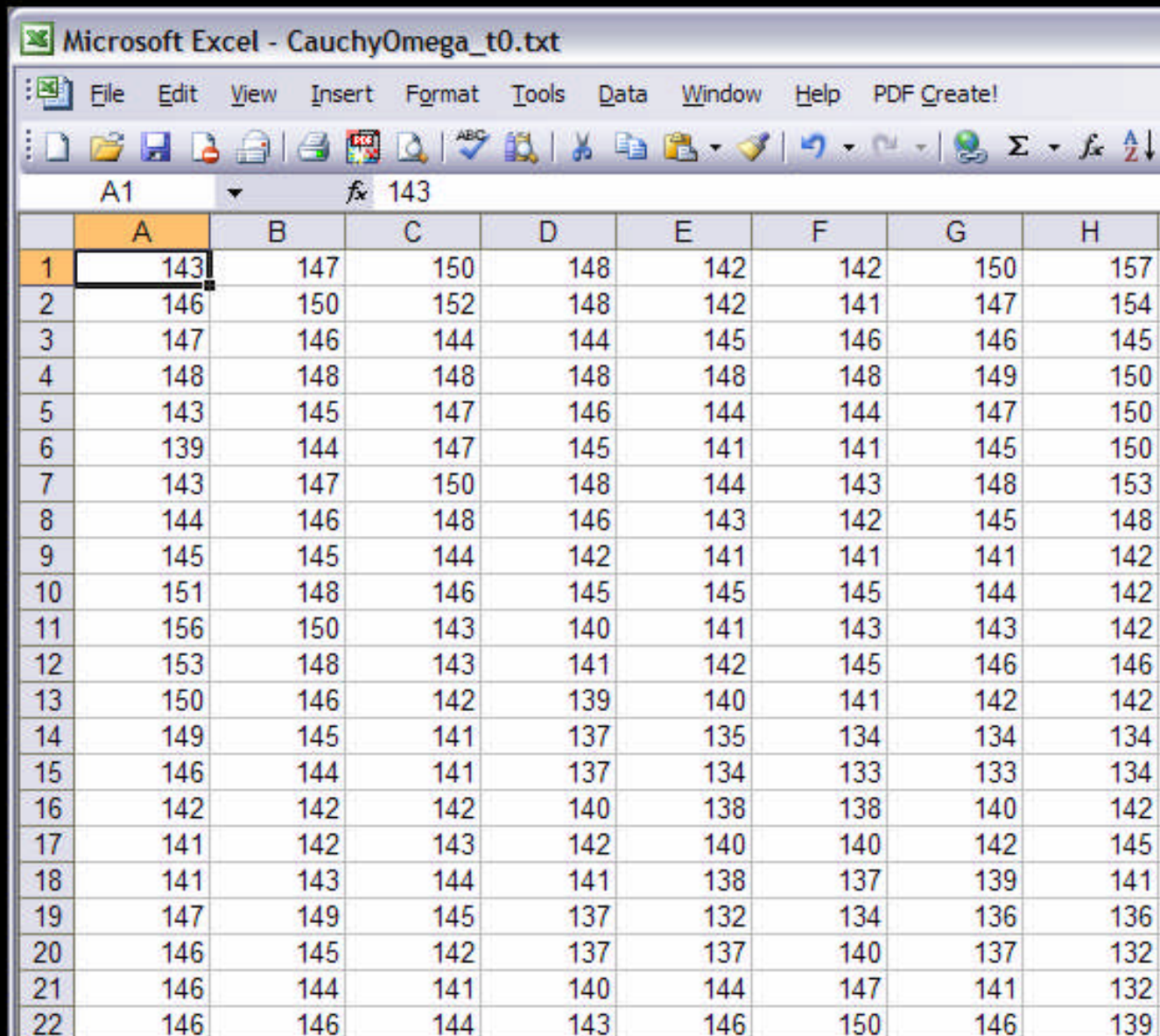
OK Cancel

	A	B	C	D	E	F	G	H
1	1.43E+02	1.47E+02	1.50E+02	1.48E+02	1.42E+02	1.42E+02	1.50E+02	1.57E+02
2	1.46E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02
3	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02
4	1.48E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02
5	1.43E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02
6	1.39E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02
7	1.43E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02
8	1.44E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02
9	1.45E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02
10	1.51E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02
11	1.56E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02
12	1.53E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02
13	1.50E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02
14	1.49E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02
15	1.46E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02
16	1.42E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02
17	1.41E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02
18	1.41E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02
19	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02
20	1.46E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02
21	1.46E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02
22	1.46E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02
23	1.44E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02
24	1.43E+02	1.47E+02	1.46E+02	1.41E+02	1.37E+02	1.39E+02	1.41E+02	1.41E+02
25	1.46E+02	1.48E+02	1.47E+02	1.42E+02	1.41E+02	1.42E+02	1.39E+02	1.34E+02

Convert and import image

Import the csv data as an Excel worksheet

After reformatting, the image pixel value map is not ready for copying into DEMCarlottoMethod.xls.

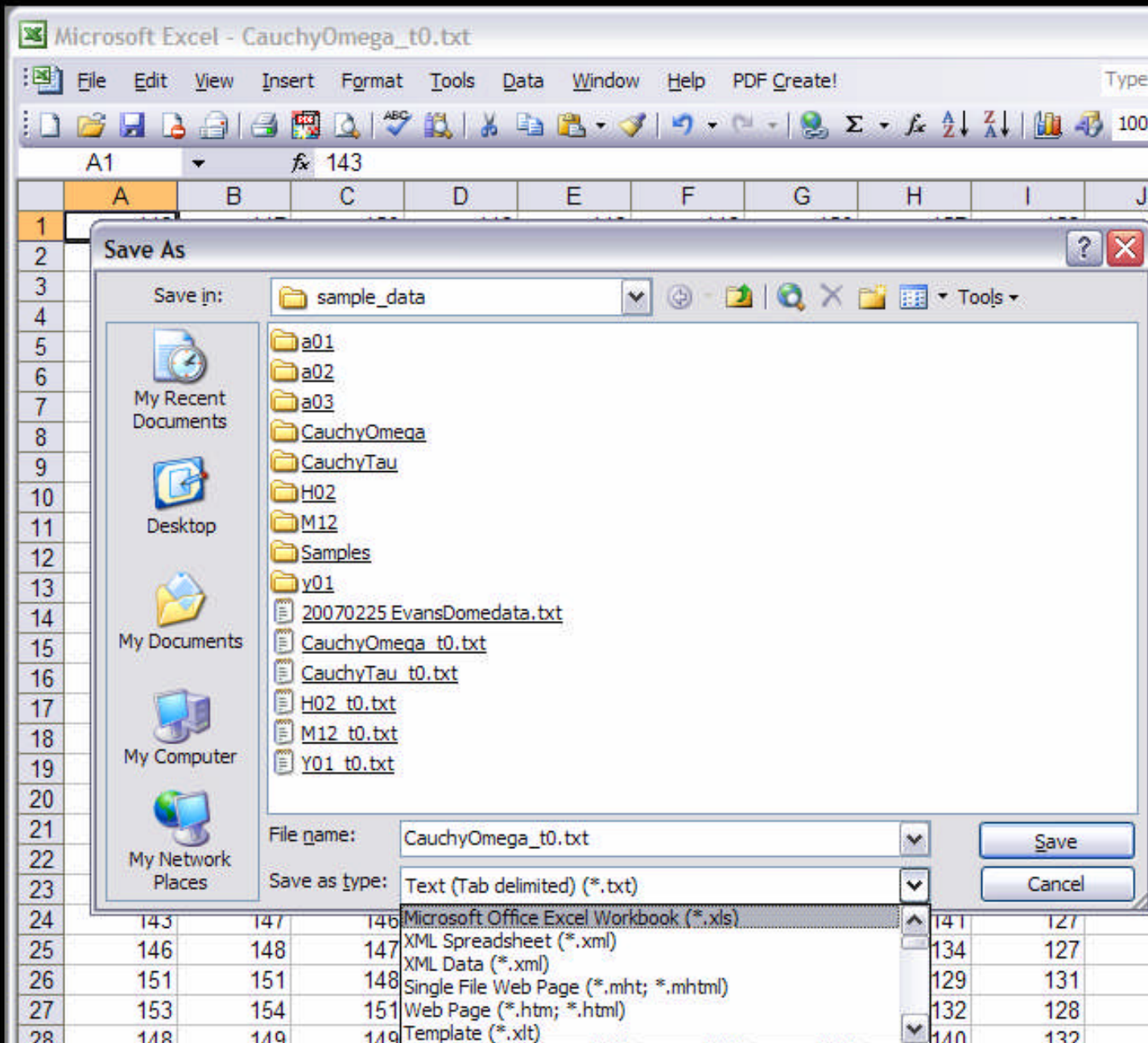


	A	B	C	D	E	F	G	H
1	143	147	150	148	142	142	150	157
2	146	150	152	148	142	141	147	154
3	147	146	144	144	145	146	146	145
4	148	148	148	148	148	148	149	150
5	143	145	147	146	144	144	147	150
6	139	144	147	145	141	141	145	150
7	143	147	150	148	144	143	148	153
8	144	146	148	146	143	142	145	148
9	145	145	144	142	141	141	141	142
10	151	148	146	145	145	145	144	142
11	156	150	143	140	141	143	143	142
12	153	148	143	141	142	145	146	146
13	150	146	142	139	140	141	142	142
14	149	145	141	137	135	134	134	134
15	146	144	141	137	134	133	133	134
16	142	142	142	140	138	138	140	142
17	141	142	143	142	140	140	142	145
18	141	143	144	141	138	137	139	141
19	147	149	145	137	132	134	136	136
20	146	145	142	137	137	140	137	132
21	146	144	141	140	144	147	141	132
22	146	146	144	143	146	150	146	139

Convert and import image

Import the csv data as an Excel worksheet

Finally, save your text file from Excel as an Excel spreadsheet.



Convert and import image Working files created to this point.

8-bit rectified greyscale
conversion fits-jpg

Original color fits image

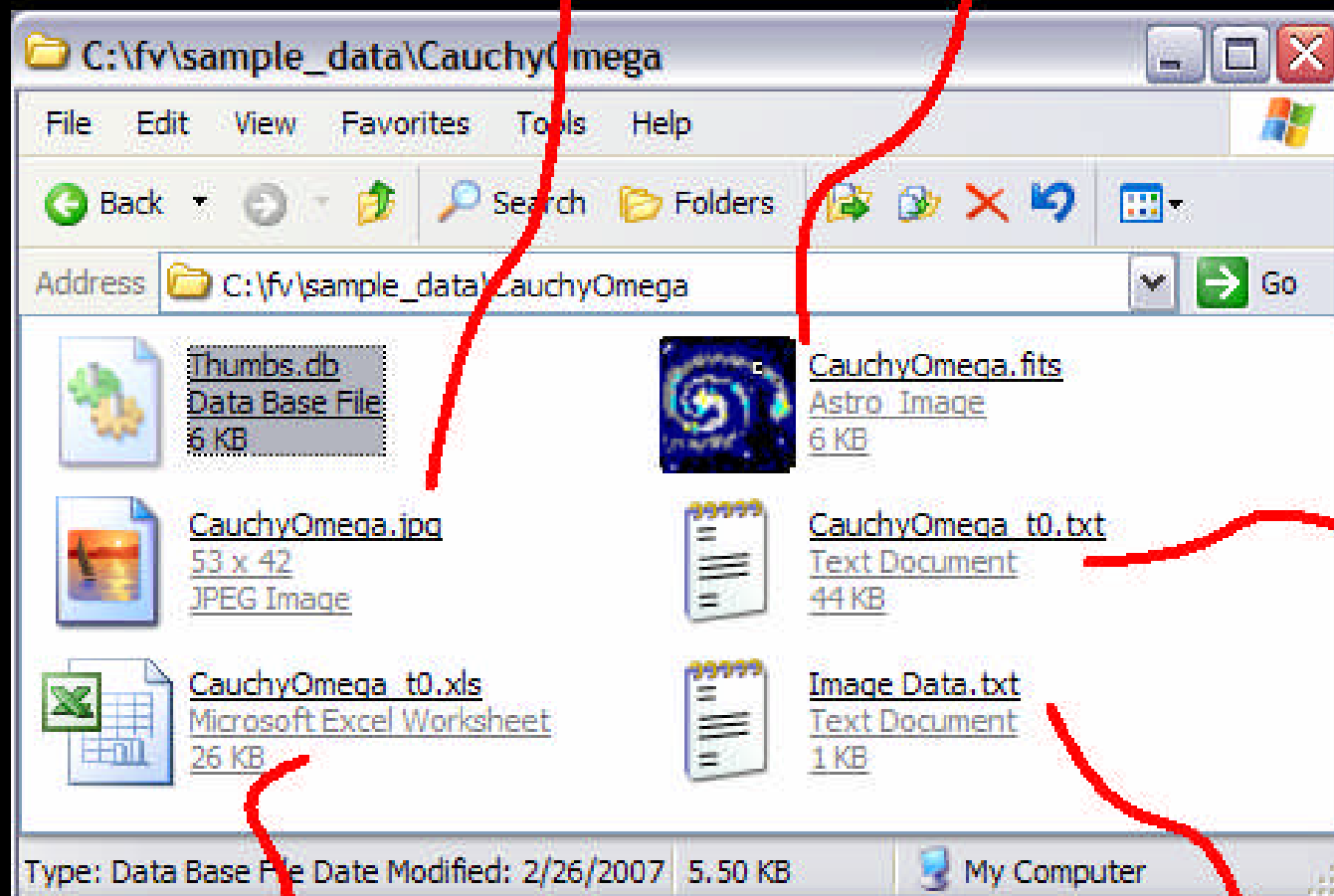


Image
converted to
csv data

csv data saved as
an Excel worksheet

Notes on image characteristics
and ephemeris data

Convert and import image

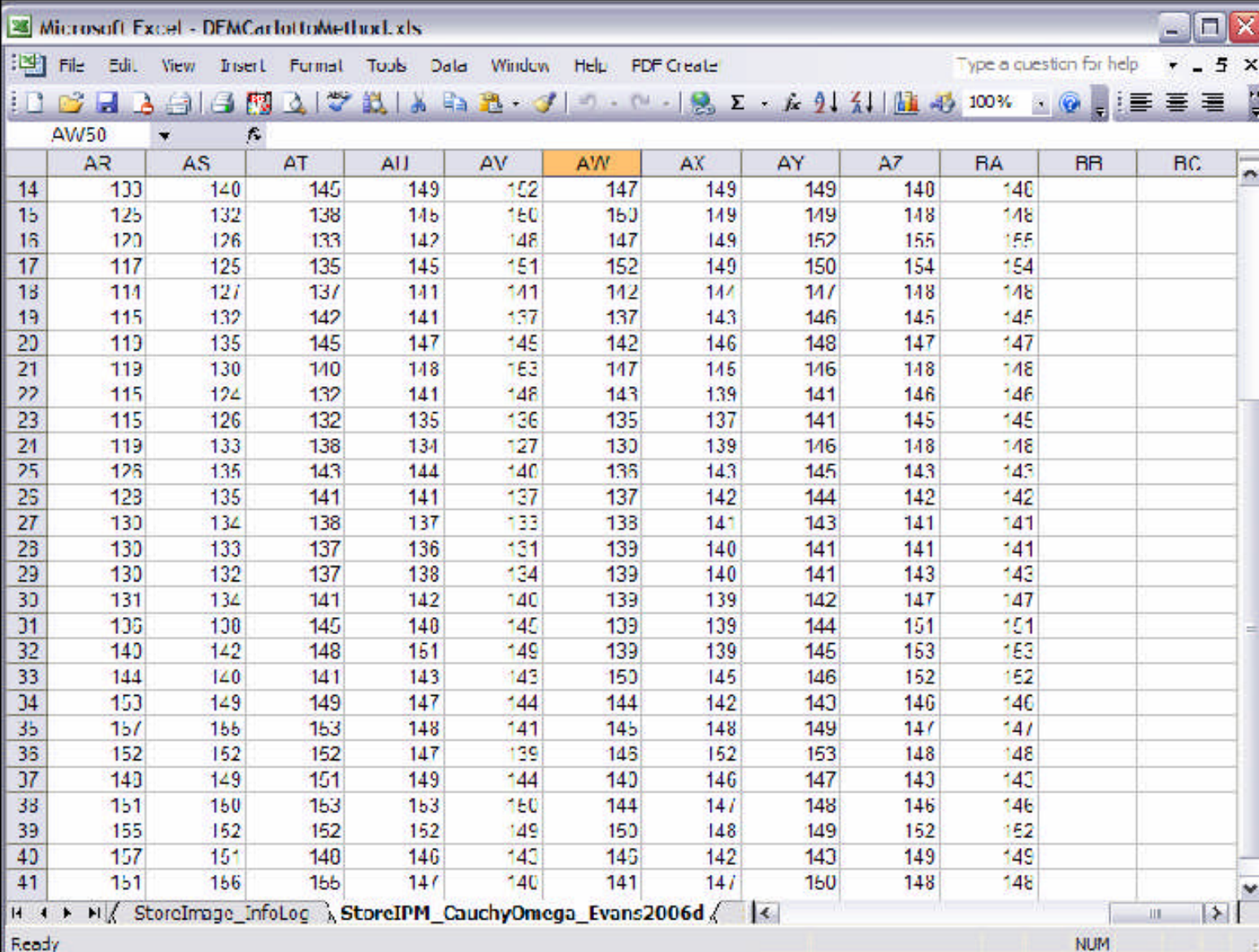
Copy/move the NxM matrix in the Excel worksheet to a storage worksheet in DEMCarlottaMethod.xls

The next step in the process involves moving the image pixel value map in the temporary Excel worksheet into DEMCarlottaMethod.xls.

Convert and import image

Copy/move the NxM matrix in the Excel worksheet to a storage worksheet in DEMCarlottoMethod.xls

Open DEMCarlottoMethod.xls



Microsoft Excel - DEMCarlottoMethod.xls

File Edit View Insert Format Tools Data Window Help PDF Create

Type a question for help

AW50

	AR	AS	AT	AIJ	AV	AW	AX	AY	A7	RA	RR	RC
14	133	140	145	149	152	147	149	149	140	140		
15	125	132	138	146	160	153	149	149	148	148		
16	120	126	133	142	148	147	149	152	155	155		
17	117	125	135	145	151	152	149	150	154	154		
18	114	127	137	141	141	142	144	147	148	148		
19	115	132	142	141	137	137	143	146	145	145		
20	113	135	145	147	145	142	146	148	147	147		
21	119	130	140	148	163	147	145	146	148	148		
22	115	124	132	141	148	143	139	141	146	146		
23	115	126	132	135	136	135	137	141	145	145		
24	119	133	138	134	127	130	139	146	148	148		
25	126	135	143	144	140	136	143	145	143	143		
26	123	135	141	141	137	137	142	144	142	142		
27	130	134	138	137	133	138	141	143	141	141		
28	130	133	137	136	131	139	140	141	141	141		
29	130	132	137	138	134	139	140	141	143	143		
30	131	134	141	142	140	139	139	142	147	147		
31	136	130	145	140	145	139	139	144	151	151		
32	140	142	148	151	149	139	139	145	153	153		
33	144	140	141	143	143	150	145	146	152	152		
34	153	149	149	147	144	144	142	143	146	146		
35	157	156	153	148	141	145	148	149	147	147		
36	152	152	152	147	139	145	152	153	148	148		
37	143	149	151	149	144	143	146	147	143	143		
38	151	150	153	153	160	144	147	148	146	146		
39	155	152	152	152	149	150	148	149	152	152		
40	157	151	140	146	143	145	142	143	149	149		
41	151	156	155	147	140	141	147	150	148	148		

Ready NUM

Convert and import image

Copy/move the NxM matrix in the Excel worksheet to a storage worksheet in DEMCarlottoMethod.xls

Open the temporary spreadsheet that contains your image pixel value map.

The screenshot shows a Microsoft Excel window titled "CauchyOmega_t0.xls". The spreadsheet contains a 20x13 grid of numerical data. A context menu is open over the grid, with the "Move or Copy..." option selected. Red arrows indicate the process of right-clicking on the worksheet tab "CauchyOmega_t0" and then clicking on the "Move or Copy..." option in the context menu.

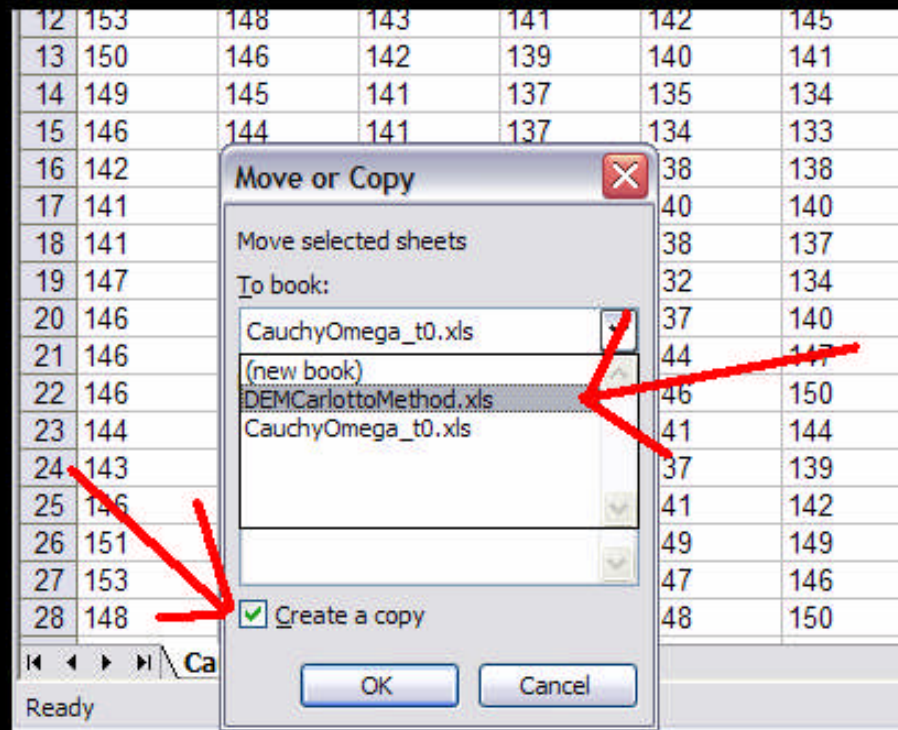
	A	B	C	D	E	F	G	H	I	J	K	L
1	143	147	150	148	142	142	150	157	153	149	148	152
2	146	150	152	148	142	141	147	154	151	147	146	150
3	147	146	144	144	145	146	146	145	152	155	156	152
4	148	148	148	148	143	148	149	150	150	154	155	152
5	143	145	147	146	144	144	147	150	147	151	153	151
6	139	144	147	145	141	141	145	150	146	149	151	148
7	143	147	150	148	144	143	148	153	149	152	153	149
8	144	146	148	146	143	142	145	148	152	155	155	150
9	145	145	144	142	141	141	141	142	150	152	152	147
10	151	148	146	145	145	146	144	142	144	146	147	142
11	156	150	143	140	141	143	143	142	147	142	142	140
12	153	148	143	141	142	145	146	146	139	138	137	135
13	150	146	142	139	140	141	142	142	134	133	132	129
14	149	145	141	137	135	134	134	134	130	130	130	128
15	146	144	141	137	134	133	133	134	130	131	130	128
16	142	142	142	140	138	138	140	142	133	131	128	123
17	141	142	143	142	140	140	142	145	136	130	123	114
18	141	143	144	141	139	137	139	141	136	129	118	107
19	147	149	145	137	132	134	136	136	133	126	115	106
20	146	145			137	140	137	132	126	118	108	100
21	146	144			144	147	141	132	124	115	104	96
22	146	146			145	150	146	139	129	119	106	97
23	144	147			141	144	145	144	131	119	106	98
24	143	147			147	139	141	141	127	115	103	97
25	146	148			144	142	139	134	127	115	103	99
26	151	141			149	149	140	129	131	120	107	102
27	153	154			147	146	140	132	128	122	117	113
28	148	144			143	150	146	140	132	126	119	113

Then right-click on the worksheet tab to begin the move-copy process.

Convert and import image

Copy/move the NxM matrix in the Excel worksheet to a storage worksheet in DEMCarlottoMethod.xls

In the move dialogue box, set the target "to book" to DEMCarlottoMethod.xls.

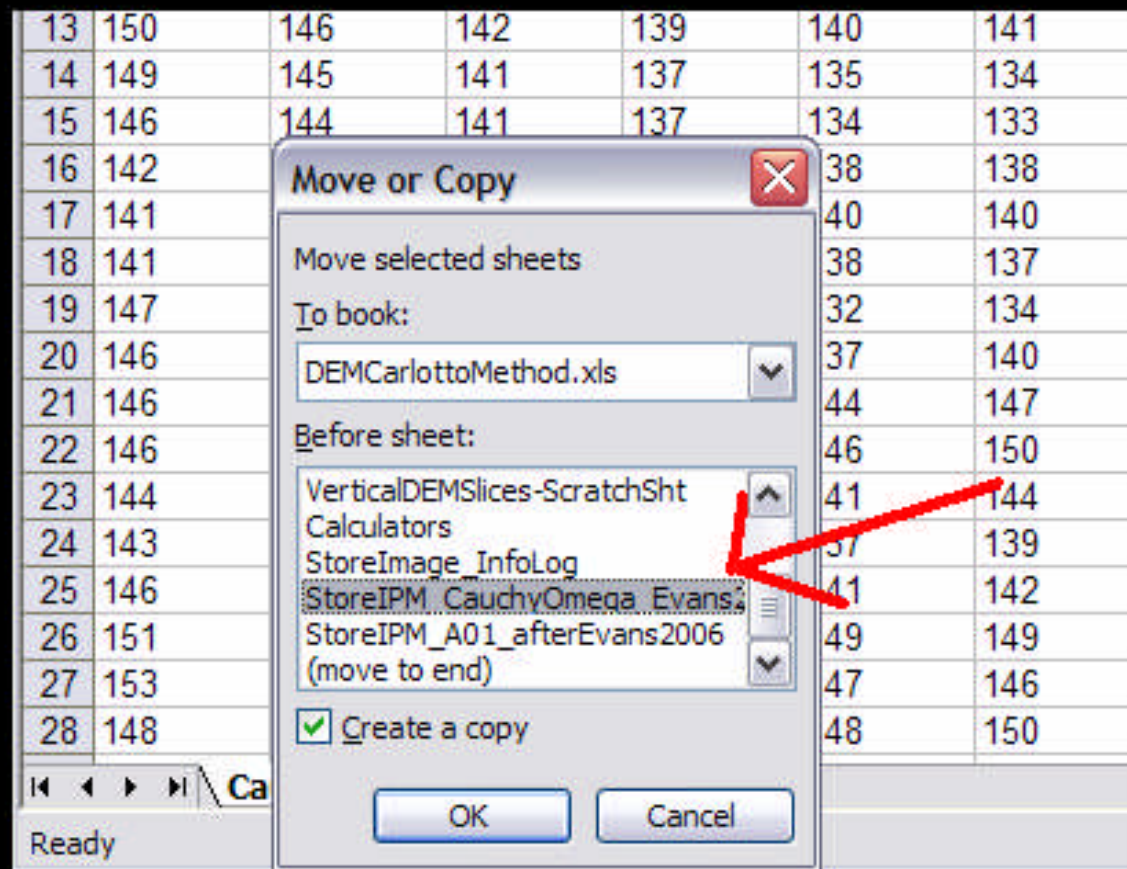


Check the "Create a copy" option button.

Convert and import image

Copy/move the NxM matrix in the Excel worksheet to a storage worksheet in DEMCarlottoMethod.xls

Again responding to the move/copy worksheet dialogue, set the position inside DEMCarlottoMethod.xls where you want to copy your new image pixel value map.



In the example, we will move the new image pixel map for storage after the StoreImage_InfoLog worksheet.

Convert and import image

Copy/move the NxM matrix in the Excel worksheet to a storage worksheet in DEMCarlottoMethod.xls

Executing the move/copy operation copies your new image data for storage in DEMCarlottoMethod.xls.

23	144	147	147	142	141	144	145	144	131
24	143	147	146	141	137	139	141	141	127
25	146	148	147	142	141	142	139	134	127
26	151	151	148	147	149	149	140	129	131
27	153	154	151	148	147	146	140	132	128
28	148	149	149	147	148	150	146	140	132

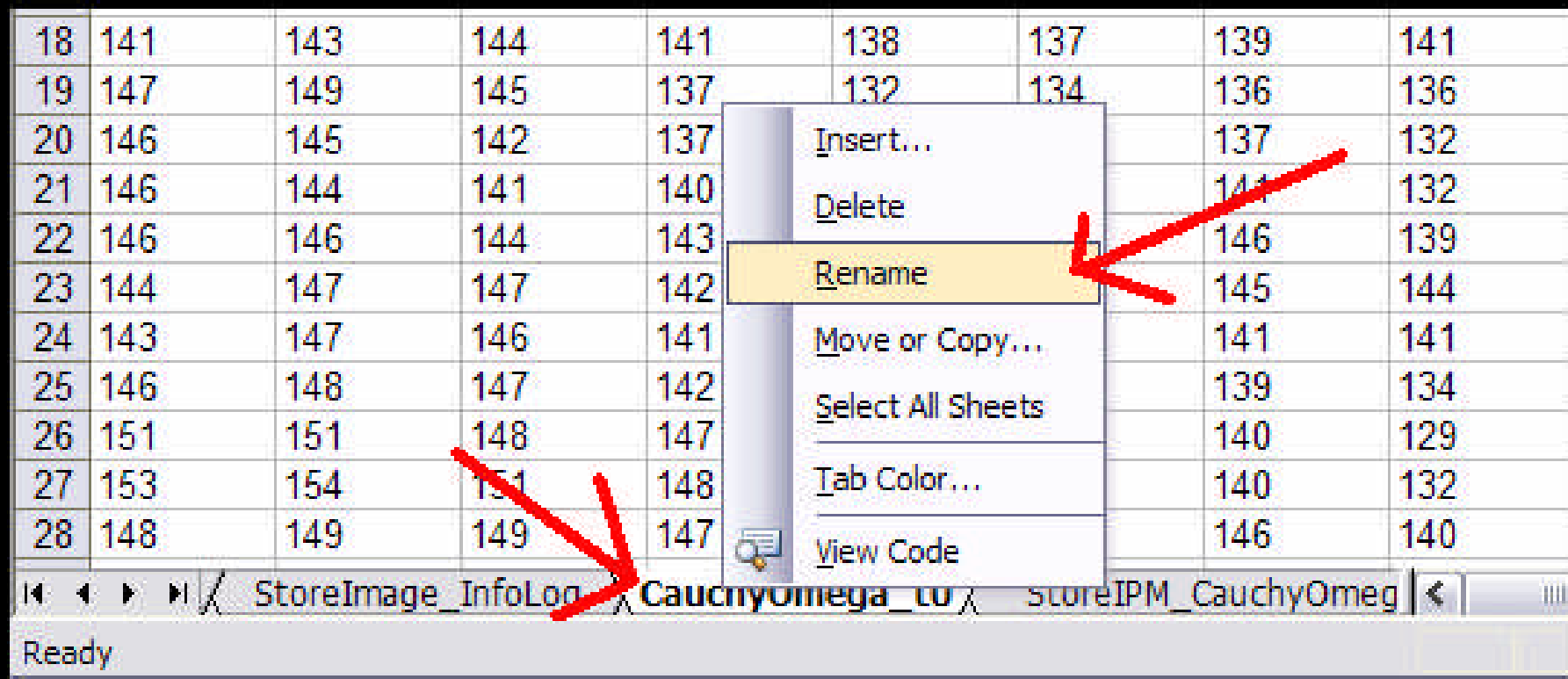
Navigation: StoreImage_InfoLog \ CauchyOmega_t0 \ StoreIPM_CauchyOmegeg | < | |||

Ready

Convert and import image

Copy/move the NxM matrix in the Excel worksheet to a storage worksheet in DEMCarlottaMethod.xls

This worksheet inside DEMCarlottaMethod.xls is a permanent storage worksheet for the image's pixel values. To rename the worksheet something meaningful, right-click the worksheet's tab.



The screenshot shows an Excel spreadsheet with a grid of numerical data. A context menu is open over the worksheet tab 'CauchyOmega_tu', with the 'Rename' option highlighted. Red arrows point to the 'Rename' option and the worksheet tab. The spreadsheet data is as follows:

18	141	143	144	141	138	137	139	141
19	147	149	145	137	132	134	136	136
20	146	145	142	137			137	132
21	146	144	141	140			144	132
22	146	146	144	143			146	139
23	144	147	147	142			145	144
24	143	147	146	141			141	141
25	146	148	147	142			139	134
26	151	151	148	147			140	129
27	153	154	151	148			140	132
28	148	149	149	147			146	140

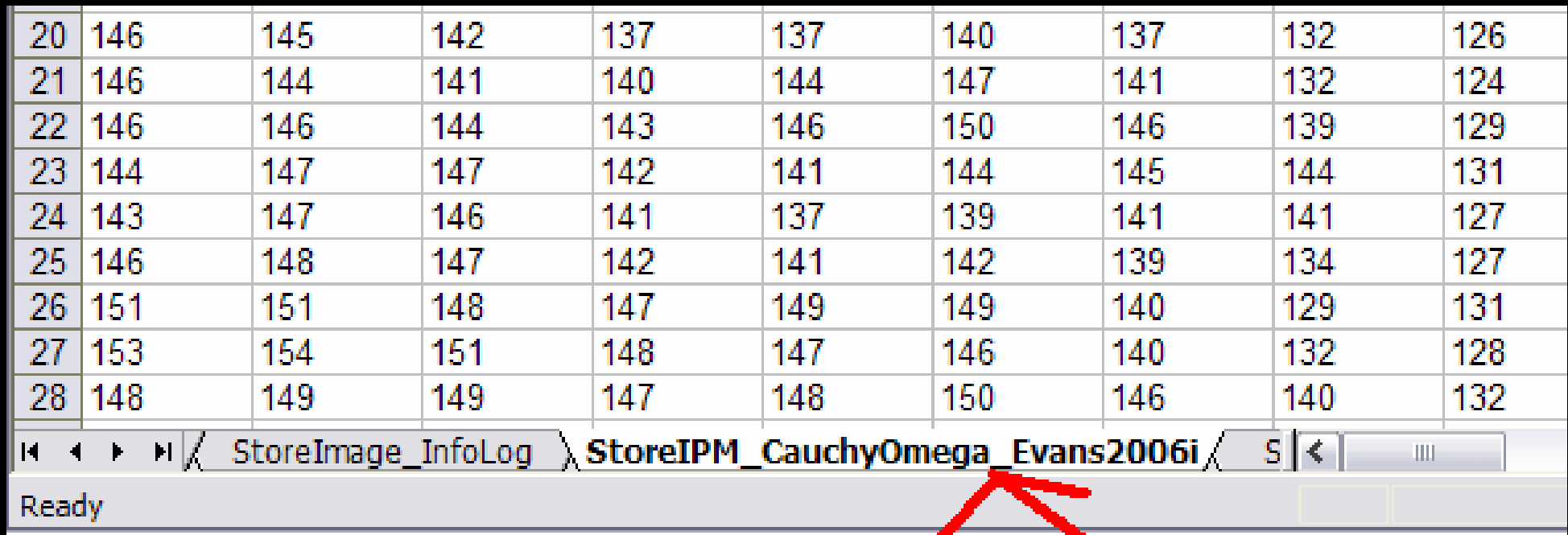
The worksheet tabs at the bottom are: StoreImage_InfoLog, CauchyOmega_tu, and ScoreIPM_CauchyOmega. The status bar shows 'Ready'.

Convert and import image

Copy/move the NxM matrix in the Excel worksheet to a storage worksheet in DEMCarlottoMethod.xls

A new name has been assigned to the stored data.

20	146	145	142	137	137	140	137	132	126
21	146	144	141	140	144	147	141	132	124
22	146	146	144	143	146	150	146	139	129
23	144	147	147	142	141	144	145	144	131
24	143	147	146	141	137	139	141	141	127
25	146	148	147	142	141	142	139	134	127
26	151	151	148	147	149	149	140	129	131
27	153	154	151	148	147	146	140	132	128
28	148	149	149	147	148	150	146	140	132



Ready

Convert and import image

Copy/move the NxM matrix in the Excel worksheet to a storage worksheet in DEMCarlottoMethod.xls

Finally, update the image's data to the image info log.

The screenshot shows a Microsoft Excel window titled "Microsoft Excel - DEMCarlottoMethod.xls" with the following data table:

	F	G	H	I	J	K	L	M	N	O
1	Observer	Observer	Observer	Feature	Feature_I	Image sca	Image sca	Image sca	Solar altit	Base t
2	Unknown	Unknown	Unknown	7.23	38.32	363	meters/px	10%	4.19	Unknov
3	Unknown	Unknown	Unknown	7.23	38.32	363	meters/px	10%	4.19	Unknov
4	Unknown	Unknown	Unknown	21.96	7.66	321	meters/px	10%	2.68	Unknov
11										

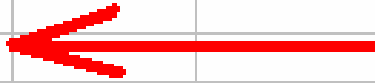
A red arrow points from the cell containing "7.66" in the table to a file named "Image Data.txt" in a Windows Explorer window. The Explorer window shows a list of files:

- JPEG Image (44 KB)
- CauchyOmega t0.xls (Microsoft Excel Worksheet, 26 KB)
- Image Data.txt (Text Document, 1 KB)

The Explorer window also shows a status bar at the bottom: "Type: Data Base File Date Modified: 2/26/2007 5.50 KB My Computer".

Convert and import image

Normally, the next step would be to process the image data into a DEM by moving the new image pixel value map to the working image pixel map. That process was covered in the "Spreadsheet Parts" presentation beginning at Slide 40.

1	Shape from Shading Utility after Carlotto 1996 and Evans 2006				Version:	pre-alpha
2	for Microsoft Office for Windows (not compatible with MS Office for Mac)					
3						
4	A - Process image to digital elevation map					
5						
6	Step 1 - Paste source image's luminance pixel values into worksheet ImagePixelValueMap					
7	as an NxM matrix					
8						
9	Step 2 - Identify the range of the image pixel values to this spreadsheet					
10						
11	2a	Enter the upper left-hand pixel cell name:	\$A\$1	as absolute cell reference, e		
12	2b	Enter the lower right-hand pixel cell name:	\$AJ\$26	as absolute cell reference, e		
13	2c	Click button to identify and name the range:				
14	Name pixel range					
15		Current value:	ImagePixelValueMap!\$A\$1:\$AJ\$26			
16	Clear Image Pixel Map					
17						
18						

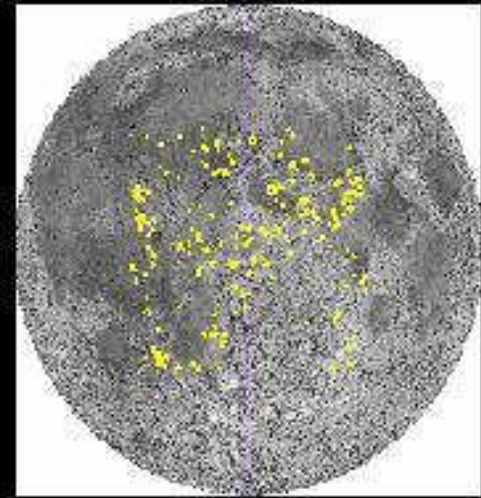
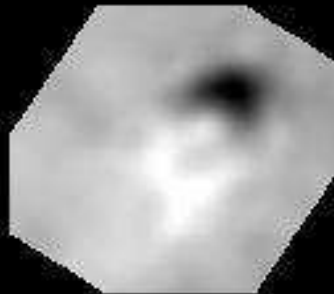
Review of learning goals for Part 3

- 1) The image is rectified and then rotated so the apparent solar azimuth is 270° .
- 2) The rectified image is saved as an 8-bit greyscale fits.
- 3) The greyscale fits is converted to csv text data using HEARSAC's FV Tools.
- 4) The csv text data is imported to a temporary working Excel worksheet and spreadsheet.
- 5) The temporary worksheet is imported for long-term storage into DEMCarlottoMethod.xls.

End of Part 3: Convert images and import



Katima, Alaska

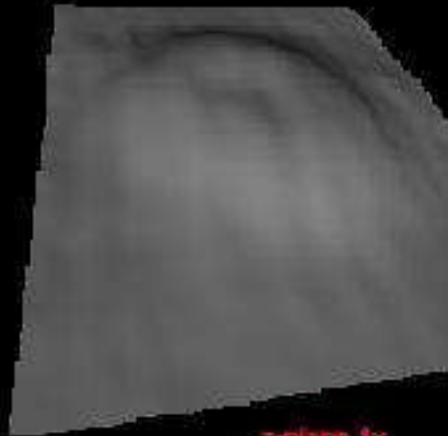


Mons Rumik - Apollo 16 AS16-07-13262



Marius Hills - Lunar Orbiter IV - N-16-402

3D floating point



z-plane bc

