A Method to Achieve High-Precision Relative Orientation of Frames Using Erdas Imagine OrthoBASE

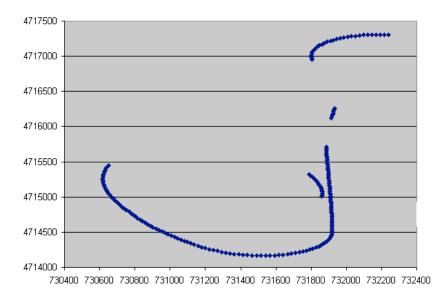
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This report documents a method of achieving triangulation with low RMS error in Erdas Imagine OrthoBASE for large numbers of frames to get very precise relative orientations of frames from a strip of images. This method was developed here in the Vision Lab at UMass by Bert Rawert, Frank Stolle, and Howard Schultz, with some contributions from earlier work of Peikang Yao. As the sole purpose of this report is to document this method for purposes of "corporate memory," there is little content other than exactly how to proceed with this method.

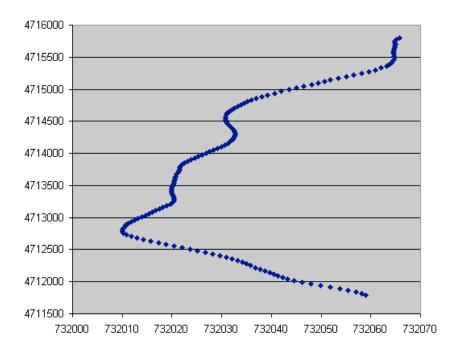
Selecting Frames

To determine which frames make up a strip, select the X and Y columns of the GPS data for your hypothesized set of frames as they appear in an Excel spreadsheet. Plot them using a scatter plot. The picture below, produced by selecting the GPS coordinates of a group of time consecutive frames, shows what the result should **not** look like.



Note the wide range of x values covering almost 2 km. This is generally bad for the Harvard Forest dataset, because flight lines were north to south, not east to west, so you should see smaller variability within a strip along the x axis. Also, note the discontinuity in the stream of frames.

The graph below shows what you should see:



Note that the range in X is now about 70 meters, with variations in flight path most likely due to wind. This looks more realistic for a flight path. Once the images for a strip have been identified, the next step is to create a new Erdas block file.

Creating a Block File

Start by clicking on the OrthoBASE icon in the Erdas Imagine tool bar. The following prompt appears:



Select OK to create a new OrthoBASE Project. Navigate to the folder where you want to store your block file and type in a filename in the following window:

Create New Block File	×
File	
Look in: 🔄 bert-erdas-work 💽 🖻 🖄	
📴 dtm	ок
ortho-band2	Cancel
tower-east1-fullstrip.blk	
tower-east2-fullstrip.blk	Help
tower-east3-fullstrip.blk tower-east4-fullstrip.blk	
tower-east5-fullstrip.blk	Recent
tower-east6-fullstrip.blk	
🗱 tower-fullstrip.blk	Goto
tower-strip23.blk	
File name: tower-east8.blk	
Files of type: Block File (*.blk)	
925 Files, 2 Subdirectories, 8 Matches, 88133084k Bytes Free	

Click OK. The following window appears:

💋 Model Setup	×
Select Geometric Model:	
Frame Camera Digital Camera Video Camera (Videography) Non-Metric Camera DPPDB Generic Pushbroom SPOT Pushbroom IRS-1C Pushbroom	OK Cancel Help
Select a proper geometric model for your data.	

Select Digital Camera for Harvard Forest data sets (or the appropriate camera type), and click OK. The following dialog appears:

💋 Block Property Setup		×
Set Ref	erence System:	
Projection: Unknow Spheroid: Zone Number: Datum:	n/Cartesian	OK Previous Next Cancel Help

Click "Set Projection...". The following dialog appears:

Standard Custom	×
Categories UTM WGS 84 North	<u>OK</u>
Projection UTM Zone 1 (Range 180W - 174W) UTM Zone 2 (Range 174W - 168W) UTM Zone 3 (Range 168W - 162W) UTM Zone 4 (Range 162W - 156W) UTM Zone 5 (Range 156W - 150W) UTM Zone 6 (Range 150W - 144W) UTM Zone 7 (Range 138W - 138W) UTM Zone 8 (Range 138W - 132W) UTM Zone 9 (Range 132W - 126W) UTM Zone 10 (Range 126W - 120W) UTM Zone 11 (Range 120W - 114W) UTM Zone 12 (Range 108W - 102W) UTM Zone 13 (Range 108W - 102W) UTM Zone 14 (Range 102W - 96W) UTM Zone 15 (Range 96W - 90W)	Cancel Help
UTM Zone 16 (Range 90W - 84W) UTM Zone 17 (Range 84W - 78W) UTM Zone 18 (Range 78W - 72W) UTM Zone 19 (Range 72W - 66W)	

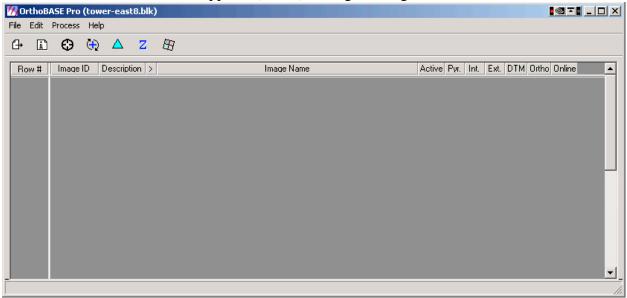
Select the appropriate Category and Projection for your project. For the Harvard Forest data, this is UTM WGS 84 North in UTM Zone 18. Click OK. Then, click "Next" in the Block Property Setup dialog (shown above) which should now display the correct Projection, Spheroid, Zone Number, and Datum. The Block Property Dialog now changes as follows:

🚧 Block Property Setup		×
F	eference Units:	
Horizontal Units: Vertical Units: Angle Units:	Meters	OK Previous Next Cancel Help

Enter the correct horizontal, vertical, and angle units. For the Harvard Forest data the defaults are correct. Click "Next". The Block Property Setup dialog now changes again as follows:

7 Block Property 🛙	Setup		×
Se	et Frame-Specific Information	1:	
Rotation System:	Omega, Phi, Kappa		ОК
Photo Direction:	Z-axis for normal images	•	Previous
Define Average f	Fly Height (meters):	0.000 *	Next
			Cancel
Import	Exterior Orientation Parame	ters	Help

Select the appropriate rotation system and photo direction. For the Harvard Forest data the defaults are again correct. Click "OK" to complete Block Property Setup. Finally, the OrthoBASE Pro main window appears (below), listing no images.



Adding Images

It is now time to select images. To do this, click the \Box (add images) icon in the OrthoBASE Pro main window to bring up the Image File Name dialog, below:

Image File Name File			×
Look in: 🔁 harvard-oct-	undistorted	• 🗈 💣	
🗟 oct6-02_00999160_und.tif	🗟 oct6-02_01005264_und.tif	a oct6-02_010113	0K.
oct6-02_00999771_und.tif oct6-02_01000381_und.tif	a oct6-02_01005875_und.tif		Cancel
et6-02_01000991_und.tif	a oct6-02_01007095_und.tif		Help
🗟 oct6-02_01002212_und.tif	🗟 oct6-02_01008316_und.tif	🗟 oct6-02_010144	
act6-02_01002822_und.tif	a oct6-02_01008927_und.tif	-	Recent
a oct6-02_01003433_und.tif	a oct6-02_01009538_und.tif	act6-02_010162	Goto
a oct6-02_01004654_und.tif	述 oct6-02_01010758_und.tif	🗟 oct6-02_010168	
		Þ	
File name:			
Files of type: TIFF			
7150 Files, 0 Subdirectories, 50	39 Matches, 88133084k Bytes F	Free	

Navigate to the directory where your undistorted images are stored (k:\scratch\harvard-octundistorted\ for the Harvard Forest data). Make sure to select the correct image format at the bottom where it says "Files of type: ," which is TIF for Harvard Forest. Select the images from your strip by selecting the first one, then, while holding down the SHIFT key on the keyboard, click the last one. This selects all the frames. To add them to the block file, click OK. The following progress meter appears:

17 meter				X
Job State:	Add multi	ple images		
Percent Done:	7% 0[100	
	OK.	Cancel	Help	

When it reaches 100%, the images appear in the OrthoBASE Pro main window:

Edit	Process He	elp										
ů	Θ 🤃) 🛆 🛛	2	B								
low #	Image ID	Description	>	Image Name	Active	Pyr.	Int.	Ext.	DTM	Ortho	Online	
141	141			k:/scratch/harvard-oct-undistorted/oct6-02_02473945_und.tif	X							
142	142			k:/scratch/harvard-oct-undistorted/oct6-02_02474580_und.tif	X							
143	143			k:/scratch/harvard-oct-undistorted/oct6-02_02475220_und.tif	X							
144	144			k:/scratch/harvard-oct-undistorted/oct6-02_02475799_und.tif	X							
145	145			k:/scratch/harvard-oct-undistorted/oct6-02_02476417_und.tif	X							
146	146			k:/scratch/harvard-oct-undistorted/oct6-02_02476997_und.tif	X							
147	147			k:/scratch/harvard-oct-undistorted/oct6-02_02477713_und.tif	X							
148	148			k:/scratch/harvard-oct-undistorted/oct6-02_02478422_und.tif	X							
149	149			k:/scratch/harvard-oct-undistorted/oct6-02_02479032_und.tif	X							
150	150			k:/scratch/harvard-oct-undistorted/oct6-02_02479643_und.tif	X							
151	151			k:/scratch/harvard-oct-undistorted/oct6-02_02480253_und.tif	X							
152	152			k:/scratch/harvard-oct-undistorted/oct6-02_02480863_und.tif	X							
153	153			k:/scratch/harvard-oct-undistorted/oct6-02_02481474_und.tif	X							
154	154			k:/scratch/harvard-oct-undistorted/oct6-02_02482139_und.tif	X							
155	155			k:/scratch/harvard-oct-undistorted/oct6-02_02482695_und.tif	X							
156	156			k:/scratch/harvard-oct-undistorted/oct6-02_02483305_und.tif	X							
157	157			k:/scratch/harvard-oct-undistorted/oct6-02_02483915_und.tif	X							

Interior Orientation and Exterior Information

Now it is time to enter the interior (camera) parameters for the frames. Click the (frame editor) icon in the OrthoBASE Pro main window to bring up the Frame Editor:

Frame Editor (oct6-02_02388)	282_und.tif)	X
Sensor Interior Orientation Exterio	or Information	
Block Model Type: Sensor Name:	oct6-02_02388282_und.tif Attach View Image Digital Camera Default Non-Metric T Edit New	OK Previous Next Cancel Help
File and sensor information		

Now, click "Edit" under the "Sensor" tab to enter some information about the camera that was obtained from calibrating the camera that was used to capture the frames. This can be done on a frame-by-frame basis, however, for the Harvard Forest data, the same camera was used for all frames. The following dialog appears:

	×
General Fiducials Radial Lens Distortion Camera Name: Duncan Description: Dana's Duncan Camera Focal Length (mm): 13.2000 Principal Point xo (mm): -0.0089 Principal Point yo (mm): -0.5069 Image: Principal Point yo (mm): -0.5069	

Enter the correct camera information. The correct information for the Duncan camera used to capture the Harvard Forest data is shown in the above screen shot. Click OK to return to the Frame Editor. Now, click the "Interior Orientation" tab at the top:

💯 Frame Editor (oct6-02_02388282_und.tif)		- 🗆 ×
Sensor Interior Orientation Exterior Information		
Pixel size in x direction (microns): Pixel size in y direction (microns):	7.4000 × 7.4000 ×	OK Previous Next Cancel Help
Interior orientation measurement.		1.

Enter the correct pixel size for the camera used. In the case of the Harvard Forest data, this is 7.4 microns for both the x and y directions. Due to a bug in OrthoBASE, you should now click "Next" once for each image in your block file to apply these interior parameters to all the frames.

Click "OK" to store all the camera parameters, and then click (frame editor) icon again to reenter the Frame Editor. Now click the "Exterior Information" tab at the top. The following dialog appears:

4	Frame	Editor (oct6-02_	02388282_u	nd.tif)						<u>_ ×</u>
	Sensor	Interior Orientation	Exterior Inform	nation						
		Pe	rspective Cente (meters)	er			Rotation Angles (degrees)			OK Previous
		Xo	Yo	Zo		Omega	Phi	Карра		Next
	Value	732058.974	4711783.9	397 🕂 704.725		0.00000	0.00000	180.00000	÷	Cancel
	Std.	1.000	1.000	1.000		1.00000	1.00000	5.00000	•	Help
	Status	Fixed	Fixed	▼ Fixed	F	Fixed	▼ Fixed	Fixed	-	
			Set Status:	Initial 💌	For Al	ll Parameters	Edit	All Images		
										li.

Now, click "Edit All Images..." to get the following dialog:

		X	o, Yo Units: m	eters Zo Unit:	s: meters	Angle l	Units: deg	grees			_ [] >
Row #	Image Name	Image ID	Xo	Yo	Zo	Omega	Phi	Карра	Std. Xo	Std. Yo	Std 🔺
1	:t6-02_02388282_u	1	0	0.000	0.000	0.0000	0.0000	0.0000	0.000	0.000	—
2	:t6-02_02388892_u	2	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.000	0.000	C
3	:t6-02_02389504_u	3	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.000	0.000	(
4	:t6-02_02390113_u		0.000	0.000	0.000	0.0000	0.0000	0.0000	0.000	0.000	(
5	:t6-02_02390724_u	5	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.000	0.000	(
6	:t6-02_02391335_u		0.000	0.000	0.000	0.0000	0.0000	0.0000	0.000	0.000	0
- 7	:t6-02_02391945_u	7	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.000	0.000	(
8	:t6-02_02392556_u	8	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.000	0.000	(
9	:t6-02_02393166_u	9	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.000	0.000	(
	:t6-02_02393776_u		0.000	0.000	0.000	0.0000	0.0000	0.0000	0.000	0.000	(
11	:t6-02_02394386_u	11	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.000	0.000	(
	t6-02_02394997_u	12	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.000	0.000	[[]
•											
			ОК		ancel	He	lp				

Select the Xo, Yo, and Zo columns by clicking on the Xo column header and dragging to Zo. Right-click and select Paste to paste in the xyz GPS data copied from an Excel spreadsheet. Enter in estimates for Omega, Phi, and Kappa (0, 0, for Omega and Phi, and either 0 or 180 for Kappa is used in the Harvard Forest data processing, depending on the flight direction) by

selecting the column, right-clicking, selecting "Formula", and entering the appropriate value in the formula, followed by a click to Apply and then Close (the Formula dialog is below):

💋 Formula				×
Columns:	Functions:	Formats:		
Image Name Image ID Xo Yo Zo Omega Phi Kappa Std. Xo	row ▲ pi mod(<a>,) abs(<a>) int(<a>) even(<a>) odd(<a>) max(<a>,) ▼	General 0 0.00 #,##0 #,##0.00 0% 0.00% 0.00% 0.00€+00 m/d/yy	7 8 9 + 4 5 6 - 1 2 3 * 0 E . / () []	
			A	[
			v	
	Clear (Close Help		

Using the same strategy, enter defaults for the standard deviations of Xo, Yo, Zo, Omega, Phi, and Kappa (values used on Harvard Forest data are 1, 1, 1, 1, 1, and 5, respectively). Finally, use the same strategy again to change the status on all images from "Unknown" to "Fixed." Click "OK" in the "Exterior Orientation Parameter Editor", followed by "OK" in the "Frame Editor". Now the main window for OrthoBASE appears as below:

D	<u>Λ</u> Δ		,	In								
ů	⊕ €	$2 \Delta 2$	1	B								
w #	Image ID	Description	>	Image Name	Active	Pyr.	Int	Ext.	DTM	Ortho	Online	
1	1		>	k:/scratch/harvard-oct-undistorted/oct6-02_02388282_und.tif	X							
2	2			k:/scratch/harvard-oct-undistorted/oct6-02_02388892_und.tif	X							
3	3			k:/scratch/harvard-oct-undistorted/oct6-02_02389504_und.tif	X							
4	4			k:/scratch/harvard-oct-undistorted/oct6-02_02390113_und.tif	X							
5	5			k:/scratch/harvard-oct-undistorted/oct6-02_02390724_und.tif	X							
6	6			k:/scratch/harvard-oct-undistorted/oct6-02_02391335_und.tif	X							
7	7			k:/scratch/harvard-oct-undistorted/oct6-02_02391945_und.tif	X							
8	8			k:/scratch/harvard-oct-undistorted/oct6-02_02392556_und.tif	X							
9	9			k:/scratch/harvard-oct-undistorted/oct6-02_02393166_und.tif	X							
10	10			k:/scratch/harvard-oct-undistorted/oct6-02_02393776_und.tif	X							
11	11			k:/scratch/harvard-oct-undistorted/oct6-02_02394386_und.tif	X							
12	12			k:/scratch/harvard-oct-undistorted/oct6-02_02394997_und.tif	X							
13	13			k:/scratch/harvard-oct-undistorted/oct6-02_02395608_und.tif	X							
14	14			k:/scratch/harvard-oct-undistorted/oct6-02_02396218_und.tif	X							
15	15			k:/scratch/harvard-oct-undistorted/oct6-02_02396828_und.tif	X							
16	16			k:/scratch/harvard-oct-undistorted/oct6-02_02397439_und.tif	X							
17	17			k:/scratch/harvard-oct-undistorted/oct6-02_02398049_und.tif	X							

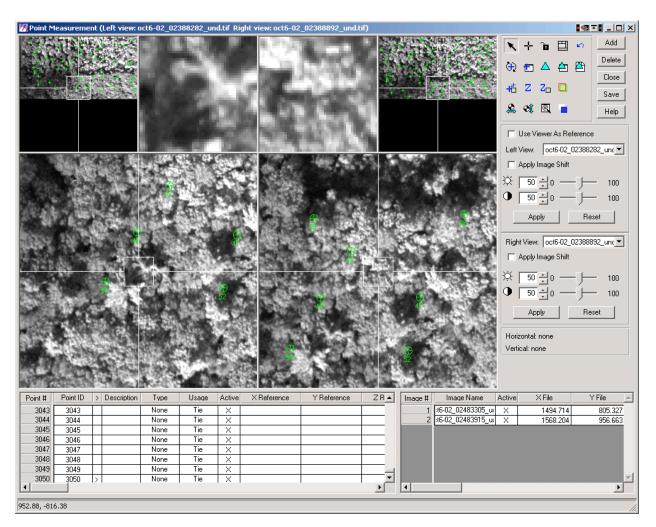
Note that the Int. and Ext. columns are now green, indicating these steps in the process of orthorectification are now complete. Now is probably a good time to save the block file by clicking File and then Save.

Automatic Tie-Point Generation

The next step is to gather tie-points to more correctly align the images. OrthoBASE can do this automatically. Click Edit and go to "Auto. Tie Point Generation Properties..." The following dialog appears:

💋 Automatic Tie Point Generation P	Properties
Images Used: 💿 All available	e 🔿 Active images only
Initial Type: 💿 Exterior/Head	der/GCP 🔿 Tie Points
Image Layer Used for Computation	. 1 .
Strategy Parameters:	Reset Strategy Parameters
Search Size: 21	Feature Pt Dense: 100%
Correlation Size: 7	Coefficient Limit: 0.85
Least Square Size: 21	Initial Accuracy: 10%
Intended Number of Points Per Imag	e: 30 💽 Keep All Points
OK Run	Cancel Help

Select 30 Points Per Image. The rest of the defaults work well for the Harvard Forest data. Click "OK". Now click the (auto tie point collection) icon in the main OrthoBASE window. This performs the automatic tie point generation. If you have not yet computed the pyramid layers for all the images, Erdas automatically does this first. Then, the tie points are automatically generated. This process may take up to an hour for block files with many images. Upon completion of finding tie points, Erdas may give a message saying that the tie points may contain "gross errors." If this is the case, then you should manually review the tie-points by clicking on the (point measurement) icon to bring up the Point Measurement Tool, as seen below:



If all the tie points make sense, then click Save. You can use the Point Measurement Tool to fix erroneous points, too.

If the automatic tie point generation generated too many errors, then manually checking and editing the points may not be practical. This may be the result of accidentally entering the wrong exterior information in the Frame Editor above, or of entering incorrect estimates of Omega, Phi, or, most likely, Kappa. Try deleting all the tie points, changing the correct exterior information, and re-running the auto tie point generation.

Triangulation

At this point, there is enough information to perform the triangulation, or bundle block adjustment to more precisely fix the location and orientation of the camera at the capture of each frame. First, we must specify which exterior information values are allowed to float. To do this,

enter the frame editor again by clicking in (frame editor) icon. Click Edit all Images again to see the Exterior Orientation Parameter Editor. Now, change all the values in all the status columns on the right to be "Initial", but set the Y column values to "fixed" for a flight which primarily traverses a north-to-south direction (kappa in (315, 45) or (135, 225)) or set the X column values to "fixed" instead for a flight which primarily traverses an east-to-west direction (kappa in (45,135) or (225, 315)). Then, set all the values for a particular frame to "fixed". The "center" frame or one of the end frames is a good choice. See below:

					Xo, Yo	Units:	meters		Zo Units:	meters		Angl	e Units: degrees		
ow #	Std. Xo	Std. Yo	Std. Zo	Std. Om	Std. Ph	Std. Ka	Sta. Xo	Sta, Yo	Sta. Zo	Sta. Om	Sta. Ph	Sta. Ka			
76	1.000	1.000	1.000	1.0000	1.0000	5.0000	Initial	Fixed	Initial	Initial	Initial	Initial			
77	1.000	1.000	1.000	1.0000	1.0000	5.0000	Initial	Fixed	Initial	Initial	Initial	Initial			
- 78	1.000	1.000	1.000	1.0000	1.0000	5.0000		Fixed	Fixed	Fixed	Fixed	Fixed			
79	1.000	1.000	1.000	1.0000	1.0000	5.0000	Initial	Fixed	Initial		Initial	Initial			
80	1.000	1.000	1.000	1.0000	1.0000	5.0000		Fixed	Initial		Initial	Initial			
81	1.000	1.000	1.000	1.0000	1.0000	5.0000		Fixed	Initial		Initial	Initial			
82	1.000	1.000	1.000	1.0000	1.0000	5.0000		Fixed	Initial		Initial	Initial			
83	1.000	1.000	1.000	1.0000	1.0000	5.0000		Fixed	Initial		Initial	Initial			
84	1.000	1.000	1.000	1.0000	1.0000	5.0000		Fixed	Initial		Initial	Initial			
85	1.000	1.000	1.000	1.0000	1.0000	5.0000		Fixed	Initial		Initial	Initial			
86	1.000	1.000	1.000	1.0000	1.0000	5.0000		Fixed	Initial			Initial			
87	1.000	1.000	1.000	1.0000	1.0000	5.0000	Initial	Fixed	Initial	Initial	Initial	Initial			
					[ΰK			Cano	. 1		He	u 1		

Now, click OK in the Exterior Orientation Parameter Editor dialog, and then OK again in the Frame Editor to return to the main OrthoBASE window.

We can now perform triangulation by clicking the \triangle (triangulation) icon in the main OrthoBASE window. The triangulation is performed and the resulting dialog appears:

奶 Triangulal	tion Summary		-	×
-	on Iteration Conver e Unit-Weight RMS	-	Yes).2064	Close
Control F	Point RMSE:	Check P	oint RMSE:	Update
Ground X:	0.0000 (0)	Ground X:	0.0000 (0)	Accept
Ground Y:	0.0000 (0)	Ground Y:	0.0000 (0)	Report
Ground Z:	0.0000 (0)	Ground Z:	0.0000 (0)	Help
Image X:	0.0000 (0)	Image X:	0.0000 (0)	
Image Y:	0.0000 (0)	Image Y:	0.0000 (0)	
RMSE Signifi	cant Digits:	4		

Check to make sure the iteration converged and that the RMSE is low enough for your requirements. Click "Report" to view the report and verify that the image orientations make sense.

-				:/docume~)	l/rawert/	locals~1/temp/			
File Edit	View	Find Help	D						
<i>i</i> 🛱		<i>🖨</i> %		2 🛦					
						tandard error ject points =	= 0.2064 0.05742		_
						tandard error ject points =	= 0.2064 0.00152		
						tandard error ject points =	= 0.2064 0.00005		
			ть	a avtario	n orie	ntation parame	atare		
image		X	3	Ys	3	Zs	OMEGA	PHI	KAPPA
	78	732021 732183		4713746 4711809		683.2385 869.0831	0.0000 -7.5417	0.0000	0.0000
	2 3 4 5 6 7			4711835		866.0554	-8.9578	-6.8543	4.9189
	4	732177		4711861		863.0293	-8.5522	-2.9574	4.7480
	5	732174		4711886		859.6987	-7.6311	-1.2947	5.6562
	ь 7	732170 732166		4711912 4711937		856.6384 853.6943	-7.8498 -7.5969	-1.1503	6.3858 6.1490
	8	732163		4711963		851.0748	-7.2418	2.6624	4.6301
	9	732159		4711988		848.9416	-6.8584	3.6307	4.0560
	10	732156		4712014		847.0913	-6.5736	4.4914	4.3722
	11	732152				845.4684	-7.2093	4.8653	4.7189
	12	732149	.5761	4712067	2900	843.9429	-7.7880	2.8304	4.6179 🚽
									Þ
Copy the S	electe	d Area							

If all looks reasonable, close the report and then click "Update" followed by "Accept", and then "Close" in the "Triangulation Summary" window.

Now is another good time to save work in the block file.

DTM Extraction

Now we can extract the DTM's for enough pair's of frames to cover the whole area reliably. To start, click the \mathbb{Z} (dtm extraction) icon in the main OrthoBASE window. This brings up the following dialog:

11 DTM Extraction	×
Output DTM Type: DEM	<u> </u>
Output Form: C Single DTM Mosaic 💿 Individual DTM Files	Run
Output DTM Prefix: dtm.img	Batch
DTM Cell Size X: 1.500000 Y: 1.500000 Meters	Cancel
Make Pixels Square	Help
DEM Background Value: Default	
Trim the DTM Border by 0% Advanced Properties	
Single or multiple output	

It seems that OrthoBASE crashes whenever we try to produce a single DTM mosaic for long strips. As a result we will output "Individual DTM Files". Make sure these individual files go into the correct directory by clicking the file folder next to the "Output DTM Prefix" text box and navigating to the correct folder. Now, set the DTM Cell Size in the X and Y directions. For the Harvard Forest Data, 1.5m provides close to the best accuracy possible given the DTM extraction process and the resolution of the images.

Now, to select which image pairs are used to compute the DTM, click the "Advanced Properties..." button to get the "DTM Extraction Properties" dialog:

eneral Im	age	Pair Area Selection Accuracy						
Recalculat	e	pairs with overlap over 🛛 🚺 🔂 🔂 🔂 65%	Active Or	nly 📘] 💌 🔍 (
Row #	>	Image Pair Name	Active	Overlap %	Image Detail	DTM Status		<u> </u>
507		oct6-02_02446272_und_oct6-02_02446883_und	X	83.907	100%			
508		oct6-02_02446272_und_oct6-02_02447494_und		63.871	100%			Cance
509		oct6-02_02446883_und_oct6-02_02447494_und	X	83.487	100%			
510		oct6-02_02446883_und_oct6-02_02448104_und		63.894	100%			
511		oct6-02_02447494_und_oct6-02_02448104_und	X	84.073	100%			Help
512		oct6-02_02447494_und_oct6-02_02448714_und		66.114	100%			
513		oct6-02_02448104_und_oct6-02_02448714_und	X	84.884	100%			
514		oct6-02_02448104_und_oct6-02_02449324_und		65.185	100%			
515		oct6-02_02448714_und_oct6-02_02449324_und	X	84.198	100%			
516		oct6-02_02448714_und_oct6-02_02449935_und		65.551	100%		•	

Select the "Image Pair" tab at the top. With the Harvard Forest data, there are enough frames to set the overlap threshold to 65% and still get more than enough coverage. After "recalculating"

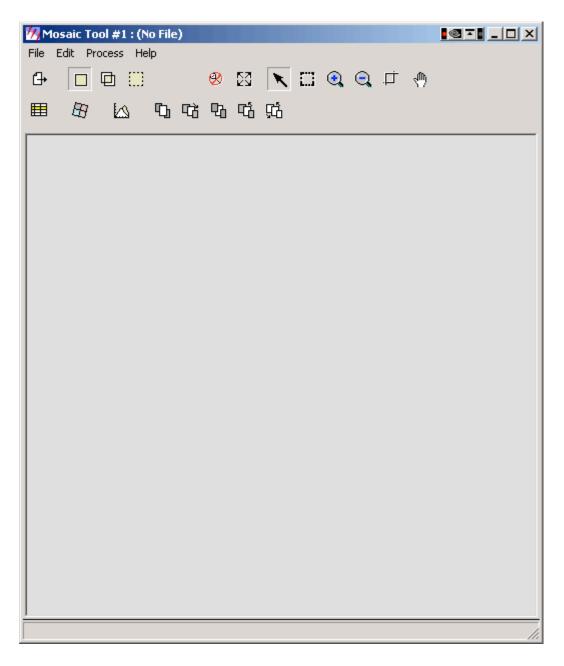
the pairs, go through and de-activate any pairs with 100% overlap because OrthoBASE can't seem to handle these. It's also a good idea to thin out the active pairs so that there aren't too many unnecessary DTM's computed. Now click OK to close the DTM Extraction Properties dialog. Now click "Run" in the DTM Extraction dialog. Wait while OrthoBASE computes the DTM frames. This is another good time to save the block file. Note that by now, all the columns to the right in the main OrthoBASE window are green except the "Ortho" column. Orthorectification is the last step in processing a block of images; we will get to this later. First, we need a unified DTM.

DTM Mosaic Generation

Once the individual DTM's have been generated, we can assemble them into a mosaic. To do this, click the "Data Prep" button in the main Erdas Imagine tool bar. This yields the following box:

💋 Data Preparation 🛛 🔀
Create New Image
Create Surface
Subset Image
Image Geometric Correction
Mosaic Images
Unsupervised Classification
Reproject Images
Recalculate Elevation Values
Imagizer Data Prep
Make RPF TOC
Close Help

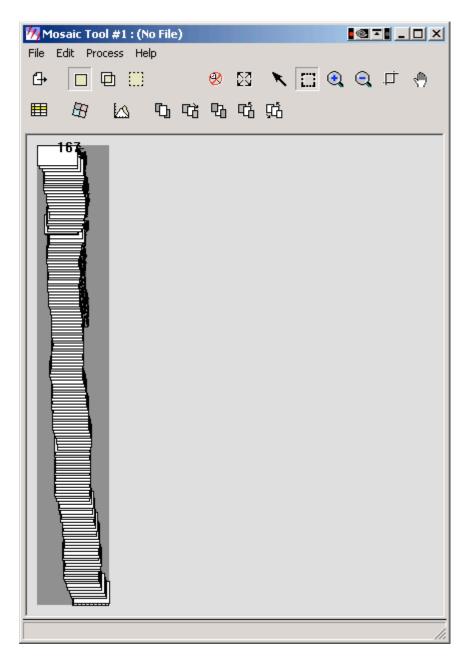
Click "Mosaic Images..." to get the following dialog:



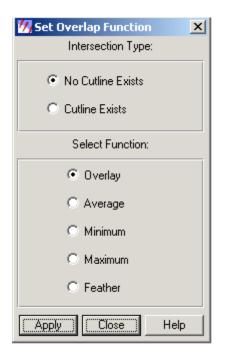
First, we must add all the DTM frames as images into this mosaic. To do this, click the \square (add images) button near the top. This yields the following dialog:

🚧 Add Images for Mosaic	X
Multiple files selected	
Clear Selection	
Method: Individual File	•
Method: Individual File Image Area Options:	•
,	•
, Image Area Options:	•
Image Area Options: © Use Entire Image	•
Image Area Options: © Use Entire Image © Crop Area	•
Image Area Options: Use Entire Image Crop Area Compute Active Area	•
Image Area Options: Use Entire Image Crop Area Compute Active Area Template AOI	•
Image Area Options: Use Entire Image Crop Area Compute Active Area Template AOI	•

You can navigate to the appropriate directory and select all the DTM's at once. The result after doing that is what you see above. Now, select "Compute Active Area", and then click add. After some processing, this gives the following:



Now, we need to set the overlap functions and the resolution of the resulting mosaic. To set the overlap function, click "Edit" and select "Set Overlap Function". This presents the following dialog:



Select the "Feather" option and then click "Apply", then "Close". Now, to set the resolution, click Edit, then "Output Options" to get:

💋 Output Image Options 🛛 🔀			
Define Output Map Area(s):			
Union of All Inputs			
C User-defined AOI			
C Map Series File (.msh)			
C USGS Maps Database			
USGS Map Series: 1:24000 💌			
Change Output Map Projection			
Output Cell Size: (meters)			
X: 0.200000 ¥ Y: 0.200000 ¥			
Output Data Type: Float Single			
OK Cancel Help			

Set the output cell sizes appropriately. For the Harvard forest data, 0.2 is probably a much higher resolution than is needed. Click OK. Now, we need to compute the mosaic.

Click "Process" and then "Run Mosaic" to get the following dialog:

💋 Run Mosaic	X			
Output File Name: (*.img)				
	e			
🔲 Output a Common Look Up Table				
Compress Output to:				
Compressed Output File Name: (*.sid)				
	e			
Which Outputs:				
C All C Selected				
Ignore Input Values: 0				
Output Background Value: 0	•			
Stats Ignore Value:	× 7			
OK Batch Cancel	Help			

Enter the appropriate filename and location (by clicking on the folder and navigating) in the Output File Name box. Then click OK to run the mosaic. Watch the progress bar:

💋 Mosaic				×
Job State:	Starting			
Percent Done:	0% 0		100	
	OK.	Cancel	Help	

When finished, we can close all the mosaic tool windows, and return to OrthoBASE to continue working on our block file. You may view the newly created DTM mosaic by opening it in a viewer.

Orthorectification

To begin the orthorectification process, click the B (ortho resampling) button in the OrthoBASE main window. This presents the following dialog:

Ortho Resampling	
General Advanced Input File Name: oct6-02_02388282_und.tif Active Area: 95.0%	OK
Output File Name: (*.img) orthooct6-02_02388282_und.img	Batch
DTM Source: DEM Vertical Units: Meters	Cancel
DEM File Name: tower-east8-fullstrip-dem-mosaic.img Properties	Help
Output Cell Sizes: X: 0.52573085	
ULX: 731748.85780273	
ULY: 4712009.13843225 LRY: 4711668.46484411	
Output rows: 649 columns: 1219 Recalculate	
Add Add Multiple Delete	
Row # Input Image Name > Active Output Image Name Active Area	Resample Methe
1 oct6-02_02388282_und. > X orthooct6-02_02388282_ 95	bilinear

Remember to change the "Active Area" percentage to 95. Next to DTM source, click the down arrow and select DEM. Then, click the DEM File Name down arrow and select "Find DEM...", then navigate to the DEM mosaic just created, and select this file. Next, click the "Add Multiple..." button near the bottom. The following dialog appears:

🚧 Add Multiple Outputs	X
Multiple outputs can be added by using some common parameters shown in Ortho Resampling dialog. These parameters include active area, resampling method, DTM source, DTM units, overlap threshold, cell sizes and ignore value. The output image name is determined by following prefix plus the input image name.	
Output File Prefix: (*.img) ortho.stk	
Use Current Cell Sizes	
Cancel Help	

Click the folder icon to the right of the text box labeled "Output File Prefix". Navigate to the directory where you want to store the individual orthorectified frames, change "Files of Type" to "IMAGINE image (*.img)", and then enter "ortho.img" in the "file name" box, then click OK. You then see the above dialog again. Check the "Use Current Cell Sizes" box, and click OK. Now the Ortho Resampling dialog reappears as this:

🕖 Ortho Resamplin	g				
General Advanced					
Input File Name:	oct6-02_023	88282_und	.tif Active Area:	95.0%	
Output File Name: (*.img) o	thooct6-02	_02388282_und.img	e	Batch
DTM Source:	DEM	•	Vertical Units: Meters	•	Cancel
DEM File Name:	tower-eas	t8-fullstrip-d	em-mosaic.imc	Properties	Help
Output Cell Sizes:	X: 0.52	573085	× Y: 0.5257	3085	
ULX: 731748.8	35780273	•	LRX: 732389.1979	7304	
ULY: 4712009	.13843225	• •	LRY: 4711668.464	84411	
Output rows:	649	columns:	1219	Recalculate	
Add	d Multiple	Delete			Show Path
Row # Input I	mage Name	> Active	Output Image Name	Active Area	Resample Methc 🔺
1 oct6-02_0)2388282_und.	> X	orthooct6-02_02388282	95	bilinear
2 oct6-02_0)2388282_und.	X	orthooct6-02_02388282_	95	bilinear
3 oct6-02_0)2388892_und.	X	orthooct6-02_02388892_	95	bilinear
4 oct6-02_0)2389504_und.	X	orthooct6-02_02389504_	95	bilinear
5 oct6-02_0)2390113_und.	X	orthooct6-02_02390113_	95	bilinear
)2390724_und.	X	orthooct6-02_02390724_	95	bilinear
7 oct6-02_0)2391335_und.	X	orthooct6-02_02391335_	95	bilinear 🔤

Notice that the first row is the same as the second row in the table at the bottom. We should delete the *first* row because it actually will place the orthoresampled image in the wrong place, leaving two copies of it. To do this, click the "1" on the left side of the table to select that row. Then, right-click, and choose "delete selection". Now you can perform the orthorectification (or orthoresampling) by clicking "OK". The process may take up to an hour or more for large block files. When complete, all the columns on the right side of the main OrthoBASE window should be green. Now, let's create the orthomosaic.

Orthomosaic

To create the orthomosaic, we follow the same process as we did in mosaicking the DEM's. See the section labeled DTM Mosaic Generation. This time, however, select the orthorectified frames for mosaicking instead of the DTM's. Also, set the output cell size to 0.1 m. Run the mosaic as before, and it can be viewed in the viewer. Now the process is complete.