PixelWrench2 - Frequently Asked Questions
Version 1.5

Q. What is PixelWrench2?

A. PixelWrench2 (PW2) is an image handling application written and copyrighted by Tetracam Inc. PW2 is supplied with all Tetracam multispectral camera products. It provides numerous image manipulation tools and two distinct interfaces to ADC and MCA cameras. It runs on Microsoft Windows platforms, the current revision requires the Dot.NET 3.5 framework to be present.

Q. Is it freeware?

A. No. PW2 is a proprietary application supplied to users of Tetracam cameras. The source code is not available and is not part of any opensource project. PW2 may not be reverse engineered or sold. It may be copied for use on multiple machines.

Q. I don't have an ADC or MCA but I am working with images from one. Can I get a copy of PW2?

A. Yes. A full installation of the latest revision of PW2 is always available at www.tetracam.com/PW2setup.zip. PW2 is updated and revised on a regular basis. Updates are free and available at www.tetracam.com/PW2update.zip.

Q. How is it structured?

A. PW2 is a Windows Multiple Document Interface application. You can work with multiple images open on the screen at once. The management and editing tools provided are accessed from both the Main menu and from an assortment of tool forms containing specialized controls.

Q. What image formats can it handle?

A. Standard file formats include BMP, TIF, JPEG, PNG, WMF and TXT. Specialized formats include Tetracam DCM and RAW. TIF's generated from RAW8 files will carry a metadata tag #9286 of 8, TIFs generated from RAW10 or DCM files will carry metadata tag #9286 of 9. To extract pixel Digital Numbers from an image type of 8 requires only reading the pixel value which will range from 0 to 255. Extracting the 10 bit value from a TIF or type 9 or a RAW10 or DCM file requires the following; The monochrome image is displayed as a 24bit DIB, three bitplanes of Green, Red and Blue each with possible values ranging from 0 to 255. To get the 10 bit value (0 to 1023) first multiply the value of the Green bitplane by 4. Then subtract the

value of the Blue bitplane from the Green bitplane. This value will fall in the range of 0 to 3. Add this to the result of the Green bitplane multiplication. Ex:

Green = 236 * 4 = 944
Blue = 234, so 236 - 234 = 2
10 bit Digital Number = 944 + 2 = 946

Q. Why use PW2 instead of another general purpose application?

A. As stated before, PW2 provides two distinct interfaces to Tetracam cameras; a USBDISK interface for cameras configured as USB mass storage devices and a "native mode" interface for cameras configured as USB stream devices. PW2 also provides very specialized tools for management of MCA image sets, color processing of Tetracam RAW and DCM files, complex batch processing tools, production of several vegetation index and canopy segmentation images, along with a comprehensive suite of image editing tools.

Q. I have some Tetracam RAW and DCM files from an ADC camera. How do I get NDVI from them?

A. Tetracam ADC *.RAW files are basically collections of raw pixel values (digital numbers) along with a small amount of embedded data including a GPS sentence (if a GPS receiver was connected to the camera), exposure time and camera serial number. DCM files are largely the same thing in a proprietary losslessly compressed format. In both cases the raw pixel values must be processed to yield a "false color" bitmap. We say false color because the most common way of representing the scene taken by an ADC is to place the near infrared light on the red bitplane of the image, the red light on the green bitplane and the green light on the blue bitplane. This results in the red/pink vegetation familiar to most users of multispectral images. Once the false color image is available PW2 can extract an NDVI image from it. All the tools needed to color process RAW and DCM files and produce vegetation indexes are on the IndexTools form. Tetracam MCA cameras also produce RAW and DCM files which do not require color processing. The pixel values in these files represent the digital number produced by the sensor when exposed to light of a specific center wavelength and bandwidth.

Q. You didn't answer my question. Which buttons do I push to process an ADC file???

A. Open a RAW or DCM file. You'll see a monochrome (grayscale) image on screen.
- Open the IndexTools form.
- From the selection box at the top of the Index tab, select *Process Raw Image:….*

- Click *Execute*. The raw, monochrome image will appear in color.
- Now from the same selection box, select NDVI, click *Execute*.
- A new image form will appear (behind the original) containing the NDVI image.

The image will be in monochrome if the Palletize box on the Palette tab was unchecked, or it will appear in palletized form if the box was checked.

You can simultaneously create a *.csv (comma separated value) file of any index for export into MS Excel. The file will include the index value (-1 to +1 etc) along with the percentage of the image at that value.

Q. There's a button called *Calibrate* on the Index tab. Please explain.

A. Ah yes, the most FA of the FAQ.

The *Calibrate* button allows you to tell PW2 what the ratio of NIR to red (and NIR to green) happened to be at the time you took the picture of the calibration tag. It's used this way; prior to taking pictures of a plot or acreage, take a shot of the Teflon calibration tag supplied with the camera. Hold the tag so it fills the field of view and make sure it is illuminated by the sun (not in the shade) and not reflecting the sun directly back at the camera. It's not necessary for the tag to be in focus. Open the calibration tag image before extracting any indexes (NDVI, Green NDVI, SAVI) and color process it. In normal conditions, a color processed calibration tag will have a cyan cast.

On the color processed image, select an area, making sure the pixels are not saturated. Once the selection is made, click the *Calibrate* button. A pair of numbers will appear in the box to the right of the button representing the NIR/red and NIR/Green mix of the image weighted to the ASTM G173-03 global tilt spectra. The appropriate number is then applied to any index extractions using the red, green and NIR .

The calibration values are not used in color processing RAW or DCM files, only when calculating the NDVI, SAVI, Green NDVI or ARVI. Canopy Segmentation does not use the calibration value.

Q. What's NIR/Green calibration and when is it used?

- It's similar to the NIR:R&G calibration tool with a few very important differences. It represents the maximum NIR/Green ratio in the sample.
- The sample is not the Teflon plate but a fully nitrolized sample plot of the species being investigated.
- It's used only for the NIR/G (Takebe) index.

Q. What's the advantage of DCM over RAW or vice versa?

A. DCM – smaller due to moderate compression, 10 bit resolution, takes time to run the compression cycle in the camera.

RAW 10bit – Very large (2 bytes/pixel), 10bit resolution, no compression time in the camera.

RAW 8bit – Sizable (1 byte/pixel), no compression time, quickest camera cycle time.

Q. Okay, to color process a RAW or DCM it says I need to load a "cpf" file. What's that?

A. A *.cpf file is a small file containing sets of numbers used in processing the raw Bayer samples. Your ADC camera shipped with a cpf file, specific to that camera. In addition a "default" cpf file for ADC 3.2mPel cameras called ADC_32_global.cpf is included in the \Support folder located in the PW2 main folder. It's loaded automatically at startup if PW2 sees that no other file has been loaded previously. Along with the color matrix, the cpf file can contain lens vignetting correction values. The current PW2 release has the ability to create two different cpf files. The default (narrowband) file models the camera response to three bands at 550, 650 and 800 nm, each 10nm wide. The "WB", or wideband file models the camera response to the TM bands, 2 3 and 4. To create the WB type cpf, check the box labeled WB. To make a custom cpf file, open a RAW or DCM of a Teflon tag (make sure the tag is not overexposed), select an area near the center of the tag and click the *Make CPF* button. The matrix values will be populated with values specific to the camera that produced the image. Save the resulting matrix to a cpf file for future use.

Q. Can't I just open the RAW or DCMs and have them color processed automatically?

A. Yes, check the *Color Process RAW or DCM on Open using......* item on the main menu. Images will be processed using the currently selected cpf file.

Q. I have an ADC and I want to get the pictures out of it. What do I do?

A. ADC cameras running firmware revision 5.118 and later can be configured as "native" streaming mode cameras or as USBDISK mode cameras. Streaming mode access uses the camera toolbar interface. To open the camera toolbar open the Edit menu and select *Show Camera Toolbar*. Make sure the camera is powered up and connected to USB, on the toolbar click the top button (*Status:ADC*). A status dialog will appear showing the firmware revision, image count etc. Click OK to close it. The remaining buttons on the toolbar will now be enabled, allowing configuration of the camera, image downloading etc. The second camera interface, only for USBDISK mode cameras is called the Image Transfer and GPS distiller tool. Launch it from the *View* menu. The GPS Distiller provides tools for configuration of the camera settings and alarms along with image transfer to disk and distillation of raw *.LOG files to compact *.gps files used to refine the position information in ADC images containing GPS data. Of course, a USBDISK device can be accessed directly from a Windows file explorer dialog for simple file transfer, erasure etc. The image files will

be located in the TTCADC or TTCMCA folder. Drag and drop the files onto the PW2 application window.

Q. I have hundreds of images that need processing. Is there a way to automate that or am I staying up all night?

A. The IndexTools form has a tab labeled *Batch*. Batch processing can be done with a collection of images already opened to the screen (Called *Screen Batch*, great when you only need to process a handful of images) or by targeting a folder containing any number of images and running *Folder Batch*. Either process will color process the RAW or DCM and extract any vegetation index, canopy segmentation or single channel color separation you indicate. If the images have been color processed already or are in a standard format (JPG, TIF etc) that's fine too. PW2 will just proceed to extracting the types of indexes you've selected. The resulting derived images are written to a target folder that you designate.

Q. I just received my MCA. Wow that thing produces a lot of image files! Does PW2 have management tools for MCA sets?

A. Again, IndexTools to the rescue. Open the MCA tab to find tools for combining RAW or DCM file sets into multipage or individual TIF files. Each multipage TIF file will contain the image from the master and each slave camera, properly registered and corrected for lens vignetting. A six channel MCA will produce multipage TIFs of 6 pages, the master image on page zero, the slaves on pages 1 through 5. If you select individual TIFs, each will be scaled, rotate and translated according to the current *.mca alignment file.

Q. So what's the workflow for getting images from the camera to some useful state?

A. It's really simple but there are a few steps;

> 1. Transfer the RAW or DCM images from all the camera CF cards to a single folder on your machine. If the camera is setup as a USBDISK device (recommended) you can either drag and drop the images from each card or use the GPS Log Distiller program included with PW2 to transfer all the images to a folder you designate.

> 2. Run PW2 and open the IndexTools form. Click to the MCA page and make sure the correct *.mca alignment file is loaded. Then click "Save RAW sets as: MultiFrame Tif" (or DCM as the case may be). You'll be asked to point to the folder you transferred the original camera files to. PW2 will correctly combine the master and slave images for each shot into a multipage TIF.

3. Open the TIF file you want to work with, select the three bands you want to combine into a 24 bit false color image and click "MultiFrame Tif > RGB". The false color image will appear on screen. That's it.

Q. How does PW2 know how to register the images from my camera?

A. Your camera shipped with a file on the CD called (your camera serial number)_Global.mca. That file should be loaded by clicking *Open MCA* before processing DCM or RAW images to TIF. The *.mca file contains a set of values that properly align the separate channels when photographing objects at large distances, a few hundred feet and beyond.

Q. What if I'm taking pictures of closer objects?

A. Beginning with PW2 version 1.0.5.7 you can specify the distance you want the images aligned for and build multipage TIFs that produce correctly registered images. You enter the camera lens focal length and the distance you took the pictures from, click on a checkbox and build the TIFs. The program modifies the values read from the *.mca file to compensate for the closer working distance.

Q. I have multipage TIFs. Now What?

A. Single pages from the TIFs can be exported to other applications or you can extract any combination of three pages to a 24 bit Windows DIB. First use the three selection boxes to select the camera channels to extract then click MultiFrame TIF > RGB. A 24 bit full color image will appear containing the three bands you selected. This image can now be processed further to a vegetation index or canopy segmentation. If you have large numbers of TIF files that you want the same channels extracted from, use the Batch > RGB button to process directly from a source folder.

Q. I know that ADC and MCA cameras can trap the output of a GPS receiver. Where is the GPS information stored? Can PW2 retrieve it?

A. MCA and ADC cameras will capture the NMEA GGA and RMC sentences emitted by a receiver connected to the camera serial port. The most recent sentence is pulled from the serial buffer and written to the RAW or DCM image header. PW2 reads the header and if it finds GPS data, it parses the sentence into readable form and writes it to the image metadata. When (or if) that processed RAW or DCM is saved out as a standard file format the metadata is written to the target file if the file type supports metadata (be aware that *.BMP doesn't). You can view the metadata embedded in any image by opening the Metadata form, available on the *View* menu. You can also save a text file containing the metadata from all the pictures in a folder.

Q. How does the Image Transfer and GPS Distiller come into all this?

A. The IT&GPS tool has several functions. First off, it's a separate executable program, called *GPSLOG.exe* located in the PW2 root folder and can be launched independently of PW2. It offers tools to gather information on any camera(s) or Tetracam camera CF card(s) on the system. It provides a simple one click multi-threaded transfer tool for getting images and log files off the CF card(s). It will distill raw camera logs into compact *.gps files that PW2 uses to refine the GPS data embedded in ADC and MCA image files. It provides a camera interface for ADC and MCA cameras allowing configuration of several important parameters. It contains an alarm editor for cameras running alarm capable firmware.

Q. What's a "raw camera log" and what's a "*.gps" file.

A. ADC and MCA systems can maintain a log of the events occurring during each use cycle. The log will contain a time, expressed in camera clock ticks and any important events that occurred at that time such as an image capture, receipt of a GPS sentence or an external tick, from an IMU for instance. The log can be very lengthy and is not at all user friendly. The *GPS Distiller* reads this raw log file and distills it into a compact (human readable) text file containing an image name/number and the correct GPS position of the camera at the time of image capture. The "correct" position is interpolated from the GPS tags preceding and following the image capture time, and the time differences of the GPS tags and the actual image capture. The resulting *.gps file is written to the same folder that the image files and the raw log were transferred to (assuming the File Transfer tool was used). When a RAW or DCM image is opened from that folder, PW2 looks for a *.gps file containing a refined GPS sentence for that image number. If one is found, it replaces the original GPS sentence embedded in the image metadata. Simple, huh?

Q. Are my images fully ground referenced?

A. No. PW2 is not designed for ground referencing or geo-tagging. There are several very powerful GIS packages on the market designed for just that.

Q. Is PW2 good for anything else? Can I edit regular image files?

A. Sure. PW2 provides common image editing tools from the Main/Edit menu and from the EditTools form. EditTools presents multiple tabs, similar to the IndexTools form. The Basic tab provides twenty five common image edit functions, HSV tab allows modification of Hue/Saturation/Value. The ApplyCurve tab allows application of arbitrary brightness curves to the image and the Text/Drwg tab provides a means of annotating images.