

Double 4K Multispectral Pix4D User Guide

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OVERVIEW

Sentera has optimized settings and a workflow for stitching Sentera Double 4K imagery with Pix4D. While Sentera does not officially support Pix4D, this guide offers a starting point for customers interested in using Pix4D with Sentera imagery. This guide is specifically for producing stitched mosaics from images taken by Sentera's Double 4K multispectral imager. FieldAgent can be used to create RGB, NDVI and NDRE images without mosaicing.

REQUIREMENTS

Pix4D, like all stitching software, performs better with high overlap. Sentera recommends a minimum of 70% overlap for Pix4D. Sentera has stitched with 65% and 60% in in ideal conditions but finds 70% to provide good results consistently.

Focal Length	5.4 mm
Pixel Pitch	1.55 um
Resolution	4000x3000 pixels
Sensor Width	6.200 mm
Sensor Height	4.640 mm

Table 1 - Camera parameters for the Double 4K camera.

PREPROCESSING

Note: Firmware Versions 0.25.2 and up will not require this step. Skip to Page 7

For Pix4D to properly process the reflectance of each band, some additional information must be added to each image. This is done by using the **'D4k-MS-Preprocessor-V1.zip'** utility provided by Sentera. To use this file:

- 1. Unzip the contents of the file to a location of your choice.
- 2. Run the 'D4k-MS-Preprocessor-V1.bat' program
- 3. A folder selection dialog will appear. From here, select a **session** folder that you wish to process. Session folders will contain both an RGB and NIR folder.
- 4. Select the session folder and click 'OK'



5. If the selected session is a multispectral session, then all images in the folder will be updated with additional information required by pix4d.



- 6. On success, a new file in the session will be created called '**p4d_preprocess_results.txt'**. The presence of this file should act as an indicator that the correct XMP tags have been added to this session.
- 7. Run this script on all sessions that you wish to use in Pix4D.

PREPARING PIX4D FOR THE NEW PROCESS

IMPORTANT: This step is only required if you have used the multispectral camera for stitching projects in the past. You will only have to do this once to convert over to the new Multispectral process. After this, you can skip this step.

Pix4D will attempt to remember any cameras and settings that you have use in previous stitching projects. As a side effect of this, it will end up ignoring the new changes to the files that allow for easier multispectral camera usage. To force Pix4D to load all the camera parameters and bands from the images instead of it's database, you have to delete the old entries from the internal database. Perform the following steps to do this:

- 1. Close any open copies of Pix4D
- 2. Navigate to the pix4d database at:
 - a. C:\Users\<Your UserName>\AppData\Local\pix4d\common\<pix4d Version #>\
- 3. **IMPORTANT:** Make a copy of the **ucmdb.xml** for backup before modifying the file.
- 4. Open the ucmdb.xml file in a text editor.

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) 🗄 Documents 🦻	* Name	Date modified Type	Size		
E Pictures	icmdb - Copyaml.bak	1/12/2018 3:22 PM BAK File	498 KB		
s 💻 MONTEGO 🧳	f icmdb.xml	1/19/2018 2:40 PM XML Document	498 KB		
F gps_session_001	ucmdb - Copy (2).xml	1/16/2018 5:21 PM XML Document	21 KB		
Outputs	ucmdb - Copy.xml	1/16/2018 5:13 PM XML Document	25 KB		
pix4d-projects	ucmdb - Copy.xml.bak	1/2/2018 5:07 PM BAK File	22 KB		
Production Checkout Procedu	ucmdb.xml	1/19/2018 2:40 PM XML Document	20 KB		
🝊 OneDrive					
This PC					
Desktop					
Documents					
Downloads					
b Music					
E Pictures					
🚪 Videos					
🚛 Local Disk (C:)					
🚛 Third Hard Drive (D:)	•				
6 items 1 item selected 19.0 KB					888 6

- 5. Search the file for entries of the following formats and delete the entire xml node (from <camera... to </camera>:
 - a. 21020-02_12MP-ERS-0001_5.4mm-0001_0016_5.4_4000x3000
 - b. 21020-02_12MP-ERS-0001_5.4mm-0001_0016_5.4_4000x3000
 - c. If there is more than one entry, delete all of them



- 6. Save the file
- 7. Reopen Pix4D and start the project as normal. Pix4D will now correctly get it's band and color correction data from the image metadata, rather than its database.

PROCESSING INSTRUCTIONS

- 1. Launch Pix4Dmapper
- 2. Create a new project.
- 3. Create a name that is meaningful to you, and choose the directory to create the project in. Once completed, click Next.

New Pro	oject			×
This wizard Choose a r	d creates a new project. name, a directory location and a t	type for your new project.		
Name:	double4k-project			
Create In:	G:\Pix4D-Projects			 Browse
Use As	Default Project Location			
Project T	Гуре			
New	Project			
O Proje	ect Merged from Existing Projects			

4. Click Add Directories.



5. Choose the directories of the images that you want to use in this project. Multiple directories can be selected at once by holding the Ctrl button and left-clicking on the directories. Click Choose.

ook in: D:\do	uble4k	- (3 0	0	B		E
S My Computer	Name	S	ize	Туре	2	Date I	M
atctest	NIR			Filo	der	7/17/2	20
a oterest	RGB			Filo	der	7/17/2	20

6. A list of images will appear. If there are more images or directories to add, do so now. Once all relevant images have been added, click Next.

Enough images are selected: press Next 1	to proceed.				
14 images selected.	Add Images	Add Directories	Add Videos	Remove Selected	Clear List
D:/double4k/NIR/IMG_00001.jpg					
D:/double4k/NIR/IMG_00002.jpg					
D:/double4k/NIR/IMG_00003.jpg					
D:/double4k/NIR/IMG_00004.jpg					
D:/double4k/NIR/IMG_00005.jpg					
D:/double4k/NIR/IMG_00006.jpg					
D:/double4k/NIR/IMG_00007.jpg					
D:/double4k/NIR/IMG 00008.jpg					
D:/double4k/NIR/IMG 00009.jpg					
D:/double4k/NIR/IMG_00010.jpg					
D:/double4k/NIR/IMG 00011.jpg					
D:/double4k/NIR/IMG_00012.jpg					
D:/double4k/NIR/IMG_00013.jpg					
D:/double4k/NIR/IMG 00014.jpg					
D:/double4k/NIR/IMG_00015.jpg					
D:/double4k/NIR/IMG_00016.jpg					
D:/double4k/NIR/IMG_00017.jpg					
D:/double4k/NIR/IMG_00018.jpg					
D:/double4k/NIR/IMG_00019.jpg					
D:/double4k/NIR/IMG_00020.jpg					
D:/double4k/NIR/IMG_00021.jpg					
D:/double4k/NIR/IMG_00022.jpg					
D:/double4k/NIR/IMG_00023.jpg					
D:/double4k/NIR/IMG_00024.jpg					
D:/double4k/NIR/IMG_00025.jpg					
D:/double4k/NIR/IMG_00026.jpg					
D ()					

Note: Step 7 to 10 only needs to be done one time and only if you have never done it before. Otherwise skip to Step 11

7. The images will appear in a list on the next page with information about the camera models. First, we will ensure that the camera model parameters that Pix4D automatically determines are correct. For each camera model, click Edit.

-	New Proj	ject			×
lm	age Pro	perties			
	Image Ge	olocation			
	Coordinat	te System			
	⊘ ⊕	Datum: World Geo	odetic System 1984; (Coordinate System: WGS 84 (egm96) Edit	
	Geolocati	on and Orientation			
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	Selected (Camera Model			
	0	21020-02_12MP-E	RS-0001_5.4mm-000	1_0014_5.4_4000x3000 (RGB) Edit	
	0	21020-02_12MP-E	RS-0001_5.4mm-000	1_0016_5.4_4000x3000 (Red edge,NIR) Edit	
	Enabled	lmage	Group	Camera Model	^
		IMG_00001.jpg	group1	21020-02_12MP-ERS-0001_5.4mm-0001_0014_5.4_4000x3000 (RGB)	44.6
	\checkmark	IMG_00001.jpg	group2	21020-02_12MP-ERS-0001_5.4mm-0001_0016_5.4_4000x3000 (Red edge,NIR)	44.6
	\checkmark	IMG_00002.jpg	group2	21020-02_12MP-ERS-0001_5.4mm-0001_0016_5.4_4000x3000 (Red edge,NIR)	44.6
	\checkmark	IMG_00002.jpg	group1	21020-02_12MP-ERS-0001_5.4mm-0001_0014_5.4_4000x3000 (RGB)	44.6
		IMG_00003.jpg	group2	21020-02_12MP-ERS-0001_5.4mm-0001_0016_5.4_4000x3000 (Red edge,NIR)	44.6
		IMG_00003.jpg	group1	21020-02_12MP-ERS-0001_5.4mm-0001_0014_5.4_4000x3000 (RGB)	44.6
		IMG_00004.jpg	group1	21020-02_12MP-ERS-0001_5.4mm-0001_0014_5.4_4000x3000 (RGB)	44.6
	¢				>
	Help			< Back Next >	Cancel

8. If the camera values look incorrect, select 'Edit' to edit the parameters. The parameters should match those in the figures below. **These values apply only to the Double 4K camera**. When finished, select "Save to DB" to use these values in the future.

Imagers with recent firmware updates will auto-populate the pixel size and focal length in the Pix4D lens model, but it's important to verify they are populated correctly, since they will not override any camera models previously saved to the Pix4D camera model database.

Double check the RGB Camera (0014) uses bands RGB, and the NIR Camera (0016) uses bands Red edge, Garbage, NIR and that all other settings are correct.

🧧 Edit Camera Model				×
Camera Model EXIF ID: 2 Camera Model Name: 1	1020-02_12MP-ERS-0001_5.4mm-00 ⓒ 21020-02_12MP-ERS-0001_5.4mm	01_0014_5.4_4000x3000 n-0001_0014_5.4_4000x3	(003)	
Camera Model Bands Bands: RGB			Save to DB Cancel Edit	
Camera Model Parameter Clear Estimat Warning: Wrong parame Perspective Lens Image Width [pixel]: Image Height [pixel]: Focal Length [pixel]: Principal Point x [pixe Principal Point y [pixe	rs te from EXIF Load Optimized Param eters can cause failure in the reconstr O Fisheye Lens 4000	eters uction. Read the Help for r Shutter Model: Glo Sensor Width [mm]: Sensor Height [mm]: Pixel Size [µm]: Focal Length [mm]: Principal Point x [mm Principal Point y [mm	more information. abal Shutter or Fast Readout ▼ 6.2 4.65 1.55 5.4 3.1]: 2.325	
Camera Model with D Radial Distortion R1: Radial Distortion R2: Radial Distortion R3:	Distortions: 5	Tangential Distortion Tangential Distortion	T1: 0	

Figure 1: 12MP RGB Camera values that should be populated.

Edit Camera Model			
Camera Model			
	00 4040 500 0004 5 4		
EXIF ID: 21020	-02_12MP-ERS-0001_5.4mm	m-0001_0016_5.4_4000x3000 (003)	
Camera Model Name: 21	1020-02_12MP-ERS-0001_5.	5.4mm-0001_0016_5.4_4000x3000	7
		Save to DB Cancel Ed	it
Camera Model Bands			
Bands: Red edge,Garbage,	NIR	▼ Edit	
Camera Model Parameters			
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Clear Estimate fro Warning: Wrong parameters Perspective Lens Image Width [pixel]: Image Height [pixel]:	m EXIF Load Optimized Pa can cause failure in the recor O Fisheye Lens 4000 3000	arameters onstruction. Read the Help for more information. Shutter Model: Global Shutter or Fast Readout Sensor Width [mm]: 6.2 Sensor Height [mm]: 4.65	•
Clear Estimate fro Warning: Wrong parameters (Perspective Lens Image Width [pixel]: Image Height [pixel]:	m EXIF Load Optimized Pa can cause failure in the recor O Fisheye Lens 4000 3000	arameters onstruction. Read the Help for more information. Shutter Model: Global Shutter or Fast Readout Sensor Width [mm]: 6.2 Sensor Height [mm]: 4.65 Pixel Size [µm]: 1.55	 ▼
Clear Estimate fro Warning: Wrong parameters (Perspective Lens Image Width [pixel]: Image Height [pixel]: Focal Length [pixel]:	m EXIF Load Optimized Pa can cause failure in the recor O Fisheye Lens 4000 3000	arameters onstruction. Read the Help for more information. Shutter Model: Global Shutter or Fast Readout Sensor Width [mm]: 6.2 Sensor Height [mm]: 4.65 Pixel Size [µm]: 1.55 Focal Length [mm]: 5.4	The second seco
Clear Estimate fro Warning: Wrong parameters Perspective Lens Image Width [pixel]: Image Height [pixel]: Focal Length [pixel]: Principal Point x [pixel]:	m EXIF Load Optimized Pa can cause failure in the recor O Fisheye Lens 4000 3000 3483.87 2000	arameters onstruction. Read the Help for more information. Shutter Model: Global Shutter or Fast Readout Sensor Width [mm]: 6.2 Sensor Height [mm]: 4.65 Pixel Size [µm]: 1.55 Focal Length [mm]: 5.4 Principal Point x [mm]: 3.1	
Clear Estimate fro Warning: Wrong parameters (Perspective Lens Image Width [pixe]]: Image Height [pixe]]: Focal Length [pixe]]: Principal Point x [pixe]]: Principal Point x [pixe]]:	m EXIF Load Optimized Pa can cause failure in the recor Fisheye Lens 4000 3000 3483.87 2000 1500	arameters onstruction. Read the Help for more information. Shutter Model: Global Shutter or Fast Readout Sensor Width [mm]: 6.2 Sensor Height [mm]: 4.65 Pixel Size [µm]: 1.55 Focal Length [mm]: 5.4 Principal Point x [mm]: 3.1 Brincipal Point x [mm]: 2.325	•
Clear Estimate fro Warning: Wrong parameters of Perspective Lens Image Width [pixel]: Image Height [pixel]: Focal Length [pixel]: Principal Point x [pixel]: Principal Point y [pixel]:	m EXIF Load Optimized Pa can cause failure in the recor Fisheye Lens 4000 3000 3483.87 2000 1500	arameters onstruction. Read the Help for more information. Shutter Model: Global Shutter or Fast Readout Sensor Width [mm]: 6.2 Sensor Height [mm]: 4.65 Pixel Size [µm]: 1.55 Focal Length [mm]: 5.4 Principal Point x [mm]: 3.1 Principal Point y [mm]: 2.325	
Clear Estimate fro Warning: Wrong parameters of Perspective Lens Image Width [pixel]: Image Height [pixel]: Focal Length [pixel]: Principal Point x [pixel]: Principal Point y [pixel]: Camera Model with Distor	m EXIF Load Optimized Pa can cause failure in the recor Fisheye Lens 4000 3000 3483.87 2000 1500 tions: 5	arameters onstruction. Read the Help for more information. Shutter Model: Global Shutter or Fast Readout Sensor Width [mm]: 6.2 Sensor Height [mm]: 4.65 Pixel Size [µm]: 1.55 Focal Length [mm]: 5.4 Principal Point x [mm]: 3.1 Principal Point y [mm]: 2.325	•
Clear Estimate fro Warning: Wrong parameters (Perspective Lens Image Width [pixe]]: Image Height [pixe]]: Focal Length [pixe]]: Principal Point x [pixe]]: Camera Model with Distor Radial Distortion R1:	m EXIF Load Optimized Pa can cause failure in the record O Fisheye Lens 4000 3000 3483.87 2000 1500 tions: 5 0	arameters onstruction. Read the Help for more information. Shutter Model: Global Shutter or Fast Readout Sensor Width [mm]: 6.2 Sensor Height [mm]: 4.65 Pixel Size [µm]: 1.55 Focal Length [mm]: 5.4 Principal Point x [mm]: 3.1 Principal Point y [mm]: 2.325	
Clear Estimate fro Warning: Wrong parameters of Perspective Lens Image Width [pixe]]: Image Height [pixe]]: Focal Length [pixe]]: Principal Point x [pixe]]: Principal Point y [pixe]]: Camera Model with Distor Radial Distortion R1: Radial Distortion R2:	m EXIF Load Optimized Pa can cause failure in the recor Fisheye Lens 4000 3000 3483.87 2000 1500 tions: 5 0 0	arameters onstruction. Read the Help for more information. Shutter Model: Global Shutter or Fast Readout Sensor Width [mm]: 6.2 Sensor Height [mm]: 4.65 Pixel Size [µm]: 1.55 Focal Length [mm]: 5.4 Principal Point x [mm]: 3.1 Principal Point y [mm]: 2.325 Tangential Distortion T1: 0 Tangential Distortion T2: 0	

Figure 2: 12MP NIR Camera values that should be populated.

- 9. Click "OK".
 - a. If you changed any settings, you will be prompted with "Information i0006", click "Yes" to save the model to the database.

Pix4Dmapper	
Information i0006: You are editing the camera model. D you want to save the model to the database before you leave the dialog?	0
🔲 Don't Display This Message Again	•
Yes No	

10. Verify that the NIR and RGB cameras have been set to different groups by looking at the Group and Camera Model tags. All pictures from a given camera model should be assigned to the same group.

Selected	Camera Model			
0	21020-02_12MP-E	RS-0001_5.4mm-000	1_0014_5.4_4000x3000 (RGB) Edit.	
0	21020-02_12MP-E	RS-0001_5.4mm-000	1_0016_5.4_4000x3000 (Red edge,NIR)	
		1		
Enabled	Image	Group	Camera Model	^
	IMG_00001.jpg	group1	21020-02_12MP-ERS-0001_5.4mm-0001_0014_5.4_4000x3000 (RGB)	44.6
	IMG_00001.jpg	group2	21020-02_12MP-ERS-0001_5.4mm-0001_0016_5.4_4000x3000 (Red edge, NIR)	44.6
	IMG_00002.jpg	group2	21020-02_12MP-ERS-0001_5.4mm-0001_0016_5.4_4000x3000 (Red edge,NIR)	44.6
	IMG_00002.jpg	group1	21020-02_12MP-ERS-0001_5.4mm-0001_0014_5.4_4000x3000 (RGB)	44.6
\checkmark	IMG_00003.jpg	group2	21020-02_12MP-ERS-0001_5.4mm-0001_0016_5.4_4000x3000 (Red edge,NIR)	44.6
\checkmark	IMG_00003.jpg	group1	21020-02_12MP-ERS-0001_5.4mm-0001_0014_5.4_4000x3000 (RGB)	44.6
\checkmark	IMG_00004.jpg	group1	21020-02_12MP-ERS-0001_5.4mm-0001_0014_5.4_4000x3000 (RGB)	44.6
<				>

- 11. Click Next and click Next on the Select Output Coordinate System menu.
- 12. On the Processing Options Template menu, if the Sentera Double4K Multispectral V6 template is not listed in the menu yet, choose any template. All settings will be overridden in the next few steps. Otherwise, choose the "Sentera Double4k Multispectral V6" template. Click Finish.

and Color Information
and Color Information
and Color Information
Start Processing Now
ck Finish Cancel

13. Now the project should be open. If you already loaded the Sentera Double 4K Multispectral V4 template in the previous step, skip to Step 21. Otherwise, click on Processing Options.



14. Click on Manage Templates.

Processing Options		×
2 1. Initial Processing	General Matching Calibration Keypoints Image Scale O Full Rapid	
2. Point Cloud and Mesh	O Custom Image Scale: 1/4 (Quarter image size). ♥ Quality Report	
3. DSM, Orthomosaic and Index	Generate Orthomosaic Preview in Quality Report	
Resources and Notifications		
Current Options: 🔗 New		
Load Template J Save Template J Manage 1	oK	Cancel Help

15. Check the Import/Export box.

I emplates Manager		?
a 3D Maps	Your description here	
3D Models		
Ag Multispectral		
Ag Modified Camera		
🛙 Ag RGB		
3D Maps - Rapid/Low Res		
3D Models - Rapid/Low Res		
Ag Modified Camera - Rapid/Low Res		
Ag RGB - Rapid/Low Res		
Thermal Camera		
ThermoMAP Camera		
Dense Trees Low Foilage		
7 New		
7 New2		
Sentera Snapdragon RGB ortho only		
Sentera Tower Flights		
5 sentera_2015_10_14_rgb		
5 sentera_2016_04_01_ndvi		
sentera_cloud_rgb_2017_06_02		
5 sentera_ndvi_2016_05_18_rca		
5 sentera_ndvi_2016_06_28		
5 sentera_no_index		
5 sentera_quad_2016_08_03		
5 sentera_rgb_2016_07_14_b - Copy		
sentera_rgb_2016_07_14_b		
5 sentera_snapcam_ndvi_2016_10_04		
		New Duplicate Remo
Import Export Folder Mor	e processing options templates (.tmpl) available <u>here</u> .	
Import/Export		OK Cancel Help

16. Click Import.

3D Maps	Your description here			
3D Models				
Ag Multispectral				
Ag Modified Camera				
Ag RGB				
3D Maps - Rapid/Low Res				
3D Models - Rapid/Low Res				
Aq Modified Camera - Rapid/Low Res				
Ag RGB - Rapid/Low Res				
Thermal Camera				
ThermoMAP Camera				
Dense Trees Low Foilage				
7 New				
7 New2				
Sentera Snapdragon RGB ortho only				
Sentera Tower Flights				
5 sentera_2015_10_14_rgb				
sentera_2016_04_01_ndvi				
sentera_cloud_rgb_2017_06_02				
sentera_ndvi_2016_05_18_rca				
sentera_ndvi_2016_06_28				
5 sentera_no_index				
5 sentera_quad_2016_08_03				
sentera_rgb_2016_07_14_b - Copy				
5 sentera_rgb_2016_07_14_b				
sentera_snapcam_ndvi_2016_10_04				
		New	Duplicate	Remov

😹 Import Template				\times
	is PC > Desktop > 2.2	✓ Ö Search 2.2	2	م
Organize 🔻 New fold	er			•
💻 montego 🛛 🖈 ^	Name	Date modified	Туре	5.4
2.1.53 Firmwa	sentera_double4k_multispectral_v3.tmpl	4/22/2019 2:26 PM	TMPL File	
Example Project	sentera_double4k_multispectral_v4.tmpl	4/22/2019 2:26 PM	TMPL File	
FieldAgent iPad	sentera_double4k_multispectral_v5.tmpl	4/22/2019 2:26 PM	TMPL File	
Rev-	sentera_double4k_multispectral_v6.tmpl	> 4/24/2019 4:32 PM	TMPL File	
	sentera_double4h_original_ndvi_v1_2016_10_84.umpl	6/24/2019 2:30 PM	TMPL File	
le OneDrive	sentera_double4k_precision_ndre_v12017_12_05.tmpl	4/22/2019 2:26 PM	TMPL File	~
¥	<			>
File n	ame: sentera_double4k_multispectral_v6.tmpl	V Urer tem	plates (*.tmpl)	~
		Оре	en Ca	ncel

17. Choose the Double 4K template provided by Sentera and click Open.

18. The template will now appear in the list on the left. Confirm that it is present and click OK.19. Click Load Template and select the template.

	emolate		
Load Template	Save Template 🗸 Manage Templates		
Personal 🕨	Dense Trees Low Foilage	ОК	Cancel Help
Standard 🔸	sentera_double4k_precision_ndre_v22017_12_06		
Rapid 🕨	sentera_double4k_precision_ndre_v3_2018_09_21		
Advanced 🕨	sentera_double4k_precision_ndre_v4 2019_09_01		
	sentera_double4k_precision_ndvi_v22018_04_24		
	sentera_quad_2016_08_03		
	sentera_single_precision_ndvi_2010_01_22		
•	sentera_double4k_multispectral_v6	>	

20. Click OK.

-- Continue here from step 13 if your template was already loaded --

- **21. IMPORTANT:** Before continuing, verify that camera calibration is enabled. This will help normalize the two separate images an allow more accurate band comparisons (such as NDVI).
 - a. Open the Processing Options
 - b. Click on the 'DSM, Orthomosaic and Index' Option
 - c. Click on the 'Index Calculator' Tab
 - d. Make sure both cameras are set to Correction Type: Camera Only (See Below). You do knot need to click on Calibrate or Reset.

Processing Options	×
	DSM and Orthomosaic Additional Outputs Index Calculator
1. Initial Processing	Radiometric Processing and Calibration
Ø	21020-02_12MP-ERS-0001_5.4mm-0001_0014_5.4_4000x3000 (RGB) Correction Type: Camera Only
2. Point Cloud and Mesh	Calibration: Calibrate Reset
	21020-02_12MP-ERS-0001_5.4mm-0001_0016_5.4_4000x3000 (Red edge,NIR)
	Correction Type: Camera Only
3. DSM, Orthomosaic and Index	Calibration: Calibrate Reset 1
	Resolution
	O Automatic
Resources and Notifications	1 🗘 x GSD
	Custom
	50 cm/pixel
	Downsampling Method: Gaussian Average 🔻
	Reflectance Map
	GeoTIFF
	Merge Tiles
	Indices
	Note: red indices won't be generated because they are invalid,
	Image: Second
	☐ 🖯 red edge = red edge
	· · · · · · · · · · · · · · · · · · ·
Current Options: 🐣 sentera_double4k_multspec	tral_v3
Load Template 🗸 Save Template 🗸 Manage Temp	plates
Advanced	OK Cancel Help

22. Scroll down to Indices and select Red, Green, Blue, Red Edge and NIR.



23. Click **Start** under the Processing pane. If the Processing pane is hidden, click on the Processing button on the Side Panel. Processing will run for any length between a few minutes and many hours, depending on the number of images and the characteristics of the image set.



24. When processing completes, Pix4D will have generated a full mosaic and reflectance maps for the imagery. These reflectance maps can be used to create indexed colormaps.

INSERTING GROUND CONTROL POINTS

- 1. Click on the Project Menu and select GCP/MTP Manager.
- 2. Set the GCP Coordinate System to match the GPC data. This can be Latitude/Longitude, Meters or Feet.
- 3. Click on the "Add Point" button.
- 4. For each GCP change the "Type" value to 2D GCP
- 5. For the "X" value type in the value that is in Latitude/Longitude, Meters or Feet.
 - a. Value is determined by the GCP Coordinate System.
- 6. For the "Y" value type in the value that is in Latitude/Longitude, Meters or Feet.
 - a. Value is determined by the GCP Coordinate System.
- 7. Repeat steps 5 and 6 for each GPC. There should be a minimum of 5-8 per project.

	ITP Table							
	Label	Туре	Latitude [degree]	Longitude [degree]	Altitude [m]	Accuracy Horz [m]	Accuracy Vert [m]	Import GC
	0	2D GCP	43.913	-93.476	361.000	0.020		
)	1	2D GCP	43.913	-93.470	364.000	0.020		
D	2	2D GCP	43.913	-93.467	359.000	0.020		

- 8. Once the GCP are added. Click on the "OK" button to ensure they are in the correct spots.
- 9. Pix4D will place a Blue "X" for each GCP.



10. Run and complete Processing Step 1, unselect Step 2 and 3. Let Step 1 complete.

- 11. Click on the Project Menu and select GCP/MTP Manager
- 12. Click on the "Basic Editor" button at the bottom of the dialog box.
- 13. Select Sort Images by Distance to GCP.



- 14. On the "Image" section select the image and zoom in and mark the GPC.
- 15. Repeat step 13 for at least 3 to 8 images. Marking the same spot each time.
- 16. Select another GCP from the GCP/MTP Table and repeat steps 13 and 14 until all of the GCP have been completed.
- 17. Click on the "OK" button at the bottom of the dialog box.
- 18. Click on the Process Menu and select "Reoptimize"
- 19. Click on the "OK" button let the process run and complete.
- 20. Run and complete Processing step 3. Ensure the Processing Step 1 is unchecked.

REFLECTANCE AND NDVI CALCUATIONS

1. Click on Index Calculator.



 Check to see if the NDVI and NDRE indices are present in the dropdown. If one more of these are missing, click Indices... and continue to Step 3. If there are NDVI or NDRE indices present, skip to Step 6.

Name		i	Formula		
🖯 red			red		0
Edit	Indices		G	enerate	Help
Band	Min	Avg	Max	Stdev	Va

3. Click Add to create a new Index.

Name	Formula	
😫 red	💿 red	
😫 green	🛛 green	
😫 blue	🕲 blue	
🖯 grayscale	0.2126 * red + 0.7152 * green + 0.0722 * blue	
sentera_NDRE	((4.082 * blue) + (-1.4 *red)) / ((2.076*b	
sentera_ndvi	🥥 ((1.25 * blue) - (0.25 * red)) / ((0.75 *blu	
grayscale_copy	((23.4/255) * red) + 13.59	
sentera_ndvi_narrow	((7.415 * blue) - (1.412* red))/((5.391 *	
🔗 Quad Band NDVI	((1.25 * group4_red) - (0.5 * group2_red))	
😤 Quad Band NDRE	((1.25 * nm800_red) - (0.5 *nm725_red)) /	
🐣 QuadBandSCCCI	((1.25 * group4_red) - (0.5 * group3_red))	
🐣 QuadBandDVI	((1.25 * group4_red) - (0.5 * group2_red))	~
	Edit Duplicate Add Remove	

4. Type the band calculation in a similar fashion as below using the band names in the calculation. Sentera provides the exact index formulae that should be used to create indexed colormaps.

effectance Man	Rand Co	laction					
Band	nm	Min	Ava	Мах	Stdev		Va
red	445	402.50	2711.00	11592.51	2070.02	4284963	.6
green	545	1.57	1312.15	4255.33	490.23	240321	.2
blue	650	399.87	2212.74	9596.84	1621.31	2628648	.4
red_edge	720	680.25	1822.68	4971.89	435.25	189439	.1
garbage	-	0.00	0.00	0.00	0.00	0	.0
nir	840	730.56	3273.99	5082.87	909.53	827253	.5
perations							
+	-		*	1		^	
()		sgrt	log		sin	
cos	tan		asin	acos		atan	1
pir-red_edge)/(pir	+red eda	ല					
In red_edge//(in	nea_eag	~/					
alid Formula							

Double 4k NDRE:

Double	4k	NDVI:
Double		

📕 Index Map - ι	unnamed					? ×
Reflectance Ma	p Band Sel	ection				
Band	nm	Min	Avg	Max	Stdev	Var
red	445	402.50	2711.00	11592.51	2070.02	4284963.62
green	545	1.57	1312.15	4255.33	490.23	240321.24
blue	650	399.87	2212.74	9596.84	1621.31	2628648.44
red_edge	720	680.25	1822.68	4971.89	435.25	189439.15
garbage	-	0.00	0.00	0.00	0.00	0.00
nir	840	730.56	3273.99	5082.87	909.53	827253.54
Operations						
+	-		*	1		^
()		sqrt	log		sin
COS	tan		asin	acos		atan
Formula						
(nir+red)/(nir+red)						
Valid Formula						
		L	OK	Cano	cel	Help

5. Give the index a meaningful name, for example "sentera-double4k-NDVI" or "sentera-double4k-NDRE". Take care to double check that your formulae match those above. Click OK.

6. Select the Index you want to generate from the dropdown and click Generate.

🔻 3. Ind	lex Map				
Name			Form	ula	
🖯 ndvi		•	= (nir -	red) / (nir + re	d) 🕑
Edit	Indices		\checkmark	Generate	Help
Band	Min	Avg	Ма	x Stde	ev Var
band1	-0.71	0.15	0.7	0 0.4	Ю 0.16

7. Under 4. Color Maps and Prescription, Sentera recommends using 5 Classes and Equal Area.



8. Under 5. Export, click the second Export button next to "Colored Index Map (GeoTIFF) and...". Your color mapped mosaics are now available in the "4_index" directory.



▼ 5. Export	
Index Values and Rates as Polygon Shapefiles (SHP) with Grid Siz $arepsilon$	Export
Colored Index Map (GeoTIFF) and GeoJPG (JPG)	Export
	Help

OUTPUT

Output files are saved in the Pix4D project directory selected when creating the project.

the providing from.) <mark>X</mark>
C v k w Documents V	pix4dmapper + sample-project-tutorial +	✓ 4y Search	h sample-project-tui	torial	م
Organize 🔻 Include in librar	y ▼ Share with ▼ New folder				0
★ Favorites	Name	Date modified	Туре	Size	
E Desktop	🐌 1_initial	10/14/2015 11:39	File folder		
🐌 Downloads	퉬 3_dsm_ortho	10/14/2015 11:40	File folder		
🖳 Recent Places	퉬 4_index	10/14/2015 11:41	File folder		
	퉬 temp	10/14/2015 11:41	File folder		
🥽 Libraries	sample-project-tutorial.log	10/14/2015 11:40	Text Document	188	KB
Documents 🔻					
5 items					

1_initial\report\<project name>_report.pdf

Contains useful information about how the imagery quality affected stitching results, as well as preview images.

1_initial\report\html

Contains a few preview pictures. These are available as soon as the quality report appears, before final mosaics are ready.

3_dsm_ortho\2_mosaic

Contains the tif file, which is the high resolution mosaic. Windows will open tif files up to 1GB. If you produce tif files larger than 1GB, it's best to view them using the Google tiles option, discussed in the appendix. Google tiles appear in this directory, when enabled.

4_index\indices

Contains subdirectories for each index generated. Each index subdirectory contains many files. <project_name>_RGBa_sentera_<index>.png is a small file that provides an easy visualization. <project_name>_RGBa_sentera_<index>.tif, along with the *.tfw and *prj file can be imported into AgVault and other GIS tools. Academic researchers may be interested in the <project_name>_index_sentera_<index>.tif, which is produced prior to color mapping.

4_index\reflectances

Contains a multiplayer tiff for each group. These contain the separated reflectance values of the RGB and nir cameras. Typically, group1 contains red,green,blue and group2 contains red edge, garbage, nir. However, this can vary depending on how the groups were set up when the project was created. The files are called: cproject_name>_transparent_reflectance_<group name>.tif.

APPENDIX A - LARGE DATA SETS

Large data sets mosaicked at high resolution can produce a merged GeoTIFF file larger than 1GB. Windows will not display tiff files larger than 1GB, so an alternative viewing method is required. In this case, it is recommended to enable Google Maps Tiles and KML. Doing so produces an HTML file and KML file in the 3_dsm_ortho\2_mosaic directory. Double click on the HTML file to view tiled imagery in a web browser. You may need to select "Allow" since some browsers disable tiled viewing by default. Install Google Earth, then double click on the KML file to open the mosaic in Google Earth. Tiled viewing allows lower resolution images to be viewed when zoomed out, and higher resolution images to be viewed when zoomed out, and higher resolution images to be viewed when zoomed in, which can provide an excellent viewing experience. However, generating the Google Maps Tiles and KML adds substantial processing time to each stitching run, and should only be enabled if it will really be used. In these cases, the GeoTIFF can optionally be disabled, if it will not be used.

Processing Options	
Processing Options Image: Constraint of the second seco	DSM and Orthomosaic Additional Outputs Index Calculator Resolution Automatic 1 x SSD (7.07832 cm/pixel) Custom 7.08 cm/pixel DSM Filters Ø Use Noise Filtering Ø Use Noise Filtering Ø Use Surface Smoothing Type: Type: Sharp Raster DSM Ø GeoTIFF Method: Triangulation Ø GeoTIFF Consider disabling Ø Merge Tiles Orthomosaic Ø Merge Tiles Consider disabling Ø Merge Tiles and KML Mapbox Tiles Mapbox Tiles Mapbox Tiles
Current Options: No Template Load Template Save Template Manag	e Templates OK Cancel Help

APPENDIX B - STITCHING FAILS

If stitching fails, review the quality report for hints. Stitching can fail for many different reasons. If your data set is simply on the edge of stitchability, do the following. Open Processing Options -> Initial Processing -> General. Select Keypoints Image Scale -> Full. Full increases processing time, but can in some cases enable mosaic generation for data sets that could not produce a mosaic on the Rapid setting.

Processing Options	23
General Matching Calibration I. Initial Processing General Matching Calibration Image Scale Full (Default)	
Constant Cloud and Mesh Constant Cloud and Image Scale: 1 (Original image size)	
Image: State of the state	
Resources	
Current Options: No Template	
Load Template Save Template Manage Templates Image: Advanced OK Cancel Help	

APPENDIX C - SAVING TEMPLATES

After creating indices, it's possible to generate the indices as a step of the main processing. Open the Processing Options, Select "3. DSM, Orthomosaic and Index", and select "Index Calculator" tab. Check the boxes next to the indices you want to generate each time and save the template. Load the template next time. Note that even when Pix4D generates the indices, there is no way to automatically export the color mapped versions of the indices. It is necessary to manually select the index and choose "Export" to generate color mapped files.

APPENDIX D - CREATING A 5 BAND SINGLE GEOTIFF

To create a single image with all five band can be done using QGIS. This single 5 Band image can be imported in to FieldAgent Desktop to produce several different indices.

- 1.) Launch QGIS. If you need to please download it first.
- 2.) Browse to the project folder from Pix4D.
- 3.) Open the 4_index folder
- 4.) Open the Indices folder

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File Home	Share	View				
← → × ↑ <mark> </mark>	>		the second second	> 4_ind	lex → indices	
🕹 Quick access		Name	Date modified	Туре	Size	
Decident		blue	8/20/2019 1:15 PM	File folder		
Desktop	R	- green	8/20/2019 1:15 PM	File folder		
👆 Downloads	*	nir	8/20/2019 1:15 PM	File folder		
🚆 Documents	A	red	8/20/2019 1:15 PM	File folder		
Pictures	*	red_edge	8/20/2019 1:15 PM	File folder		

5.) Open the first Indices folder and select the .tif file

📊 🛃 📘 🛨			Manage	blue			
File Home	Share	View	Picture Tools				
← → • ↑	>					> 4_ind	lex > indices > blue
		Name	^		Date modified	Туре	Size
Quick access		tiles			8/20/2019 1:15 PM	File folder	
Desktop	Ħ	GR029	W-1 - NDVI, Five-	Band - 9543_inde	8/19/2019 2:43 PM	PRJ File	1 KB
🖊 Downloads	*	GR029	W-1 - NDVI, Five-	Band - 9543_inde	8/19/2019 2:43 PM	TFW File	1 KB
🔮 Documents	*	GR029	W-1 - NDVI, Five-	Band - 9543_inde	8/19/2019 2:43 PM	TIF File	127,607 KB
Pictures	*						

6.) Drag that .tif file in to QGIS in the "Layers" panel.

nome snare view	Pidure Tools	
~ ↑ <mark>-</mark> >	4_index > indices > blue	✓ Ŏ Search blue
uick access	Date modified Type Size	
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ocuments 🖈 📔 GR02S	W-1-NDV), Five-Band - \$553, inde 8/19/2019 2-43 PM TIF File 127,607 KB	
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s PC	A Favorites	Q, Search
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Pictures		Q Network analysis
Videos	Ligen Obs	 Q Raster terrain analysis
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neve_kømpen (//m		 Q Vector general
ew Volume (D:)		Q Vector geometry Autor quarter
etwork		Q Vector selection
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	Topy to Opboard	
	1 Third Contract	

7.) Repeat step 6 for all 5 Indices.



8.) From the Menu bar, select Raster>>Miscellaneous>>Merge.



9.) In the Merge dialog box click on the Input layers browse button.

(Q Merge	\times
	Parameters Log	
	Input layers	\frown
	0 elements selected	()
	Grab pseudocolor table from first layer	\checkmark
	Place each input file into a separate band	
	Output data type	

10.)In the Multiple selection dialog box, drag the layers up or down until they are in order or Red, Green, Blue, Red Edge and NIR. Then click on "Select All" and "OK"

Q Multiple selection		×
 ✓ ✓	- 9543_index_red [EPSG:32614] - 9543_index_green [EPSG:32614] - 9543_index_blue [EPSG:32614] - 9543_index_red_edge [EPSG:32614] - 9543_index_nir [EPSG:32614]	Select All Clear Selection Toggle Selection Add File(s) Add Directory OK Cancel

11.) Select the check box for "Place each input file into a separate band", under "Advanced Option", place a -10000 in the "Assign specific 'nodata" for the Merged select the browse button to select a location to save and name the file. Finally click on "Run".

Q Merge	×
Parameters Log	
Input lavers	
5 elements selected	
Grab preudosolor table from first laver	
Chab pseudocolor dable irolin histrayen	
Mace each input file into a separate band	
(FIORES2	
Advanced parameters	
Input pixel value to treat as "nodata" [optional]	
Not set	\$
Assign specified "nodata" value to output [optional]	
-10000	
Addritional creation options [optional]	
Profile Default	•
News	
Value	
🖶 😑 Validate Help	
Arbor H	
Open output file after running algorithm	
GDAL/OGR console call	
python3 -m gdal_merge -separate -a_nodata -10000 -ot Float32 -of GTiff -o Z:/Been/MERGE.tifoptfile C:/Users/Steve/Ap Local/Temp/processing_7aa3876fd0794ca7af4d3a9c1b03fb1d/e203f51ac94347eaa119f54c260f908b/mergeInputFiles.txt	pData/
0%	Cancel

12.)QGIS will display a preview of the 5 Band Single GeoTiff once it has been completed. *Please note it will have a unusual color hue to it.*



APPENDIX G - IMPORT A 5 BAND SINGLE GEOTIFF INTO FIELDAGENT

Importing the 5 Band Single GeoTIFF in to FieldAgent will yield 8 different Indices to work with in FieldAgent Desktop.

- 1.) Launch FieldAgent Desktop
- 2.) Select the "Create Survey" button on the top of the screen
- 3.) Click on the "Add" button

FieldAgent™		- 🗆 X
sentera	City ~	CREATE SURVEYS 🚺 🧿 🔅
FILTERS	Clear	
Grower: Fitter by grower		Hudson
Farm: Filter by farm	New Surger(c)	Bay
The second se	Detect Photos Scan for color + NIR photos to add to the survey.	
	Currently Selected Folders to Scan:	Add
		A to C
	 Remove images of horizon? Enable flat field correction? 	a s s o e a
		Cancel Next>
	Mexico Gity Guaranta Et Sárca	Junaia Carribbean Sea
		Noregoa Maricalio Cesia Rica Panama Medellin Venezuela
Street View Satellite		Colombia ALL FIELDS (14) =

- 4.) Browse to the folder where the 5 Band Image is stored
- 5.) Select the Folder

Select Folder(s)							\times
\leftarrow \rightarrow \checkmark \uparrow \square \rightarrow This PC \rightarrow	PC > (Z:) > TA35EM-1 5 Band > Merged File V C			Search Merged Fi	le	Q	
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Folder: Merged File							
					Select Folder	Cance	9

6.) Click on the "Next>" button

Pew Survey(s)	-	- 🗌	\times
Detect Photos Scan for color + NIR photos to add to the survey.			
Currently Selected Folders to Scan:			
Z:\TA35EM-1 5 Band\Merged File	Î	Add	
 Remove images of horizon? Enable flat field correction? 			
	Cance	el Nex	:t >

7.) Validate that the import is going to the correct field and click on the "Next>" button.





8.) Select the "Five Band Map" and use the NDVI Toolbox to select the 8 different Indices.