

# **MySETIapp**

## **User's guide**

### **V1.2.5.1**

**Sept. 10,2023**

This file is part of MySETIapp.

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MySETIapp is an application that was written to help in analyzing and interpreting the bit stream message from the 'A Sign in Space' project. This is a user driven effort and has no official affiliation with Daniela de Paulis, the SETI Institute, or the European Space Agency or any other collaborating agency or institute.

## Background

'A Sign in Space'  
website, <https://asignin.space/>

A Sign in Space is an interdisciplinary project by media artist Daniela de Paulis, in collaboration with the SETI Institute, the European Space Agency, the Green Bank Observatory and INAF, the Italian National Institute for Astrophysics. The project consists in transmitting a simulated extraterrestrial message as part of a live performance, using an ESA spacecraft as celestial source. The objective of the project is to involve the world - wide Search for Extraterrestrial Intelligence community, professionals from different fields and the broader public in the reception, decoding and interpretation of the message. This process will require global cooperation, bridging a conversation around the topics of SETI, space research and society, across multiple cultures and fields of expertise, <https://www.seti.org/event/sign-space>

The message was transmitted from the ESA's ExoMars Trace Gas Orbiter (TGO) on May 24 at 19:16 UTC/12:15 pm PDT.

It was received by three radio telescopes on earth May 24,2023. A group of individuals in the Discord 'A Sign in Space' channel unscrambled the message from the radio telemetry. The message published as Data17.bin is identified as the correctly transcribed bitstream of the message payload given to ESA.

The next step in the problem is the decoding of the payload bitstream into the next level of the message, the sign in space. After that the interpretation of the sign(s) in the embedded messages can commence.

There is a Discord Interpretation Chat. The group is large and has a wide array of talent. The tools that the group is using is quite varied which includes Excel, Photoshop, GIMP, Java, Python and c/c++.

Several people are also using online tools that use file uploads, typically text based. Importing data into Excel is also generally text based.

Photoshop and GIMP can use raw binary files typically 8 bit, 16 bit or 32 bit per element.

None of these tools use bit packed binary input. The first step has been to translate the bitstream message into a format that can be used by the various tools. The next steps involve examination of the bitstream data to solve how to decode it.

This program contains a set of tools that I have used in the examination of the message. It covers several of the basic files that people are using as a starting point along with several basic bitstream and image formatting , reordering, folding, mirroring, rotation, extraction functions. Hopefully this may make it easier for others people to explore the message.

## Limitations

This is a 64 bit Windows Desktop application. It primarily operates from the user's selection of the operations they wish to perform using the application's menus. The operations consist of file input(s), parameters, and file output.

Current implementation uses the default external viewer for BMP files to display results after an operation.

### V1.0.0.1 Release

This is the first release. It includes the Visual Studio project files along with some of the 'message' data files. An application installer can also be used just for the executable application and data files.

The executable and data files can be stored in any writeable folder in Windows.

**Any installer and/or executable should be scanned for viruses when being downloaded along with a verification that the checksum for the installation matches the download.**

The installer will add a desktop shortcut to run the application along with a Window Start menu entry named MySETIapp.

There is configuration file, MySETIapp.ini, that will be created when you run the software that keeps track of what files, parameters, window size and positions are used so that you do not have to start from scratch every time you run the application. This is stored in the same folder as the executable. The application does not need to access, record, or transmit information to the Internet.

The settings are only saved when you press the OK dialog button or when the main window and image window display are closed.

### V1.1.0.1 Release

This release added:

- Image decimation using 1D or 2D decimation kernels.
- An image file resize function was also added to allow conversion of image file to a different size along with changing the pixel size.
- An external viewer was added to see the results of an image operation.
- Defaults extensions and file type was added to the Open/Save file dialogs.

### V1.2.0.1 Release

This release added:

- Added Convert text to packed bitstream file.
- Added image stats reporting not just image header stats.
- Corrected error handling of reorder list, when entry in kernel is out of bounds, file closure on error.
- Corrected error handling of reorder list, when entry in kernel is out of bounds, file closure on error.
- Clean up of ImageDlg to just rely on external viewer. Use of Windows default viewer for BMP display works adequately.

Added batch processing for reordering, this allows a series of reorder kernels to be used. Each kernel adds an index number onto the output filename. An option to generate a BMP file for each is also included.

### **V1.2.1.1 Release**

This release:

- Added import BMP to image file (.raw). BMP file must be of type 1 bit, 8 bit, or 24 bit.
- Added HEX text file to binary file.
- Correction, when display results is enabled only display the results file once.
- Correction, Decimation process, corrected incorrect calculation for new Y dimension when row decimation occurs.

### **V1.2.2.1 Release**

This release:

- Correction, check that the path exists when specifying file is open/save dialog
- Correction, change default folders\filenames
- Correction, change default app settings, removed Autosize setting
- Corrected bug in V1.2.1 when importing BMP file which resulted in incorrect frame size.

### **V1.2.3.1 Release skipped**

This release was skipped because of a mix-up in the V1.2.2, V1.2.1 release.

### **V1.2.4.1 Release**

This release:

- Added, Import of CamIRa IMG files (not applicable to A Sign in Space project)
- Added, Add/Subtract constant from images
- Added, batch mode for Bit stream to Image file
- Changed, Sum images to Add/Subtract images
- Cleanup of file open/save dialog filename handling

### **V1.2.5.1 Release**

This release:

- Added standard image decimation (summation)
- Updated, handling of default directories
- Updated, Tab order and default buttons in all dialogs

## **Installation**

The installer is a very simple one. **The default install location is the windows volume drive \MySETIapp.** This is used because the application needs to be able to have read/write access of the folder it is installed. The 'Programs folder' requires administrative privileges to write to it. I use 'C:\MySETIapp' as the installation location. You can change the folder installation of the application using the browse button during the install.

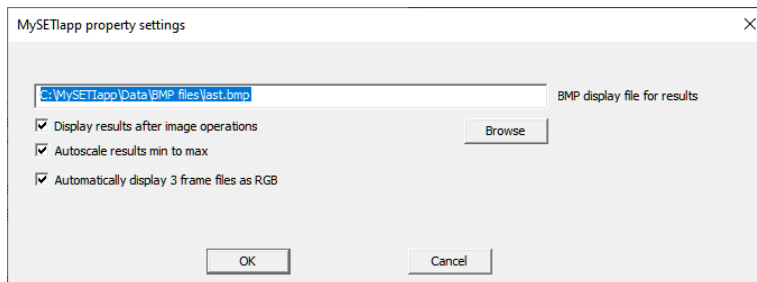
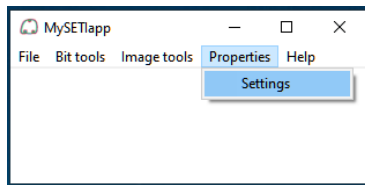
The project source is also available on GitHub. The source project and solution uses Visual Studio 2019 or later. It has not been tested against earlier versions.



## First time running the application

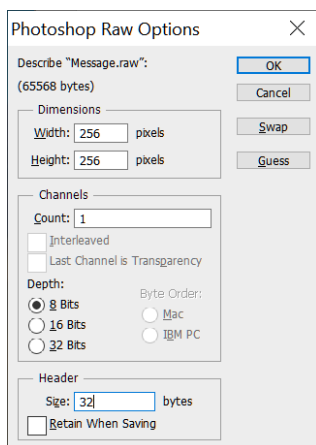
The first time you open a dialog there are defaulted parameters that should be changed and set, in particular the filenames. Use the browse button to select the appropriate folder location for the files. Click OK in the dialog to save the dialogs parameters for the next time. Pressing the OK button saves the dialog settings. It rarely performs the dialog action. Most of the operations in the application have a specific dialog button to press to perform the operation, like Extract, Append, Reorder, ...

It is recommended that the application 'settings' be set when you first run the application so that it allows the application to display the results from the last image operation. A BMP file must be specified for this to work.



## IMPORTING IMAGE FILE INTO PHOTOSHOP

Importing an image file into Photoshop is done with files having a .raw extension. In Photoshop do a File -> Open. Select the .raw file you want to import. You will get a Photoshop Raw Options dialog.



Set the header size to 32 bytes. Set the Width and Height to match what is in the raw file. Set the Channels to the number of frame in the image file. Set the Depth to match the image file pixel size. You can get all these parameters from the MySETIapp under the menu Image tools->Image file properties.

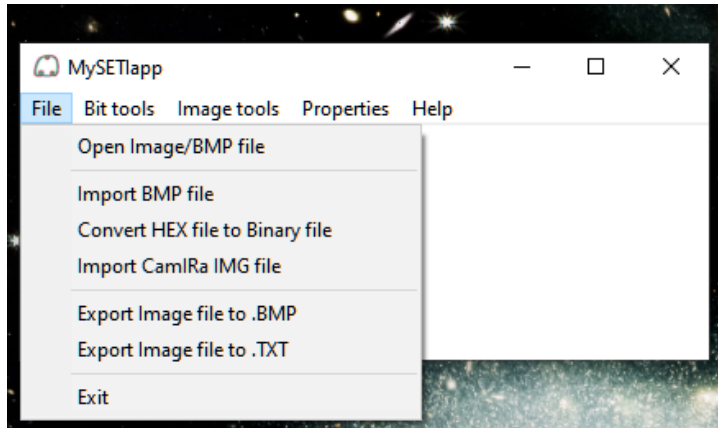
## Menu operations

Operations are centered around reading and generating files based on parameters entered in the dialog for that operation. The dialog typically needs 1 or 2 input filename, a set of operation parameters and an output filename.

The menus are split into 5 groups with 2 main groups that comprise the most of the functionality:

File      **Bit tools**      **Image Tools**      Properties      Help

File



### Open Image/BMP file

This will be implemented in the next release. Currently it just generates the BMP display file for results set in the application properties settings.

### Import BMP File

The import BMP file function imports 3 types of BMP file and converts them to an Image file. The BMP must be uncompressed. Color tables in the BMP file are not used or preserved.

#### Monochrome 1 bit/pixel BMP file

This file type also provides an option to invert the image (0->1, 1->0).

#### 8 bit/pixel BMP file

The image is imported using the image pixel values as a monochrome image. It ignores the color table.

#### 24 bit/pixel BMP file

This type of file is RGB (8 bits per color). This is converted into a 3 frame Image file with Red being the 1<sup>st</sup> frame, Green being the 2<sup>nd</sup> frame and Blue being the 3<sup>rd</sup> frame.

### Convert HEX file to binary file

This reads in a text file of HEX ASCII coded bytes which are space delimited, ex: AD 0B 07. Each byte is a 2 character HEX code. Leading 0s are included. This is a straight conversion into a binary file. No interpretation of file type is done.

## Import CamIRa IMG file

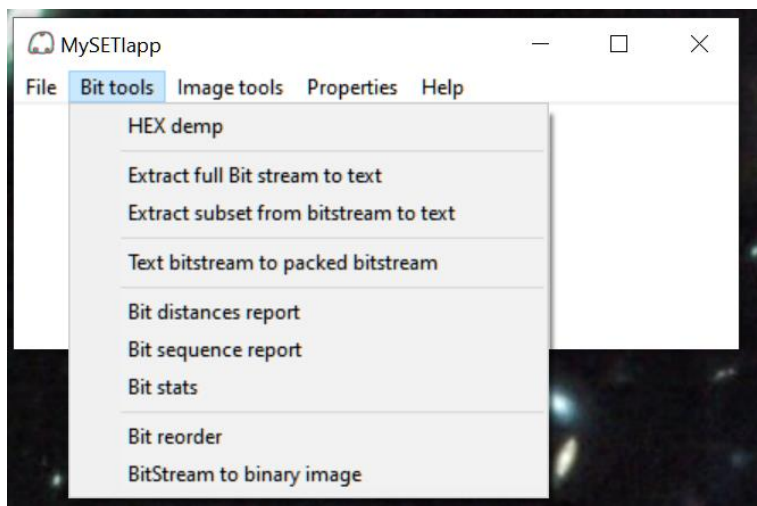
This function imports a CamIRa IMG file into an image file. This is limited to 8 and 16 bit non-extended file formats. No metadata is imported. This function is not applicable to the 'A Sign in Space' project.

## Export Image file to .BMP file

Exporting to a BMP file can generate 2 types of BMP files. For image files that are single frame or multi-frame not divisible by 3 the BMP is saved as a greyscale image. For image files with multiples of 3 frames there is an option to use an RGB representation. The first frame is Red, 2<sup>nd</sup> frame is assigned Green and the third frame is assigned Blue. Only the first frame or 3 frames (RGB output) are converted into a BMP file. You can use auto scale to scale image from black to white. Auto scaling stretches the greyscale bitmap to represent a black to white image even for a single bit pixel.

'Export image file to text' to text allows an image file to be output in a text form that can be used as inputs for programs like Excel or various online applications.

## Bit tools



The initial functionality in analyzing the bitstream are the bit tools that allow you to take the packed binary bit stream and examine it. The bit tools can also be used to dismantle and export packed bitstream file in various text or image representations.

It also has some tools that just help you look at what the bitstreams looks like in terms of spacing and sequences.



## HEX Dump

The dialog box is titled "Convert packed bitstream file HEX text file". It contains the following elements:

- A text input field for the "Packed bitstream input file" with the path "C:\MySETIapp\Data\OriginalSource\data17.bin" and a "Browse" button.
- A numeric input field for "X size (number of HEX bytes per line)" with the value "16". Below it, text reads "0 - no EOL".
- A text input field for "Text Output" with the path "C:\MySETIapp\Data\data17-hex.txt" and a "Browse" button.
- Buttons: "Convert", "OK", "Cancel", and "Browse" (for the output file).
- Labels: "(doesn't save settings)" near the "Convert" button, "(save settings, don't convert)" near the "OK" button, and "(don't save)" near the "Cancel" button.

Hex dump generates a byte oriented hex dump of the input file. This could be either the packed bitstream or an image file. X size is the number of HEX coded bytes to put on a single line. If 0 then all the bytes in the file are output in a single line with no end of line (new line or '\n') at the end. Any file can be HEX dumped. There is white space between the ASCII HEX coded bytes.

## Extract full Bit Stream to text

The dialog box is titled "Convert packed bitstream file to text file". It contains the following elements:

- A text input field for the "Packed bitstream input file" with the path "C:\MySETIapp\Data\OriginalSource\data17.bin" and a "Browse" button.
- Input fields for "# bits in prologue" (value 80) and "#bits in header for a block" (value 0).
- Input fields for "#bits in block" (value 65536) and "X size" (value 256).
- An input field for "Number of blocks" (value 1).
- A text input field for "Text Output" with the path "C:\MySETIapp\Data\data17.txt" and a "Browse" button.
- Buttons: "Convert", "OK", "Cancel", and "Browse" (for the output file).
- Labels: "(doesn't save settings)" near the "Convert" button, "(save settings, don't convert)" near the "OK" button, and "(don't save settings)" near the "Cancel" button.

This converts the entire bitstream file into a text file. The text file is separated into 4 sections; prologue (set to 0 to exclude), header bits for a block in a file (set to 0 to exclude), block of bits output in the lines of X size bits, comma separated. The block header and blocks are repeated for the number of block(s) specified, everything after the last block is treated as the footer.

## Extract subset from Bitstream to text

The dialog box titled "Extract Bitstream to text file" contains the following elements:

- Packed bitstream input file:** A text field with the path "C:\MySETIapp\Data\OriginalSource\data17.bin" and a "Browse" button.
- # bits to skip:** A text field with the value "80".
- # bits to output:** A text field with the value "65536".
- # of bits per line (0 all on one line):** A text field with the value "256".
- Text Output:** A text field with the path "C:\MySETIapp\Data\message.txt" and a "Browse" button.
- Buttons:** "Extract", "OK", and "Cancel".
- Labels:** "(doesn't save settings)" is placed above the "Extract" button. "(save settings, don't convert)" is placed to the left of the "OK" button. "(don't save settings)" is placed to the right of the "Cancel" button.

This converts only part of the bitstream file into a text file. The values on a lines are comma separated. This is useful for importing into other programs as csv files. This useful for separating the header, message, and footer with different x sizes.

## Extract subset from Bitstream to text

The dialog box titled "Convert text file to packed bitstream file" contains the following elements:

- Text input file:** A text field with the path "Data\data17.txt" and a "Browse" button.
- Packed bitstream output file:** A text field with the path "Data\bitstream.bin" and a "Browse" button.
- Buttons:** "Convert", "OK", and "Cancel".
- Labels:** "(doesn't save settings)" is placed above the "Convert" button. "(only save settings)" is placed to the left of the "OK" button. "(don't save settings)" is placed to the right of the "Cancel" button.

This converts a text file of space delimited values into a packed bitstream file. If a value is less than 0 an error is generated. A value  $\geq 1$  is taken as a bit with value of 1. A value of 0 is taken as a bit value of 0. If the number of bits number of values in not a divisible by 8 then 0s are padded to the last byte output in the packed bitstream file.

## Bit distances report

The dialog box titled "Report distance between 1 bits" contains the following elements:

- Packed bitstream input file:** A text field with the path "C:\MySETIapp\Data\OriginalSource\data17.bin" and a "Browse" button.
- # bits to skip:** A text field with the value "0" and a "Browse" button.
- Text Output:** A text field with the path "C:\MySETIapp\Data\data17-bit-distances.txt" and a "Browse" button.
- Buttons:** A "Report" button, an "OK" button (with "(save settings, don't convert)" to its left), a "Cancel" button, and a "(don't save)" label.
- Labels:** "(doesn't save settings)" is located to the left of the "Report" button.

This generates a csv style report of the bit position of each set bit in the bitstream and the distance to the from the last set bit. If the first bit in the file is set the distance is reported as 1.

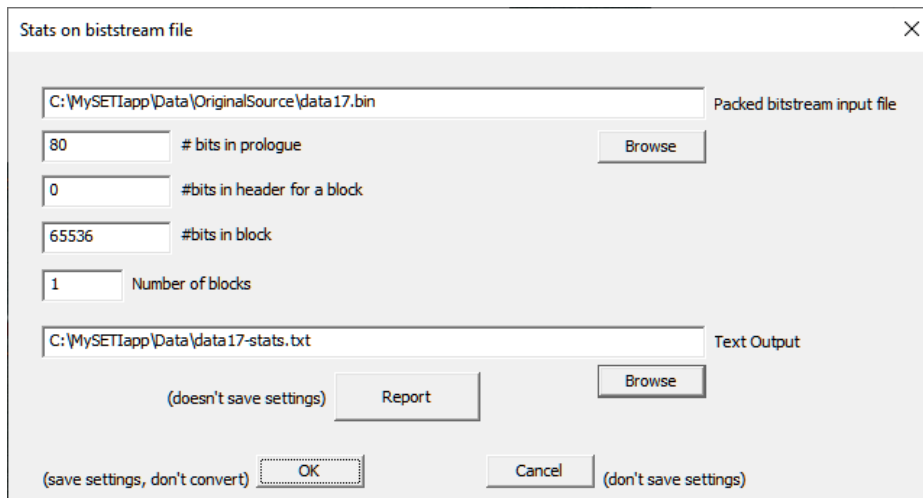
## Bit Sequences report

The dialog box titled "Report bit sequences" contains the following elements:

- Packed bitstream input file:** A text field with the path "C:\MySETIapp\Data\OriginalSource\data17.bin" and a "Browse" button.
- # bits to skip:** A text field with the value "0" and a "Browse" button.
- Text Output:** A text field with the path "C:\MySETIapp\Data\data17-bit-sequences.txt" and a "Browse" button.
- Buttons:** A "Report" button, an "OK" button (with "(save settings, don't convert)" to its left), a "Cancel" button, and a "(don't save)" label.
- Labels:** "(doesn't save settings)" is located to the left of the "Report" button.

This generates a csv style report that gives the starting position and length of sequences of set bits.

## Bit Stats



Stats on bistream file

C:\MySETIapp\Data\OriginalSource\data17.bin Packed bitstream input file

80 # bits in prologue Browse

0 #bits in header for a block

65536 #bits in block

1 Number of blocks

C:\MySETIapp\Data\data17-stats.txt Text Output

(doesn't save settings) Report Browse

(save settings, don't convert) OK Cancel (don't save settings)

This generates the following report text file:

Bitstream file stats

File report settings:

Header size:80

Number of Blocks:1

Header size per block:0

Block size:65536

Bit stats:

Number of bits set in prologue (header): 32, 40.0%

Number of bits set in body, block 0: 625, 1.0%

Number of bits found in footer: 80

Number of bits set in footer: 22, 27.5%

Total number of bits set: 679

## Bitstream to binary image

The dialog box is titled "Convert packed bitstream file to Image file". It contains the following fields and controls:

- Packed bitstream input file:** A text box with the path "C:\MySETIapp\Data\OriginalSource\data17.bin" and a "Browse" button.
- # bits in prologue (skipped):** A text box with the value "80".
- MSB to LSB:** An unchecked checkbox.
- #bits in header for a block (skipped):** A text box with the value "0".
- #bits in block:** A text box with the value "65536".
- X size:** A text box with the value "256".
- image bit depth:** A text box with the value "1".
- Number of blocks:** A text box with the value "1".
- end X size (if end X size > than X size then batch mode):** A text box with the value "0".
- ANY FOOTER BITS ARE SKIPPED:** An unchecked checkbox.
- Scale binary 0, 1 to 0,255 in output image:** An unchecked checkbox.
- Image Output file:** A text box with the path "C:\MySETIapp\Data\Message.raw" and a "Browse" button.
- Buttons:** "Convert", "OK", "Cancel", and a "Browse" button for the output file.
- Labels:** "(doesn't save settings)" near the "Convert" button, "(only save settings)" near the "OK" button, and "(don't save settings)" near the "Cancel" button.

This does the work of converting packed bitstream files into image files. This includes generating 1D image files which can use 1d linear bit reordering or 1D convolutions on the stream.

The conversion of the bitstream also allows the stream to be treated as having bit depths of 1 to 32 bits. It allows MSB->LSB or LSB->MSB decoding from the bitstream for bit depths > 1. The output can also be scaled so a binary image is displayed from black to white. The # bits in block should be divisible by (Xsize \* image bit depth) but is not required. The Ysize of the output image = #bits in block / (X size \* image bit depth). The number of blocks becomes the number of frames in the file.

If the end X size is greater than the X size then a batch mode is used. In batch mode the output filename will be appended with an \_index matching the X size for each step. If the global Display Results flag is set then a BMP file with the index is also created in the same location but not displayed.

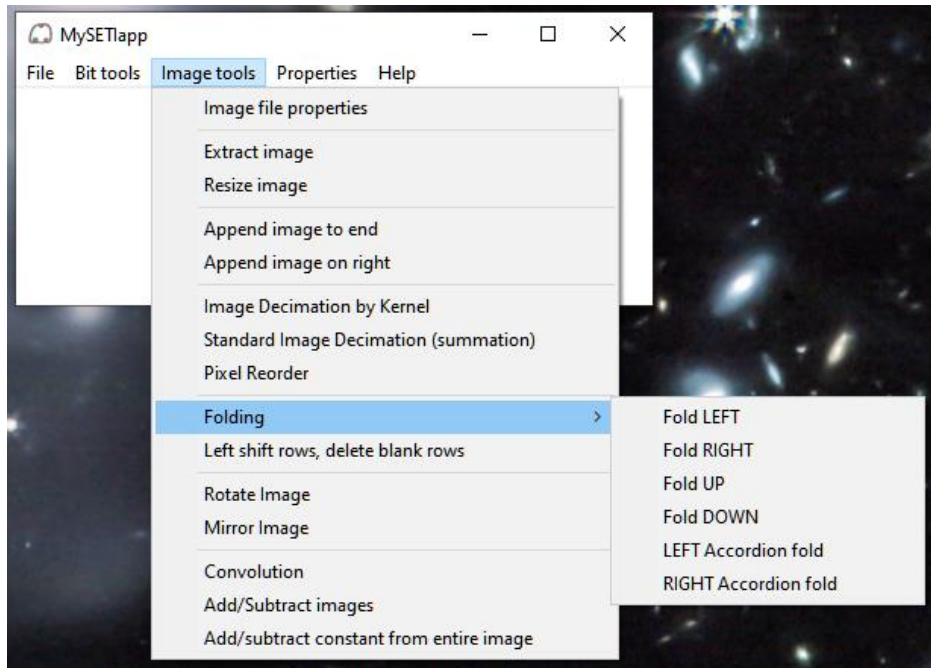
## Bit reorder

The dialog box is titled "Reorder bits, input file must be linear". It contains the following fields and controls:

- Bit Stream as linear image file:** A text box with the path "C:\MySETIapp\Data\LinearMessage.raw" and a "Browse" button.
- Input Image size:** A label with "1 # of frames".
- X size:** A text box with the value "65696".
- Y size:** A text box with the value "1".
- Pixel reorder file:** A text box with the path "C:\MySETIapp\Data\Reorder\16x1 reverse order.txt" and a "Browse" button.
- Output Image file:** A text box with the path "C:\MySETIapp\Data\Reorder\ReorderedLinearMessage.raw" and a "Browse" button.
- Scale binary to 0,255:** An unchecked checkbox.
- Buttons:** "Reorder", "OK", "Cancel", and a "Browse" button for the output file.
- Labels:** "(doesn't save settings)" near the "Reorder" button, "(save settings, don't convert)" near the "OK" button, and "(don't save settings)" near the "Cancel" button.

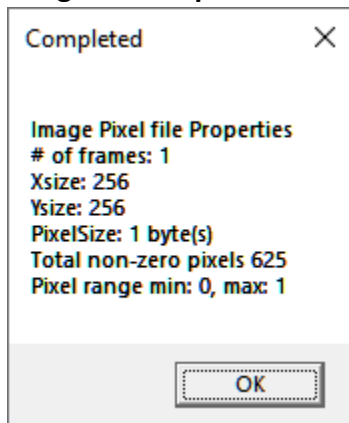
See the Image reordering documentation for the formats that can be used for the reorder files. When using bit reorder from the bit tools menu the reordering must be 1D (Ysize = 1). The X size must be divisible by the Xsize of the reordering kernel. The linear image is divided into groups the X size of the kernel. The bits within the kernel are reordered according to the kernel specification.

## Image Tools



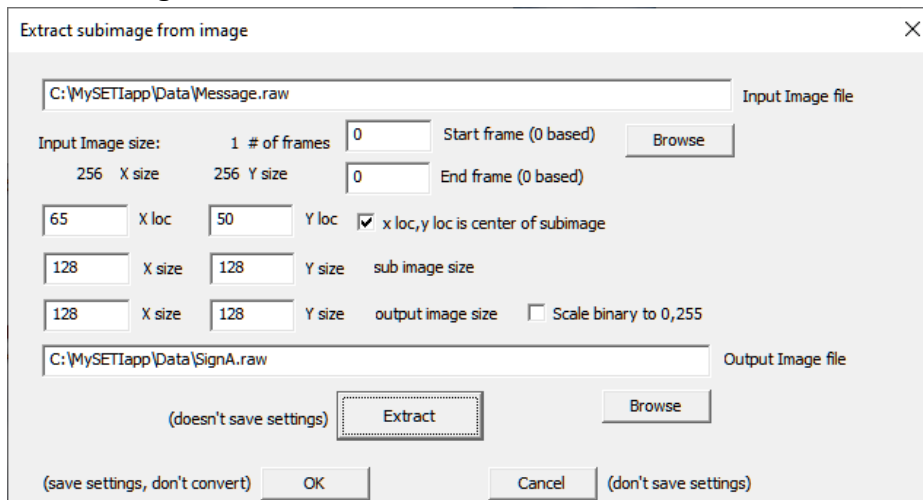
The purpose image tools is to manipulate 2D images. This includes mirroring, rotation, folding, extraction, convolution, summation, and appending images.

## Image File Properties



This reports the header information for the selected image file and some basic image stats. It does not generate a report file.

## Extract Image

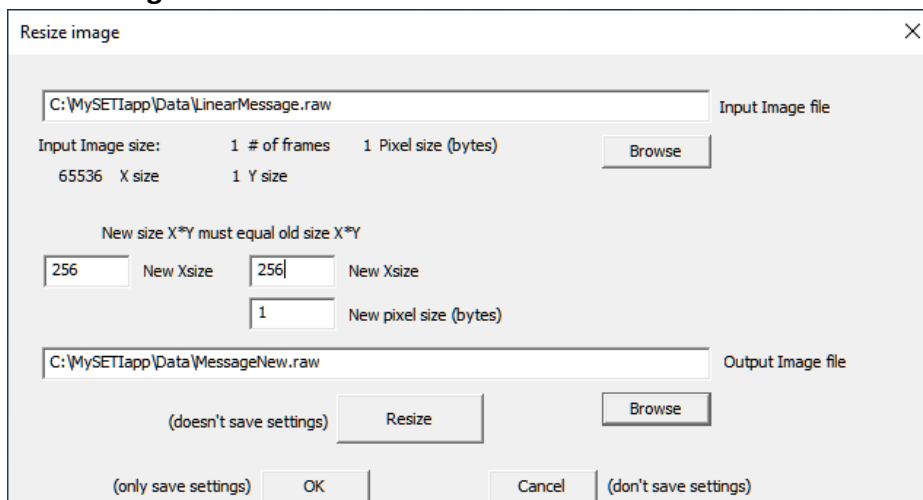


The 'Extract subimage from image' dialog box is used to extract a sub-image from a source image. It features the following controls:

- Input Image file:** A text field containing 'C:\MySETIapp\Data\Message.raw'.
- Input Image size:** A label with '256 X size' and '256 Y size'.
- # of frames:** A text field with '1'.
- Start frame (0 based):** A text field with '0' and a 'Browse' button.
- End frame (0 based):** A text field with '0'.
- X loc:** A text field with '65'.
- Y loc:** A text field with '50'.
- Centering:** A checked checkbox labeled 'x loc, y loc is center of subimage'.
- sub image size:** Text fields for 'X size' (128) and 'Y size' (128).
- output image size:** Text fields for 'X size' (128) and 'Y size' (128).
- Scale binary to 0,255:** An unchecked checkbox.
- Output Image file:** A text field containing 'C:\MySETIapp\Data\SignA.raw'.
- Buttons:** 'Extract' (highlighted), 'Browse' (for output), 'OK', 'Cancel', and a '(doesn't save settings)' button.

This allows a sub-image to be extracted from a source image. The extraction can be for a range of frames in the source image. The X,Y size of the sub-image must be  $\leq$  the X,Y size of the output image. The output image can be larger than the input image. The sub-image position is either the upper left corner of the sub-image in the source image or the center of the sub-image in the source image. The output image will be zero padded as needed if the sub-image size extends beyond the bounds of the source image. The use of the centering option can be used to center a specific pixel from the input image to be in the center of the output image. This can make alignments to other sub images easier along with ensuring the other sub images are also the same size.

## Resize Image



The 'Resize image' dialog box is used to resize an image file. It features the following controls:

- Input Image file:** A text field containing 'C:\MySETIapp\Data\LinearMessage.raw'.
- Input Image size:** A label with '65536 X size' and '1 Y size'.
- # of frames:** A text field with '1'.
- Pixel size (bytes):** A text field with '1' and a 'Browse' button.
- Resizing constraints:** A label 'New size X\*Y must equal old size X\*Y'.
- New Xsize:** A text field with '256'.
- New Ysize:** A text field with '256'.
- New pixel size (bytes):** A text field with '1'.
- Output Image file:** A text field containing 'C:\MySETIapp\Data\MessageNew.raw'.
- Buttons:** 'Resize', 'Browse' (for output), 'OK', 'Cancel', and a '(only save settings)' button.

This operation copies an image file to another image file while changing the X, Y size and the Pixel Size. This is useful for converting a flat image file (Y size is 1) to a 2D image. It also allows the Pixel size to be changed between 1, 2 or 4 bytes per pixel.

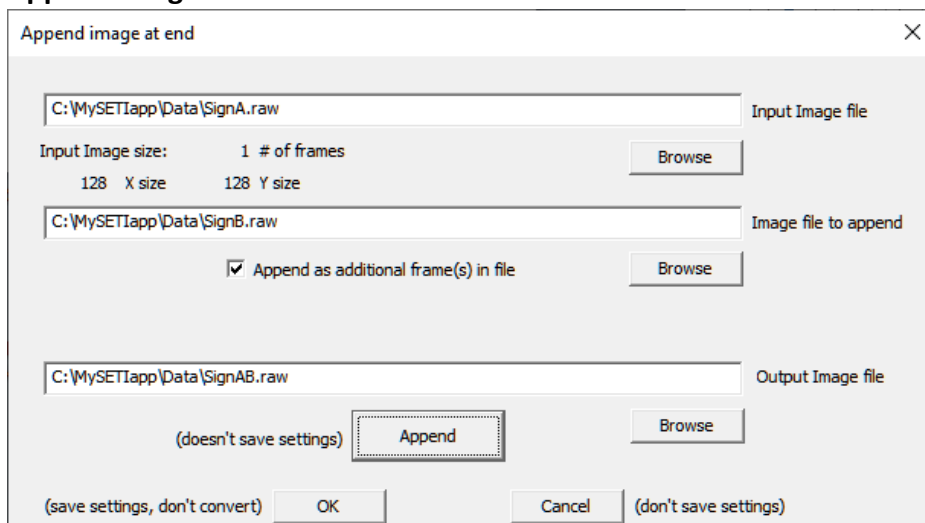
### Limitations:

The new image (X size \* Y size) must be equal to the old image (X size \* Y size). No removal or additional pixels can be added to a the frame. The new image file will have the same number of frames as the old file.

If the new Pixels size is smaller than the old pixel size then the values will be clipped as follows:

- 1 byte - clipped at 255
- 2 bytes - clipped at 65535
- 4 bytes - negative numbers will be set to 0

### Append image to end



Images are be appended at the end of another image or added as additional frame(s) in the image file.

### Appended to frame condition

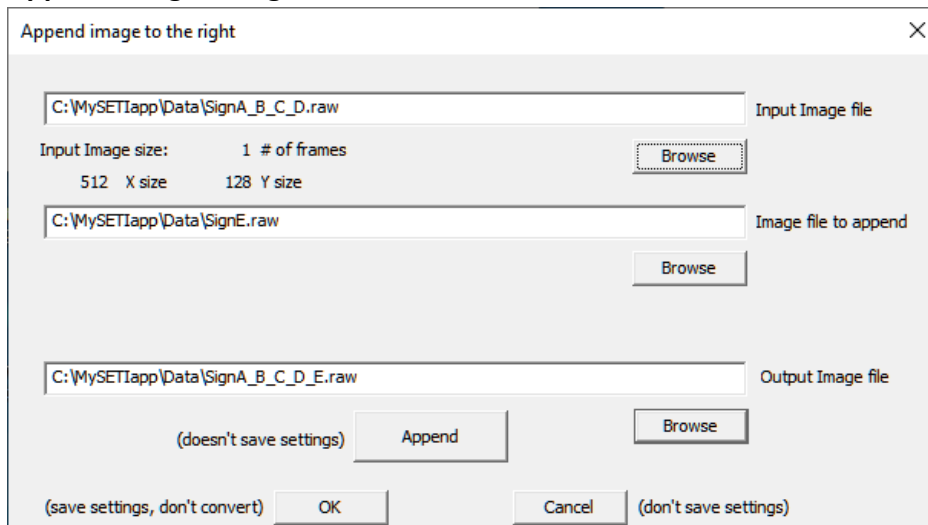
If the 2<sup>nd</sup> image is being appended on the first frame without being added as an additional frame then the output image will be the Y size of the first image plus the Ysize of the second image. Appending the X size of both input image files be the same along with the same number of frames in each input file.

### Appended as additional frames condition

The first and 2<sup>nd</sup> input image files must have the same X, Y size. The number of frames in each input image file can be different. The number of frames in the output image will be the number of frames from the first input image plus the number of frames from the 2<sup>nd</sup> input image. This is particularly useful when generating a 3 frame file that you want to convert to an RGB representation. When exporting a 3 frame file the 3 frames can be interpreted as frame 1 is Red, frame 2 is Green and frame 3 is Blue.



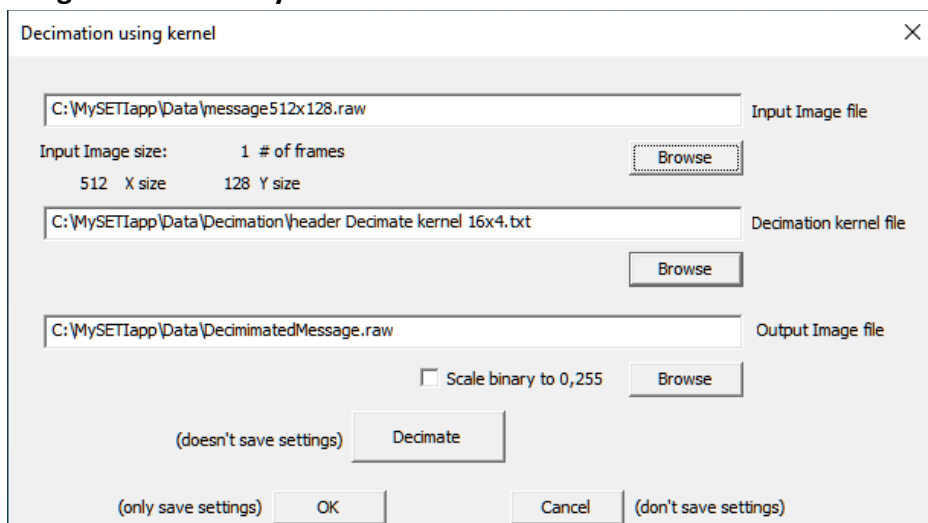
## Append image on right



The 'Append image to the right' dialog box contains three file input fields. The first field, labeled 'Input Image file', has the path 'C:\MySETIapp\Data\SignA\_B\_C\_D.raw' and a 'Browse' button. Below it, 'Input Image size:' is shown as '1 # of frames' with '512 X size' and '128 Y size'. The second field, labeled 'Image file to append', has the path 'C:\MySETIapp\Data\SignE.raw' and a 'Browse' button. The third field, labeled 'Output Image file', has the path 'C:\MySETIapp\Data\SignA\_B\_C\_D\_E.raw' and a 'Browse' button. At the bottom, there is an 'Append' button, an 'OK' button, and a 'Cancel' button. Text labels '(doesn't save settings)' and '(save settings, don't convert)' are positioned near the 'Append' and 'OK' buttons respectively.

This appends the second image to the right side of the first image. This can be used to string a set of sub-images together into one image with a common x and Y alignment. Such as the possible 5 signs in the “A Sign In Space” message.

## Image Decimation by Kernel



The 'Decimation using kernel' dialog box contains three file input fields. The first field, labeled 'Input Image file', has the path 'C:\MySETIapp\Data\message512x128.raw' and a 'Browse' button. Below it, 'Input Image size:' is shown as '1 # of frames' with '512 X size' and '128 Y size'. The second field, labeled 'Decimation kernel file', has the path 'C:\MySETIapp\Data\Decimation\header Decimate kernel 16x4.txt' and a 'Browse' button. The third field, labeled 'Output Image file', has the path 'C:\MySETIapp\Data\DecimatedMessage.raw' and a 'Browse' button. There is a checkbox labeled 'Scale binary to 0,255'. At the bottom, there is a 'Decimate' button, an 'OK' button, and a 'Cancel' button. Text labels '(doesn't save settings)', '(only save settings)', and '(don't save settings)' are positioned near the 'Decimate', 'OK', and 'Cancel' buttons respectively.

Image decimation reduces the X and Y resolution of an image by deleting pixels in the image. How the pixels are removed is based on a decimation kernel file. You can create decimation kernels that are 1D or 2D. 1D kernels remove pixels in a row or a column but not both. 2D kernels can removed pixels in both rows and columns. The first line of a kernel specifies the x and y size of the kernel and must be comma separated. A list (x\*y) of kernel values follow that are separated by whitespace. A kernel value can be 0 or 1. Values of 0 will result in that pixel being removed from the image. A value of 1 includes a pixel in the new image. A description can be added after all the kernel values.

### Limitations:

For 2D kernels, the number of decimated pixels in each rows must be the same unless all the pixels on a row are removed (all 0s).

The input image x, y size must both be divisible by the decimation kernel x, y size.

A new size for the output image is calculated from the decimation kernel and the input image size.

Examples:

2,2

0 0

0 1

This removes every even number column and row from the image.

16,4

0 0 0 0 0 1 1 0 1 0 0 1 0 0 0 0

0 0 1 0 1 0 0 0 0 1 0 0 0 0 0 1

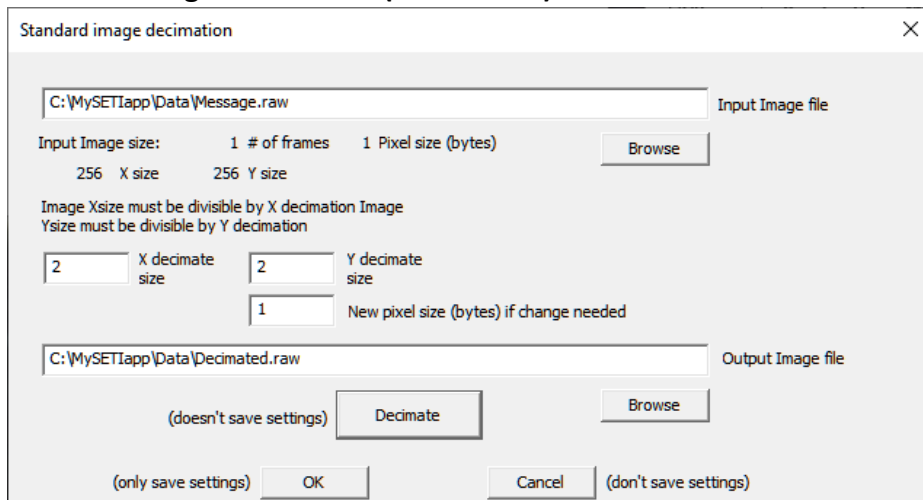
0 1 0 0 0 1 0 0 1 0 0 0 1 0 0 0

0 1 0 0 0 1 0 0 1 0 0 0 1 0 0 0

16x4 linear decimation, using message header as a decimation kernel

This would change a 512Hx128V image to a 128Hx128V image.

### Standard Image Decimation (summation)



The dialog box titled "Standard image decimation" contains the following elements:

- Input Image file:** A text field with the path "C:\MySETIapp\Data\Message.raw" and a "Browse" button to its right.
- Input Image size:** A section with three labels: "1 # of frames", "1 Pixel size (bytes)", and "256 X size 256 Y size". A "Browse" button is located to the right of these labels.
- Decimation settings:** Two text fields for "X decimate size" and "Y decimate size", both containing the value "2". Below them is a text field for "New pixel size (bytes) if change needed" containing the value "1".
- Output Image file:** A text field with the path "C:\MySETIapp\Data\Decimated.raw" and a "Browse" button to its right.
- Buttons:** At the bottom, there are four buttons: "(doesn't save settings)", "Decimate", "Browse", and "OK". Below the "OK" button are the labels "(only save settings)", "Cancel", and "(don't save settings)".

Standard Image decimation reduces the X and Y resolution of an image by summing groups of pixels in the image. The x,y decimation size is the size of the group. All pixels in a group are summed and become the a new pixel value in the output image.

Restrictions:

The x,y size of the image must be divisible by the x,y decimation size.

## Pixel Reorder

Reorder pixels in image

C:\MySETIapp\Data\Message.raw Input Image file

Input Image size: 256 X size 256 Y size 1 # of frames Browse

C:\MySETIapp\Data\Reorder\8x1\Permutations8.txt Pixel reorder file

☒ Enable batch reordering file ☒ Generate BMP file for each Browse

C:\MySETIapp\Data\Batch\Reordered.raw Output Image file

☐ Scale binary to 0,255 Browse

(doesn't save settings) Reorder

(only save settings) OK Cancel (don't save settings)

1D/2D pixel reordering divides an image up into blocks which are the size of the reordering kernel. The pixels inside each block are reordered according to the kernel specification. The limit on the size of the kernel is the X,Y size of the image. This of course would allow you to arbitrarily remap any pixel to any other place in the image. Someone could make the resulting image into almost any representation desired. It is more likely that a much smaller reordering kernel would be used.

Batch processing of kernel is also an option. This option lets the user explore many possible permutation orders for reordering in one request. For example, 8 column reordering has 40320 possible permutations for the order. While it is easy to generate the entire list, it is tedious to perform this one by one. Using the generate BMP option, you can generate a movie from the resulting BMP file using Photoshop or other tool. This lets you watch the results as a video.

When the Enable Batch flag is checked then the reordering file is interpreted as having 1 or more kernels sequentially listed in the reordering file. Batch processing ends when a comment, end of file or an error in a kernel is encountered. An index number is added to the filename starting at 1. If the Generate BMP file flag is also checked then a ,BMP file is also generated with the same name as the .raw file (including the index number).

### File format for reordering files

The reordering file for 1D/2D reordering has the following 3 text formats.

The following example kernels reverses the order of pixels left to right in the block and swaps the rows so that an 8x2 block of pixel values:

```
0 1 2 3 4 5 6 7
8 9 10 11 12 13 14 15
becomes
15 14 13 12 11 10 9 8
7 6 5 4 3 2 1 0
```

- 1.) Relative pixel mapping format  
n,m

followed by  $n*m$  pairs of values with whitespace between the pairs. After all the  $n*m$  pairs of values are listed an optional description is recommended. The reordering values are relative to the its position in the kernel. A 0,0 means the pixel is not moved.

Example file contents format – relative pixel maps

8,2

7,1 5,1 3,1 1,1 -1,1 -3,1 -5,1 -7,1

7,-1 5,-1 3,-1 1,-1 -1,-1 -3,-1 -5,-1 -7,-1

8X2 kernel. This swaps the two rows and reverse the order of a row

2.) 0 based linear kernel address format

$n,m,0$

followed by  $n*m$  values with whitespace between the values after all the  $n*m$  values an optional description is recommended. Reordering values is the linear address of replacement pixel in the kernel, 0 based.

Example file contents format –0 based linear kernel address

8,2,0

15 14 13 12 11 10 9 8

7 6 5 4 3 2 1 0

8X2 kernel. This swaps the two rows and reverse the order of a row

3.) 1 based linear kernel address format

$n,m,1$

followed by  $n*m$  values with whitespace between the values after all the  $n*m$  values an optional description is recommended. Reordering values is the linear address of replacement pixel in the kernel, 1 based.

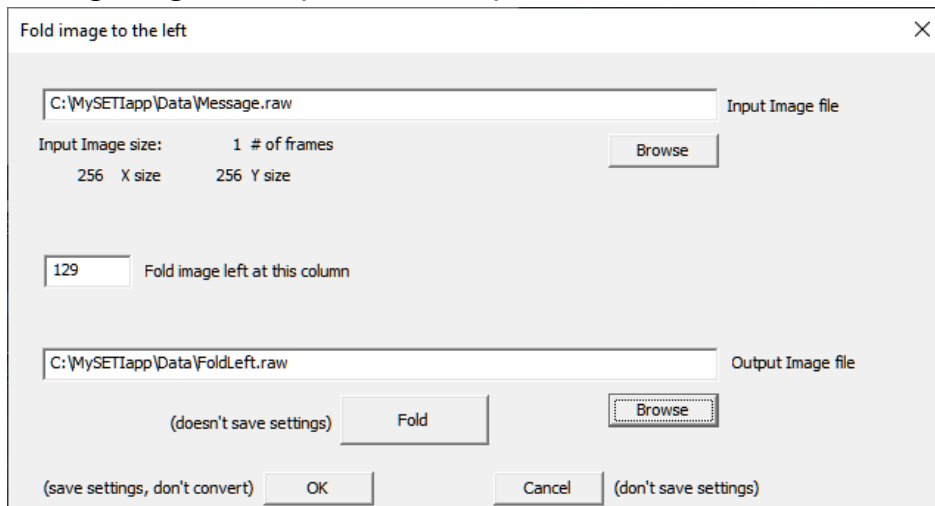
Example file contents format –1 based linear kernel address

8,2,1

16 15 14 13 12 11 10 9

8 7 6 5 4 3 2 1

## Folding along column (LEFT or RIGHT)

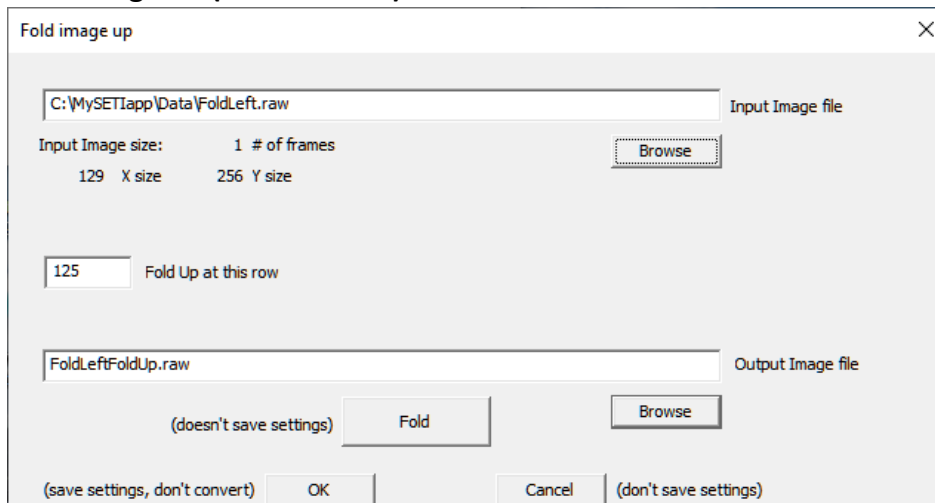


The dialog box is titled "Fold image to the left" and has a close button (X) in the top right corner. It contains the following elements:

- Input Image file:** A text box containing "C:\MySETIapp\Data\Message.raw" and a "Browse" button to its right.
- Input Image size:** A label with "1 # of frames" to its right. Below it, "256 X size" and "256 Y size" are displayed.
- Fold image left at this column:** A text box containing "129".
- Output Image file:** A text box containing "C:\MySETIapp\Data\FoldLeft.raw" and a "Browse" button to its right.
- Buttons:** A "Fold" button is centered. To its left is a button labeled "(doesn't save settings)". To its right is a button labeled "Browse".
- Footer:** Three buttons: "(save settings, don't convert)", "OK", and "Cancel". To the right of "Cancel" is the text "(don't save settings)".

The input image is folded at the specified column either LEFT or RIGHT. The LEFT fold is shown above. If the image is not folded exactly in the center the resulting image is enlarged to accommodate the fold location. The resulting new image size is also reported. If there are multiple frames in the image file then each frame is identically folded. The pixels in the fold image are added together. If 2 pixels overlap as a result of the fold the new pixel value is the sum of the 2 overlapped pixels.

## Fold along row (UP or DOWN)



The dialog box is titled "Fold image up" and has a close button (X) in the top right corner. It contains the following elements:

- Input Image file:** A text box containing "C:\MySETIapp\Data\FoldLeft.raw" and a "Browse" button to its right.
- Input Image size:** A label with "1 # of frames" to its right. Below it, "129 X size" and "256 Y size" are displayed.
- Fold Up at this row:** A text box containing "125".
- Output Image file:** A text box containing "FoldLeftFoldUp.raw" and a "Browse" button to its right.
- Buttons:** A "Fold" button is centered. To its left is a button labeled "(doesn't save settings)". To its right is a button labeled "Browse".
- Footer:** Three buttons: "(save settings, don't convert)", "OK", and "Cancel". To the right of "Cancel" is the text "(don't save settings)".

The input image is folded at the specified row either UP or DOWN. The UP fold is shown above. If the image is not folded exactly in the center the resulting image is enlarged to accommodate the fold location. The resulting new image size is also reported. If there are multiple frames in the image file then each frame is identically folded. The pixels in the fold image are added together. If 2 pixels overlap as a result of the fold the new pixel value is the sum of the 2 overlapped pixels.

Restrictions: Image must be even sized. Odd sized folds planned in future update.

## Accordion fold (LEFT or RIGHT)

The dialog box is titled "Accordion fold image to the left" and has a close button (X) in the top right corner. It contains the following elements:

- An input field for the "Input Image file" with the path "C:\MySETIapp\Data\Message.raw" and a "Browse" button to its right.
- Below the input field, the text "Input Image size: 1 # of frames" is displayed, followed by "256 X size" and "256 Y size". A "Browse" button is also present to the right of the frame count.
- A numeric input field containing "16" with the label "size of accordion (fold to the left)" to its right.
- An output field for the "Output Image file" with the path "C:\MySETIapp\Data\AccordionLeft.raw" and a "Browse" button to its right.
- At the bottom, there are three buttons: "Fold" (with "(doesn't save settings)" to its left), "OK" (with "(save settings, don't convert)" to its left), and "Cancel" (with "(don't save settings)" to its right).

This function does an accordion fold an image along a vertical axis. It folds the left or right side of the accordion fold to the opposite side of the fold. The folded file is 1/2 the width of the unfolded image. The width of the input image must be divisible by the accordion size. The input image file width must be even. The accordion size must also be even. Think paper being cut into strips that are the width of the accordion size. Then the strip is folded and the folded strips stuck back together. Restrictions: Image must be even sized. Odd sized folds planned in future update.

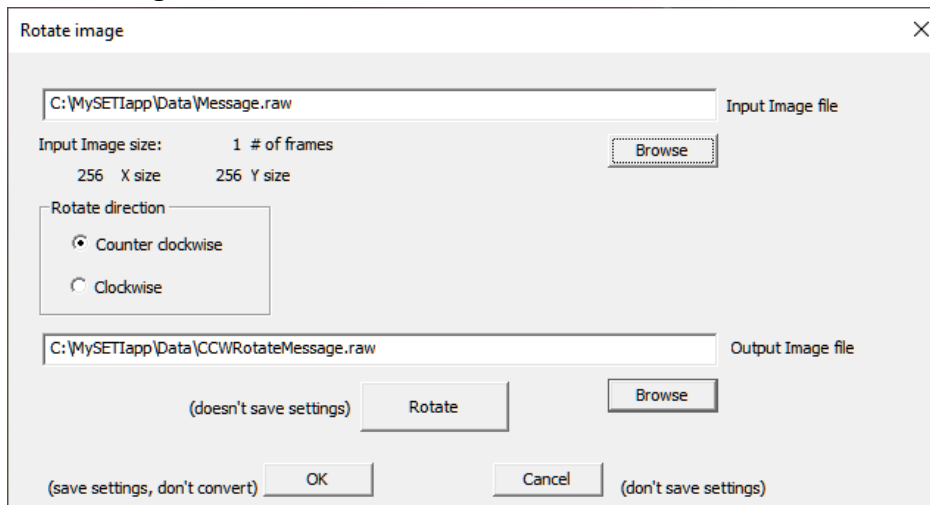
## Left shift rows, delete blank rows

The dialog box is titled "Left shift rows, delete blank rows" and has a close button (X) in the top right corner. It contains the following elements:

- An input field for the "Input Image file" with the path "C:\MySETIapp\Data\Message.raw" and a "Browse" button to its right.
- Below the input field, the text "Input Image size: 1 # of frames" is displayed, followed by "256 X size" and "256 Y size". A "Browse" button is also present to the right of the frame count.
- An output field for the "Output Image file" with the path "C:\MySETIapp\Data\LeftShiftMessage.raw" and a "Browse" button to its right.
- At the bottom, there are three buttons: "Shift" (with "(doesn't save settings)" to its left), "OK" (with "(save settings, don't convert)" to its left), and "Cancel" (with "(don't save settings)" to its right).

This function shifts a row to the left so that leading 0s are eliminated. Blank rows are also deleted. This operation does not appear to be applied to the 'A Sign In Space' message. It is useful for asynchronous serial streams with varying packet lengths.

## Rotate Image

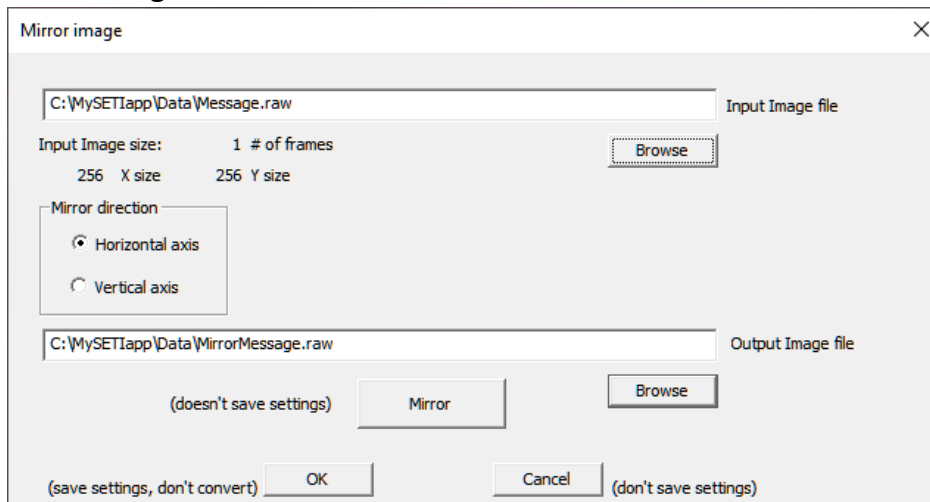


The 'Rotate image' dialog box contains the following elements:

- Input Image file:** A text field with the path 'C:\MySETIapp\Data\Message.raw' and a 'Browse' button to its right.
- Input Image size:** A label 'Input Image size:' followed by '1 # of frames', '256 X size', and '256 Y size'. A 'Browse' button is to the right of the frame count.
- Rotate direction:** A group box containing two radio buttons: 'Counter clockwise' (selected) and 'Clockwise'.
- Output Image file:** A text field with the path 'C:\MySETIapp\Data\CCWRotateMessage.raw' and a 'Browse' button to its right.
- Buttons:** At the bottom, there are three buttons: 'Rotate' (with '(doesn't save settings)' to its left), 'OK' (with '(save settings, don't convert)' to its left), and 'Cancel' (with '(don't save settings)' to its right).

This rotates an image counter clockwise or clockwise. If the image is not square the new image X and Y size will change to reflect the rotation.

## Mirror image



The 'Mirror image' dialog box contains the following elements:

- Input Image file:** A text field with the path 'C:\MySETIapp\Data\Message.raw' and a 'Browse' button to its right.
- Input Image size:** A label 'Input Image size:' followed by '1 # of frames', '256 X size', and '256 Y size'. A 'Browse' button is to the right of the frame count.
- Mirror direction:** A group box containing two radio buttons: 'Horizontal axis' (selected) and 'Vertical axis'.
- Output Image file:** A text field with the path 'C:\MySETIapp\Data\MirrorMessage.raw' and a 'Browse' button to its right.
- Buttons:** At the bottom, there are three buttons: 'Mirror' (with '(doesn't save settings)' to its left), 'OK' (with '(save settings, don't convert)' to its left), and 'Cancel' (with '(don't save settings)' to its right).

This mirrors an image counter on the specified axis. The If the image is not square the new image X and Y size will change to reflect the rotation.

## Convolution

Image convolution

C:\MySETIapp\Data\Message.raw Input Image file

Input Image size: 1 # of frames  
256 X size 256 Y size

Browse

C:\MySETIapp\Data\Convolution\3x3smooth.txt Convolution kernel file

Browse

C:\MySETIapp\Data\Convolution\ConvolvedMessage.raw Output Image file

(doesn't save settings) Convolve Browse

(save settings, don't convert) OK Cancel (don't save settings)

This applies a convolution kernel to the specified image. It does not scale the results afterwards. This function does a kernel convolution on the input image. It does not scale the results afterwards. The convolution kernel is read in from a text file. The kernel weights are floating point numbers and can be less than 0. Kernel sizes do not have to be square and can even be linear (such as a convolution kernel for a 1D image file). If you are not familiar with convolution there is material online and in image processing textbooks that explain it. The border of an image that has been convolved may be missing data due to the convolution. The size of the kernel will dictate how many rows and columns on the border of the image are affected. These will be 0 filled in the output file.

### Kernel file format

n,m                      Kernel size, n wide by m long  
w1 w2 w3 ....        List n\*m long of weights white space delimited  
optional description

### Example

```
3,3
0.071428571 0.142857143 0.071428571
0.142857143 0.142857143 0.142857143
0.071428571 0.142857143 0.071428571
3x3 kernel, smoothing using weighted average
```



## Add/Subtract images

Dialog box titled "Add or Subtract images".

Input Image file: C:\MySETIapp\Data\Signs\SumABCD.raw  
Input Image size: 1 # of frames  
128 X size 128 Y size

Image to add: C:\MySETIapp\Data\Signs\E.raw  
Input Image size: 1 # of frames  
128 X size 128 Y size

Output Image file: C:\MySETIapp\Data\Signs\SumABCDE.raw

(doesn't save settings) Add Subtract Browse

(only save settings) OK Cancel (don't save settings)

This add or subtracts the second to/from the first image. Both input files must have the same X,Y size and number of frames. If there is more than 1 frame in a file than the summation is frame by frame from each file. If the results for pixel is less than 0 it will be set to 0.

## Add/Subtract constant from entire image

Dialog box titled "Add/Subtract constant from entire image".

Input Image file: C:\MySETIapp\Data\Signs\SumABCDE.raw  
Input Image size: 1 # of frames  
128 X size 128 Y size

-1 Pixel value to add/subtract across image

Output Image file: C:\MySETIapp\Data\Signs\Result.raw

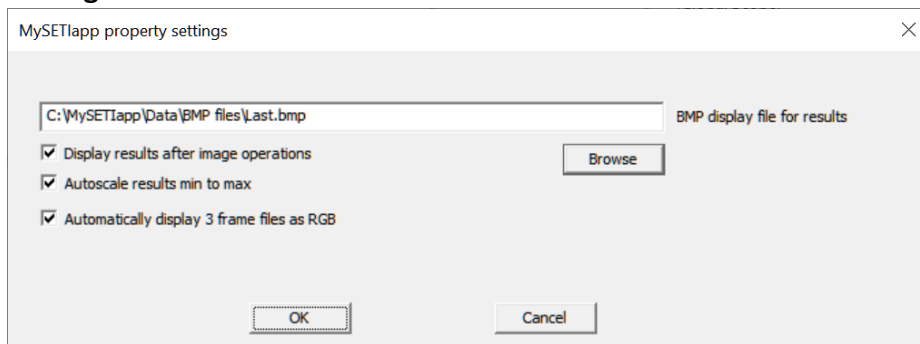
(doesn't save settings) ADD/SUBTRACT Browse

(only save settings) OK Cancel (don't save settings)

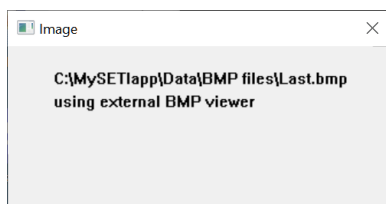
This function adds a constant value across the entire image. The value can be  $< 0$ . If the result for a pixel is less than 0 then the pixel is set to 0.

## Properties and Help menu

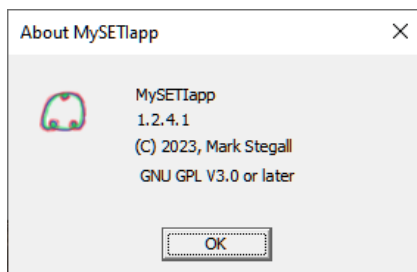
### Settings



The Properties menu allows you to set program settings. Operations that generated an output image file will also generate a BMP file in the folder using the name specified in this settings dialog. The Display results after image operations must be checked for this to happen. This will also cause a bitmap image to be displayed in a separate window.



### About



This displays the application's current About dialog.

## Version information

- V1.0.0.1 Aug 20,2023 Initial release
- V1.1.0.1 Aug 22,2023 Added file type specifications to open/save dialogs  
Added resize image  
Added image decimation  
Added external BMP viewer to show result of an image operation
- V1.2.0.1 Aug 31,2023 Added Convert text to packed bitstream file.  
Added image stats reporting not just image header stats.  
Corrected error handling of reorder list, when entry in kernel is out of bounds, file closure on error.  
Corrected error handling of reorder list, when entry in kernel is out of bounds, file closure on error.  
Clean up of ImageDlg to just rely on external viewer. Use of Windows default viewer for BMP display works adequately.
- V1.2.1.1 2023-09-06 Added import BMP to image file (.raw). Must be 1 bit or 8 bit  
Added HEX text file to binary file  
Decimation process, corrected incorrect calculation for new Y dimension.  
Corrected ImageDlg to display results file only once.
- V1.2.2.1 2023-09-06 Correction, check that the path exists when specifying file is open/save dialog  
Correction, change default folders\filenames  
Correction, change default app settings, removed Autosize setting  
Corrected bug in V1.2.1 when importing BMP file which resulted in incorrect frame size.
- V1.2.3.1 2023-09-06 This release was skipped because of a mix-up of V1.2.1 and V1.2.2
- V1.2.4.1 2023-09-09 Added, Import of CamIRa IMG files (not applicable to A Sign in Space project)  
Added, Add/Subtract constant from images  
Added, batch mode for Bit stream to Image file  
Changed, Sum images to Add/Subtract images  
Cleanup of file open/save dialog filename handling
- V1.2.5.1 2023-09-10 Added standard image decimation (summation)  
Updated, handling of default directories  
Updated, Tab order and default buttons in all dialogs