

MySETIapp

User's guide

V1.2.7.1

Oct 1,2023

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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.

Operations on image files generally result in a new image file. A BMP file of that new image file can be generated. 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

V1.2.6.1 Release

This release:

Added, Increase image size by replication of pixels.

Added, algorithm driven reordering, only 5 algorithms initially implemented.

Added, Block symbol/phrase extraction from either 1D or 2D image file.

Changed, HEX file output to include # bytes to skip at the beginning of the input file

Changed, Display Image/BMP file to include 16 and 32 bit image files using a scaled 8bpp BMP file. (This is not applicable to the 'A Sign in Space' project.)

Correction, Display Image/BMP file was not displaying some BMP files.

V1.2.7.1 Release

This release:

Added, Inversion of inputs bits in bitstream when using Bit stream to text and Bit stream to image operations.

Added, Insert/add image into an existing image, to able to recreate 'A Sign in Space' starmap from the 5 sign image or to make up one's own message.

Correction, 2d symbol extraction requires image y size to be divisible by the y symbol size.

Change, Block symbol extraction now allows highlighting phrases.

Change, added skeleton for adding 5 more algorithms to algorithm reordering operation.

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.

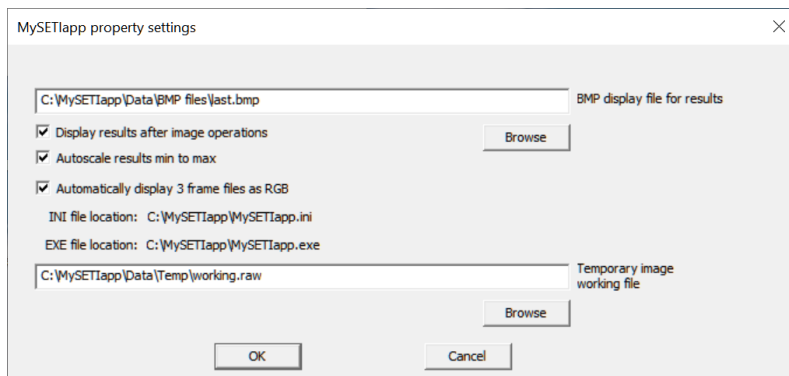
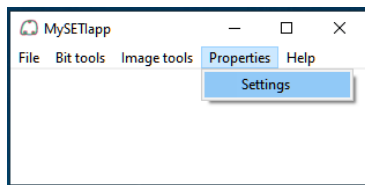
The installer and MySETIapp executable are not digitally signed. You should always check the installation downloads with anti-virus software and verify the MD5 signature of the installer matches just to be safe.

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, ...

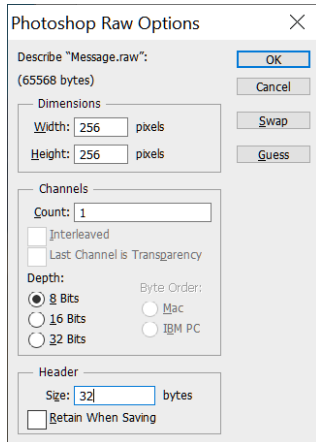
It is recommended that the application 'settings' be set when you first run the application so that it allows the application to display the results from the last image operation. A BMP file must be specified for this to work.

A temporary image working file can be specified. (Currently only used for debugging by saving intermediate processing results.)



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.

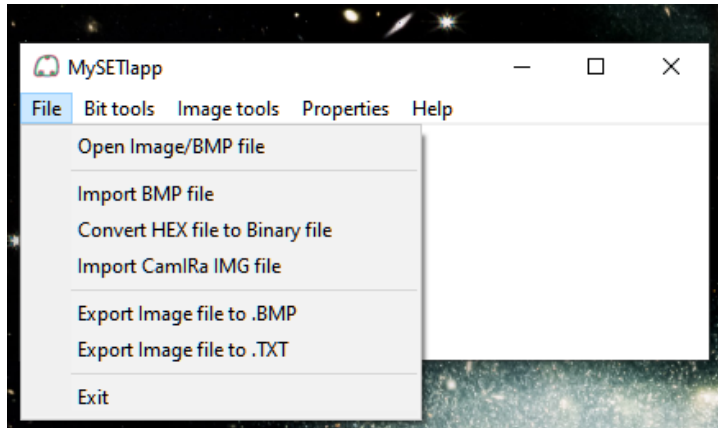
Menu operations

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 1st frame, Green being the 2nd frame and Blue being the 3rd 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

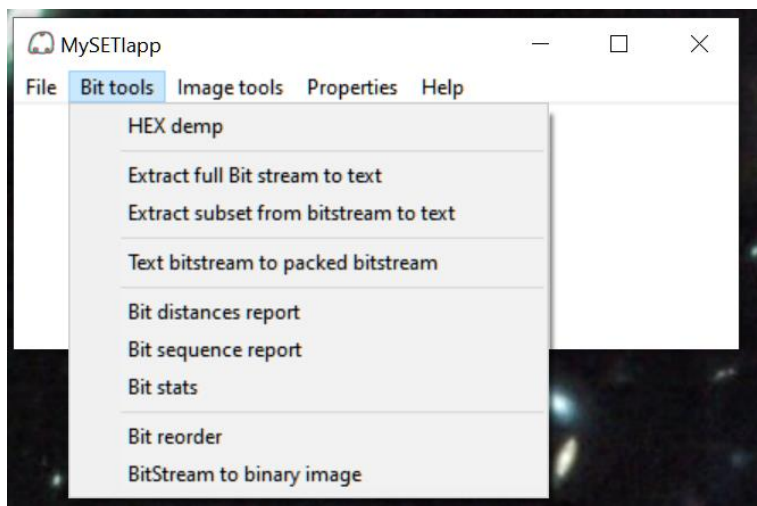
This function imports a CamIRa IMG file into an image file. This is limited to 8 and 16 bit non-extended file formats. No metadata is imported. This function is not applicable to the 'A Sign in Space' project.

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, 2nd 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 fields and controls:

- Packed bitstream input file:** A text box containing "C:\MySETIapp\Data\stream\Message128 wide-4bit.raw" with a "Browse" button to its right.
- # bytes to skip at start of file:** A text box containing "0".
- X size (number of HEX bytes per line):** A text box containing "16", with a note "0 - no EOL" below it.
- Text Output:** A text box containing "C:\MySETIapp\Data\stream\Message128 wide-4bit.hex.txt" with a "Browse" button to its right.
- Buttons:** A "Convert" button, an "OK" button (labeled "(only save settings)"), a "Cancel" button, and a "don't save" 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.

You can specify the number of bytes to skip at the beginning of the input file. This is useful if you do not want to include the 32 byte header of an image file.

Extract full Bit Stream to text

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

- Packed bitstream input file:** A text box containing "C:\MySETIapp\Data\Albert\GuessWhatThatIs4.bin" with a "Browse" button to its right.
- # bits in prologue:** A text box containing "80".
- #bits in header for a block:** A text box containing "0".
- #bits in block:** A text box containing "65536".
- X size:** A text box containing "32".
- Number of blocks:** A text box containing "1".
- Invert bits:** An unchecked checkbox.
- Text Output:** A text box containing "C:\MySETIapp\Data\Albert\Guess4.txt" with a "Browse" button to its right.
- Buttons:** A "Convert" button, an "OK" button (labeled "(only save settings)"), a "Cancel" button, and a "don't save settings" 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. The Invert bits flag inverts the input bits from the bit stream.

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" and a "Browse" button.
- #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.

Text bitstream to packed bitstream

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 ≥ 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:

- A text input field for the "Packed bitstream input file" with the path "C:\MySETIapp\Data\OriginalSource\data17.bin".
- A numeric input field for "# bits to skip" with the value "0", accompanied by a "Browse" button.
- A text input field for the "Text Output" with the path "C:\MySETIapp\Data\data17-bit-distances.txt", accompanied by a "Browse" button.
- A "Report" button.
- Three status labels: "(doesn't save settings)" to the left of the "Report" button, "(save settings, don't convert)" to the left of the "OK" button, and "(don't save)" to the right of the "Cancel" button.
- "OK" and "Cancel" buttons at the bottom.

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.

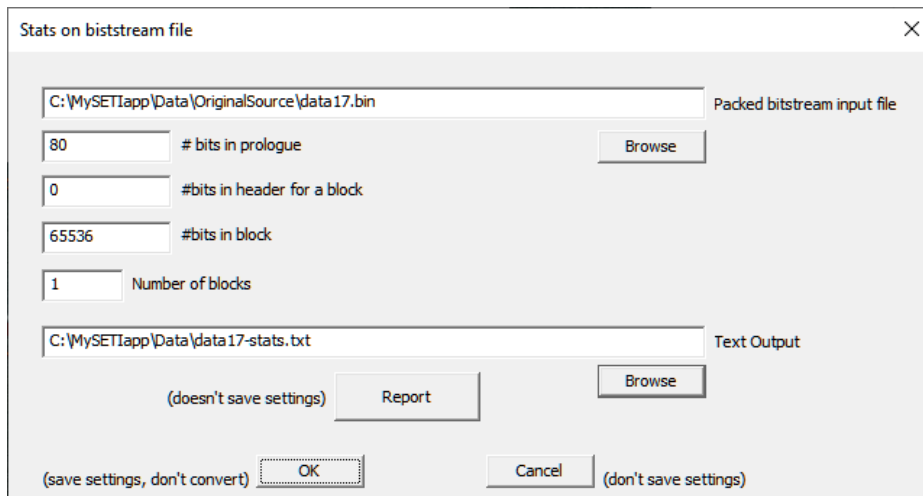
Bit Sequences report

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

- A text input field for the "Packed bitstream input file" with the path "C:\MySETIapp\Data\OriginalSource\data17.bin".
- A numeric input field for "# bits to skip" with the value "0", accompanied by a "Browse" button.
- A text input field for the "Text Output" with the path "C:\MySETIapp\Data\data17-bit-sequences.txt", accompanied by a "Browse" button.
- A "Report" button.
- Three status labels: "(doesn't save settings)" to the left of the "Report" button, "(save settings, don't convert)" to the left of the "OK" button, and "(don't save)" to the right of the "Cancel" button.
- "OK" and "Cancel" buttons at the bottom.

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\Albert\GuessWhatThatIs4.bin" and a "Browse" button.
- # bits in prologue (skipped):** A text box with the value "0".
- 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 "65672".
- X size:** A text box with the value "64".
- 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.
- Invert bits:** An unchecked checkbox.
- Image Output file:** A text box with the path "C:\MySETIapp\Data\Albert\junk.raw" and a "Browse" button.
- Buttons:** "Convert", "OK", and "Cancel".
- Labels:** "(doesn't save settings)" above the "Convert" button, "(only save settings)" above the "OK" button, and "(don't save settings)" above 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. . Invert bits flag invert the input bits from the bit stream.

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.

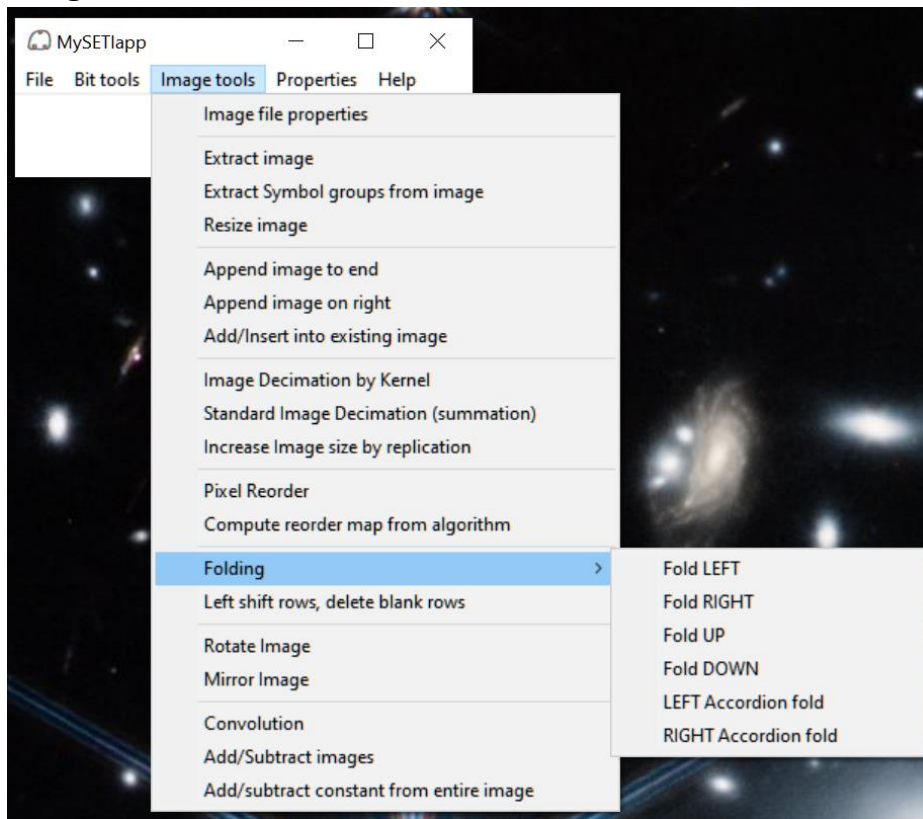
Bit reorder

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", and "Cancel".
- Labels:** "(doesn't save settings)" above the "Reorder" button, "(save settings, don't convert)" above the "OK" button, and "(don't save settings)" above the "Cancel" button.

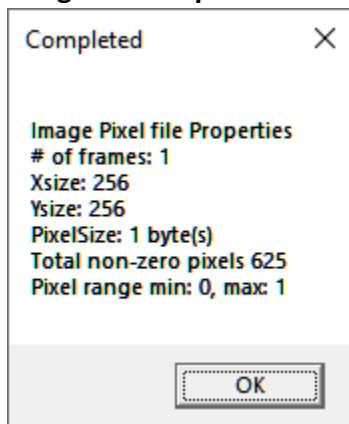
See the Image reordering documentation for the formats that can be used for the reorder files. When using bit reorder from the bit tools menu the reordering must be 1D (Ysize=1). The X size must be divisible by the Xsize of the reordering kernel. The linear image is divided into groups the X size of 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 dialog box is titled "Extract subimage from image". It contains the following fields and controls:

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

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.

Extract Symbol sequence packets for image file

The dialog box is titled "Extract Symbol sequence packets from image file". It contains the following fields and controls:

- Symbol image file:** A text box containing "C:\MySETIapp\Data\Message256x256.raw" with a "Browse" button to its right.
- Input Image size:** A label with "256 X size" and "256 Y size".
- 1 Pixel size (bytes):** A text box containing "1" with a "Browse" button to its right.
- symbol X size:** A text box containing "16".
- symbol Y size:** A text box containing "16".
- Max # of consecutive null symbols allowed sentence:** A text box containing "1".
- Input File Approach:** A group box containing two radio buttons: "1D linear list" (unchecked) and "2D subdivided into symbols" (checked).
- Highlight symbols:** A checked checkbox.
- Results image file of symbols:** A text box containing "C:\MySETIapp\Data\Symbols\2D 16x16-1m.raw" with a "Browse" button to its right.
- Buttons:** "(doesn't save settings)", "Extract", "Browse", "(only save settings)", "OK", "Cancel", and "(don't save settings)".

This function extracts block symbols from an image file. This can be either a 1D extraction or a 2D extraction. This also creates phrases which are a series of symbol separated by small blank space (null

symbols) and ended with a longer blank space (null symbols). Highlight symbols is enabled that the null symbols in the results image will be used to highlight the symbols and phrases.

Resize Image

Resize image

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

Input Image size: 1 # of frames 0 Pixel size (bytes)

256 X size 256 Y size

Browse

New size X*Y must equal old size X*Y

256 New Xsize 256 New Ysize

1 New pixel size (bytes)

Output Image file: C:\MySETIapp\Data\Resized.raw

(doesn't save settings) Resize

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

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.

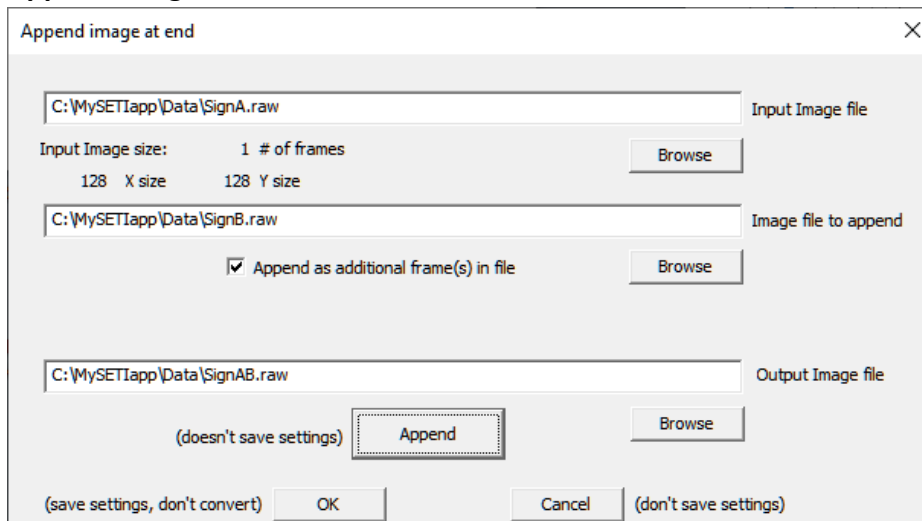
Limitations:

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



The dialog box titled "Append image at end" contains the following fields and controls:

- Input Image file:** A text box containing "C:\MySETIapp\Data\SignA.raw" with a "Browse" button to its right.
- Input Image size:** A label with "1 # of frames" to its right. Below it are two labels: "128 X size" and "128 Y size".
- Image file to append:** A text box containing "C:\MySETIapp\Data\SignB.raw" with a "Browse" button to its right.
- Append as additional frame(s) in file:** A checked checkbox with a "Browse" button to its right.
- Output Image file:** A text box containing "C:\MySETIapp\Data\SignAB.raw" with a "Browse" button to its right.
- Buttons:** At the bottom, there is a "(doesn't save settings)" label, an "Append" button, and a "Browse" button. Below these are three buttons: "(save settings, don't convert)", "OK", and "Cancel", followed by another "(don't save settings)" label.

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

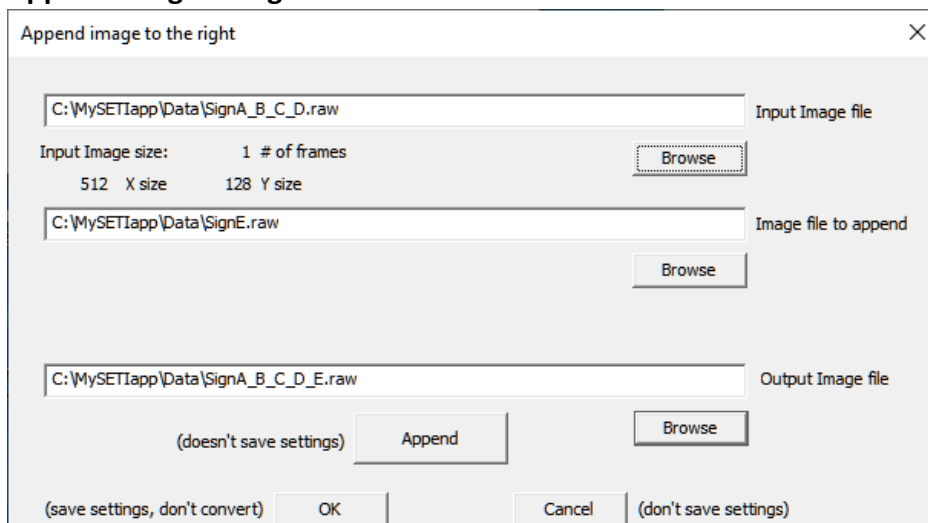
Appended to frame condition

If the 2nd 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 2nd 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 2nd 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 dialog box titled "Append image to the right" contains the following fields and controls:

- Input Image file:** A text box containing "C:\MySETIapp\Data\SignA_B_C_D.raw" with a "Browse" button to its right.
- Input Image size:** A label with "1 # of frames" to its right. Below it are two labels: "512 X size" and "128 Y size".
- Image file to append:** A text box containing "C:\MySETIapp\Data\SignE.raw" with a "Browse" button to its right.
- Output Image file:** A text box containing "C:\MySETIapp\Data\SignA_B_C_D_E.raw" with a "Browse" button to its right.
- Buttons:** At the bottom, there is a "(doesn't save settings)" label, an "Append" button, and a "Browse" button. Below these are three buttons: "(save settings, don't convert)", "OK", and "Cancel", followed by another "(don't save settings)" label.

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.

Add/Insert into existing image

Insert or adds and image into an existing image. Normally the image being added would be smaller than the existing image. The existing image sets the output image size and is not extended. If the image being added/inserted extends outside the bounds of the existing image then those portions of the added/inserted image are excluded. The added/inserted image is centered at the x,y location specified in the existing image. Selecting ‘Add’ sums the the image into the existing image. Selecting ‘Overwrite’ replaces that area of the existing image with the inserted image.

Image Decimation by Kernel

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)

Standard image decimation

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

Input Image size: 1 # of frames 1 Pixel size (bytes) Browse

256 X size 256 Y size

Image Xsize must be divisible by X decimation Image Ysize must be divisible by Y decimation

2 X decimate size 2 Y decimate size

1 New pixel size (bytes) if change needed

C:\MySETIapp\Data\Decimated.raw Output Image file

(doesn't save settings) Decimate Browse

(only save settings) OK Cancel (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 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.

Increase image size by replication

The dialog box titled "Increase image size by replication" contains the following fields and controls:

- Input Image file:** A text field with the path "C:\MySETIapp\Data\128x512\FoldUp4x.raw".
- Input Image size:** A section showing "1 # of frames", "0 Pixel size (bytes)", "32 X size", and "32 Y size". A "Browse" button is to the right.
- X duplication size:** A text field with the value "8".
- Y duplication size:** A text field with the value "8".
- Output Image file:** A text field with the path "C:\MySETIapp\Data\128x512\replicated.raw".
- Buttons:** "(doesn't save settings)", "Replicate", "Browse" (for output file), "(only save settings)", "OK", "Cancel", and "(don't save settings)".

This increases the image size by the x,y the duplication values. The new image size is original x size * x duplication size by original y size * y duplication size. Each pixel in the original image is turned into a block x,y duplication size and written to the new image file.

Pixel Reorder

The dialog box titled "Reorder pixels in image" contains the following fields and controls:

- Input Image file:** A text field with the path "C:\MySETIapp\Data\Message.raw".
- Input Image size:** A section showing "1 # of frames", "256 X size", and "256 Y size". A "Browse" button is to the right.
- Pixel reorder file:** A text field with the path "C:\MySETIapp\Data\Reorder\8x1\Permutations8.txt".
- Options:** Two checked checkboxes: "Enable batch reordering file" and "Generate BMP file for each". A "Browse" button is to the right.
- Output Image file:** A text field with the path "C:\MySETIapp\Data\Batch\Reordered.raw".
- Scale binary to 0,255:** An unchecked checkbox with a "Browse" button to its right.
- Buttons:** "(doesn't save settings)", "Reorder", "(only save settings)", "OK", "Cancel", and "(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

Compute reorder map from algorithm

Reordering using algorithm

Input Image file: C:\MySETIapp\Data\Signs\CleanA.raw

Input Image size: 128 X size, 128 Y size, 1 # of frames, 1 Pixel size (bytes)

Algorithm selected: Quadrant UL,UR,LL,LR, left to right, top to bottom

New Xsize: 256, New Ysize: 256, New size X*Y must equal old size X*Y

If algorithm does not change size enter the input image size: 0, New pixel size (bytes), 0 keep input image pixel size

Output Image file: C:\MySETIapp\Data\Reorder\MySignTestQ.raw

(doesn't save settings) Reorder Browse

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

The image is reordering using the selected algorithm.

Folding along column (LEFT or RIGHT)

Fold image to the left

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

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

Fold image left at this column: 129

Output Image file: C:\MySETIapp\Data\FoldLeft.raw

(doesn't save settings) Fold Browse

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

Fold image up

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

Input Image size: 129 X size, 256 Y size, 1 # of frames

Browse

Fold Up at this row: 125

Output Image file: FoldLeftFoldUp.raw

(doesn't save settings) Fold Browse

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

Accordion fold image to the left

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

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

Browse

size of accordion (fold to the left): 16

Output Image file: C:\MySETIapp\Data\AccordionLeft.raw

(doesn't save settings) Fold Browse

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

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 has a title bar with a close button. It contains two text input fields for file paths, each with a 'Browse' button to its right. The first input field is labeled 'Input Image file' and contains the path 'C:\MySETIapp\Data\Message.raw'. Below it, the 'Input Image size' is shown as '1 # of frames', '256 X size', and '256 Y size'. The second input field is labeled 'Output Image file' and contains the path 'C:\MySETIapp\Data\LeftShiftMessage.raw'. Below the output field is a 'Shift' button. At the bottom, there are three buttons: 'OK', 'Cancel', and a third button. To the left of 'OK' is the text '(save settings, don't convert)', and to the right of the third button is the text '(don't save settings)'. Above the 'Shift' button is the text '(doesn't save settings)'.

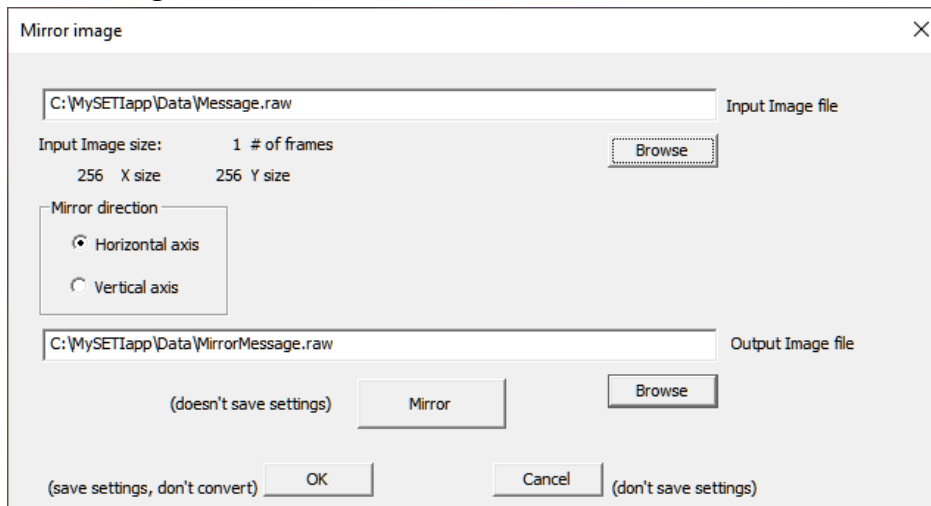
This function shifts a row to the left so that leading 0s are eliminated. Blank rows are also deleted. This operation does not appear to be applied to the 'A Sign In Space' message. It is useful for asynchronous serial streams with varying packet lengths.

Rotate Image

The dialog box has a title bar with a close button. It contains two text input fields for file paths, each with a 'Browse' button to its right. The first input field is labeled 'Input Image file' and contains the path 'C:\MySETIapp\Data\Message.raw'. Below it, the 'Input Image size' is shown as '1 # of frames', '256 X size', and '256 Y size'. Below the input size is a 'Rotate direction' section with two radio buttons: 'Counter clockwise' (selected) and 'Clockwise'. The second input field is labeled 'Output Image file' and contains the path 'C:\MySETIapp\Data\CCWRotateMessage.raw'. Below the output field is a 'Rotate' button. At the bottom, there are three buttons: 'OK', 'Cancel', and a third button. To the left of 'OK' is the text '(save settings, don't convert)', and to the right of the third button is the text '(don't save settings)'. Above the 'Rotate' button is the text '(doesn't save settings)'.

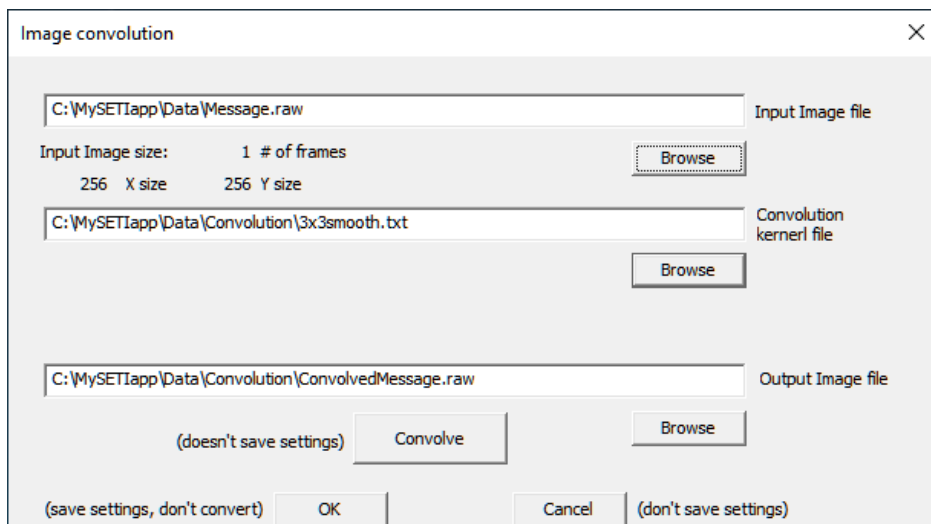
This rotates an image counter clockwise or clockwise. If the image is not square the new image X and Y size will change to reflect the rotation.

Mirror image



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



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

Add or Subtract images

C:\MySETIapp\Data\Signs\SumABCD.raw Input Image file

Input Image size: 1 # of frames
128 X size 128 Y size Browse

C:\MySETIapp\Data\Signs\E.raw Image to add

Input Image size: 1 # of frames
128 X size 128 Y size Browse

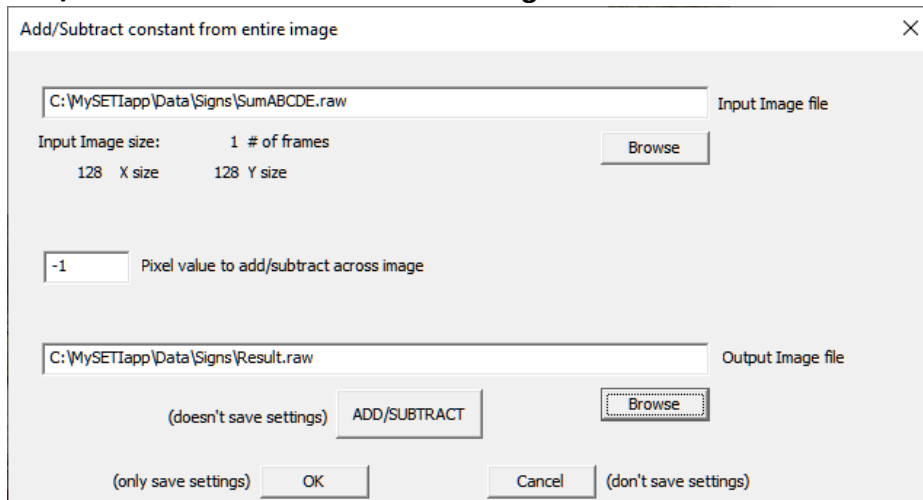
C:\MySETIapp\Data\Signs\SumABCDE.raw Output Image file

(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 then the summation is frame by frame from each file. If the results for pixel is less than 0 it will be set to 0.

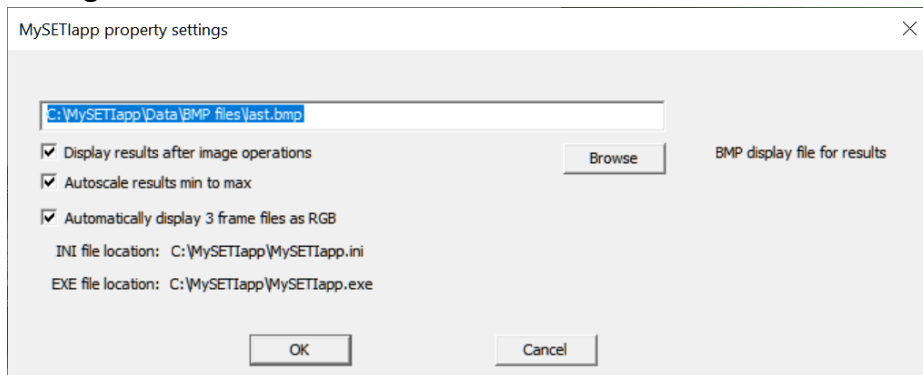
Add/Subtract constant from entire image



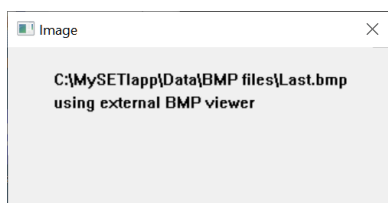
This function adds a constant value across the entire image. The value can be < 0 . If the result for a pixel is less than 0 then the pixel is set to 0.

Properties and Help menu

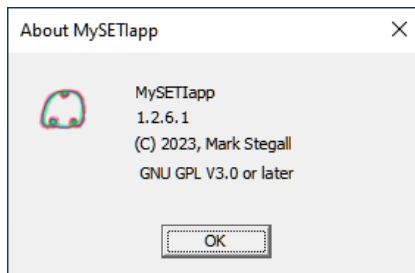
Settings



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
- V1.2.6.1 2030-09-24 Added, Increase image size by replication of pixels.
Added, algorithm driven reordering, only 5 algorithms initially implemented.
Added, Block symbol/phrase extraction from either 1D or 2D image file.
Changed, HEX file output to include # bytes to skip at the beginning of the input file.
Changed, Display Image/BMP file to include 16 and 32 bit image files using a scaled 8bpp BMP file. (This is not applicable to the 'A Sign in Space' project.)
Correction, Display Image/BMP file was not displaying some BMP files.

V1.2.7.1 2023-10-01 Added missing description for the Block symbol extraction.
Added, Inversion of inputs bits in bitstream when using Bit stream to text and Bit stream to image operations.
Added, Insert/add image into an existing image, to able to recreate 'A Sign in Space' starmap from the 5 sign image or to make up one's own message.
Correction, 2d symbol extraction requires image y size to be divisible by the y symbol size. Change, Block symbol extraction now allows highlighting phrases.
Change, added skeleton for adding 5 more algorithms to algorithm reordering operation.