Calibration Tool is a tool for calibrating camera and measuring distances.

1. Package Contents

bin	include executables and dll files
cal	container for images needed in calibration
data	container for images needed in distance measurement
img	a hided folder containing images needed by this tool
User Manual v1.8.2.doc	this file

2. Environment

(1). The check-board images should be put in:

Calibration Tool v1.8.2/Cal/boards/

(2). The pole images be put in:

Calibration Tool v1.8.2/Cal/poles/

(3). The animal tracking images be put in:

Calibration Tool v1.8.2/data/ $folderName/$imageName

(The folder's name and images' name can be defined by user. But please note that there should be no space within the names.)

E.g. You can have some sequences of data put here:

/data/sequence_1/image_1.jpg

/data/sequence_1/image_2.jpg

/data/sequence_2/image_1.jpg

/data/sequence_2/image_2.jpg

(4). Temp files generated will be put in the root directory of the calibration tool. They include:

Distortion.xml

Intrinsics.xml

stick2D_camera3D.txt

points_2D3D.txt

(5). Output file will also be put in the root directory of the calibration tool.

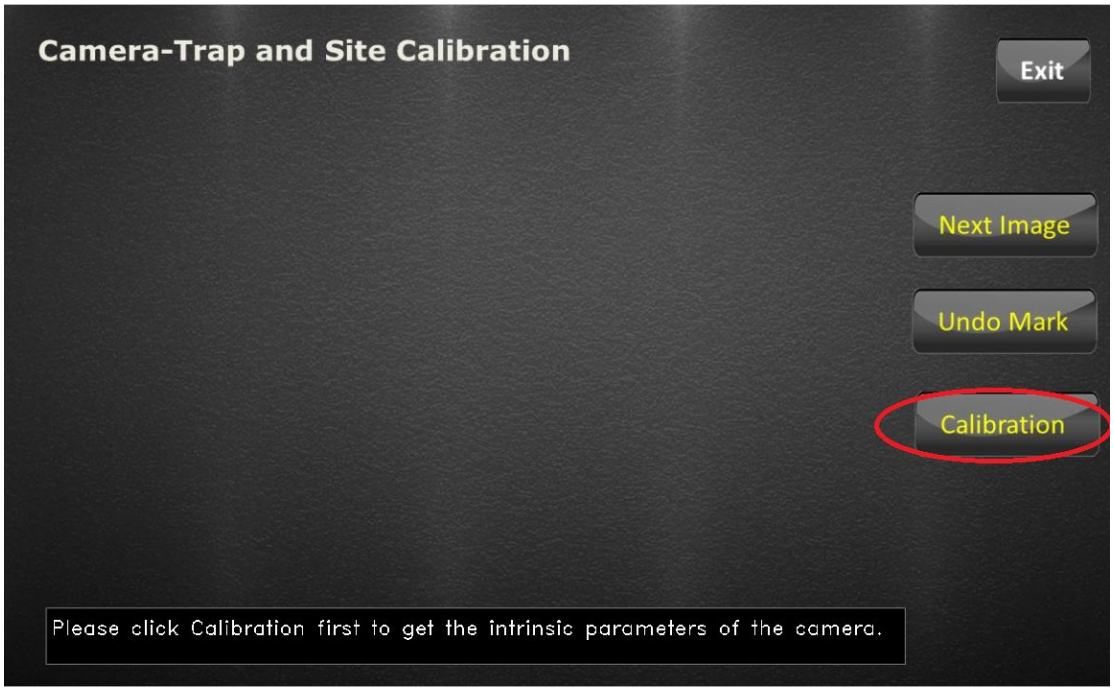
The output file is:

data.xml

It includes measurement results.

3. How to use it:

*3.1 Run **calibrate.exe***

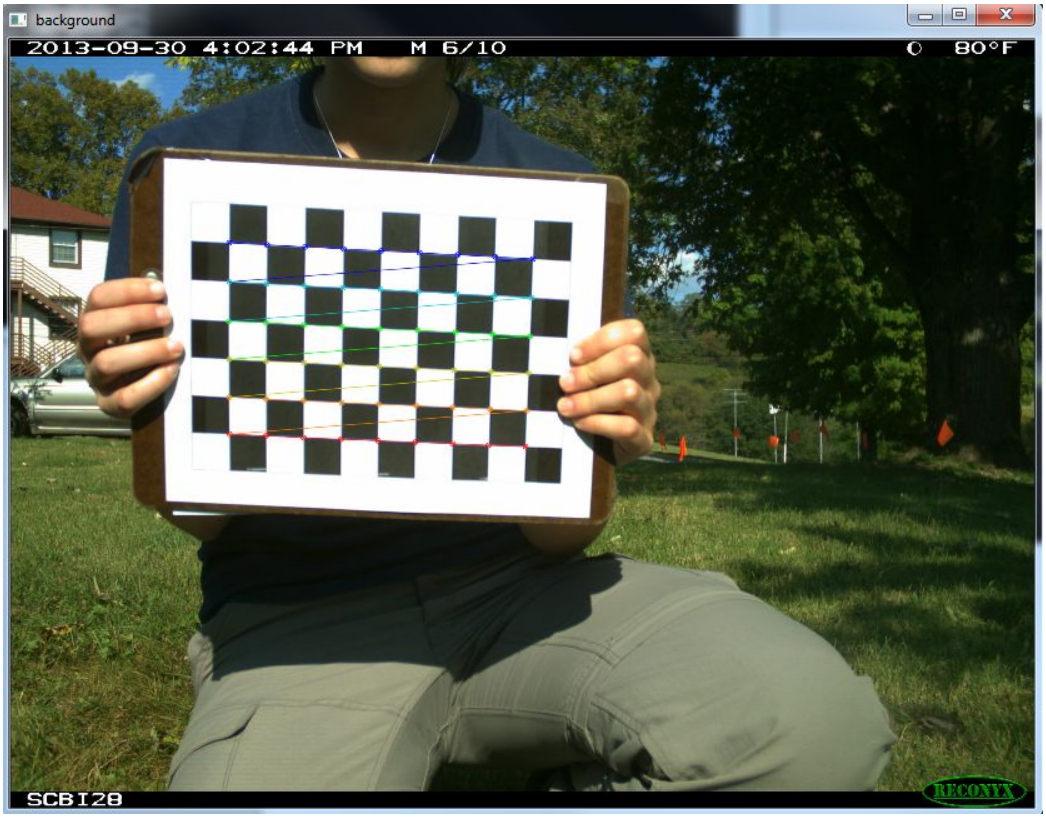


(Fig.1 Board Calibration)

If the environment is set successfully, the above window in Fig.1 will show up. Simply click calibration to do board calibration. During this step, camera/intrinsic parameters will be learned.

If however, the environment not set up successfully, Fig.2 will show up to indicate that board images and pole images need to be put in the right place.

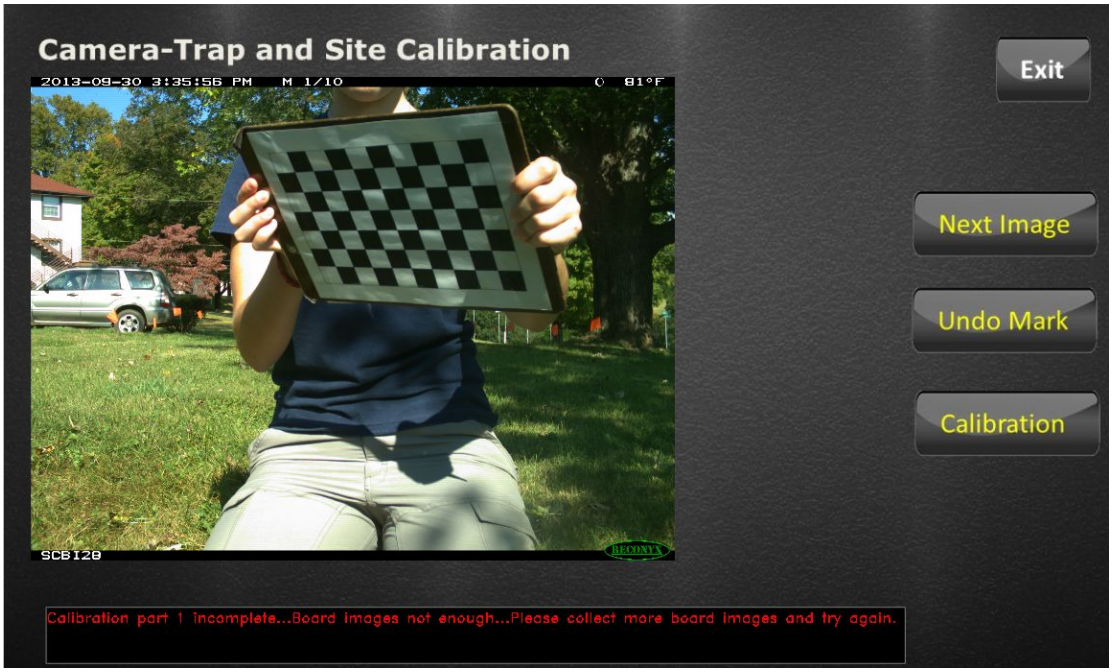
(Fig.2 Environment not successfully setup)



(Fig.3 Board Calibration in process)

After clicking *Calibration* button, a new window shown in Fig.3 will appear with board images in it. Colorful lines will be seen if the current board image is good and can be used for camera calibration. Please wait until camera calibration process is finished.

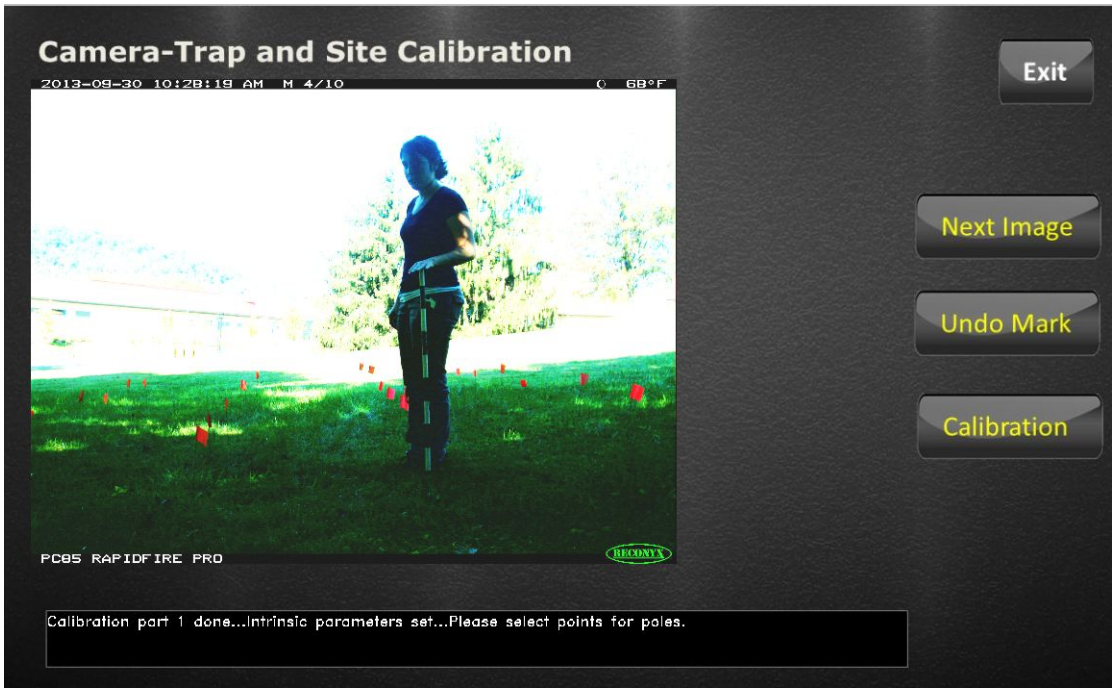
If board images in colorful lines are not abundant, which means not enough information can be absorbed by the tool, a window like Fig.4 will appear showing that board images not enough.



(Fig.4 Board Images not abundant)

3.2 Positioning poles.

If board calibration is successful, then pole calibration process begins, where some work need to be done by hand.



(Fig. 5 Pole Calibration)

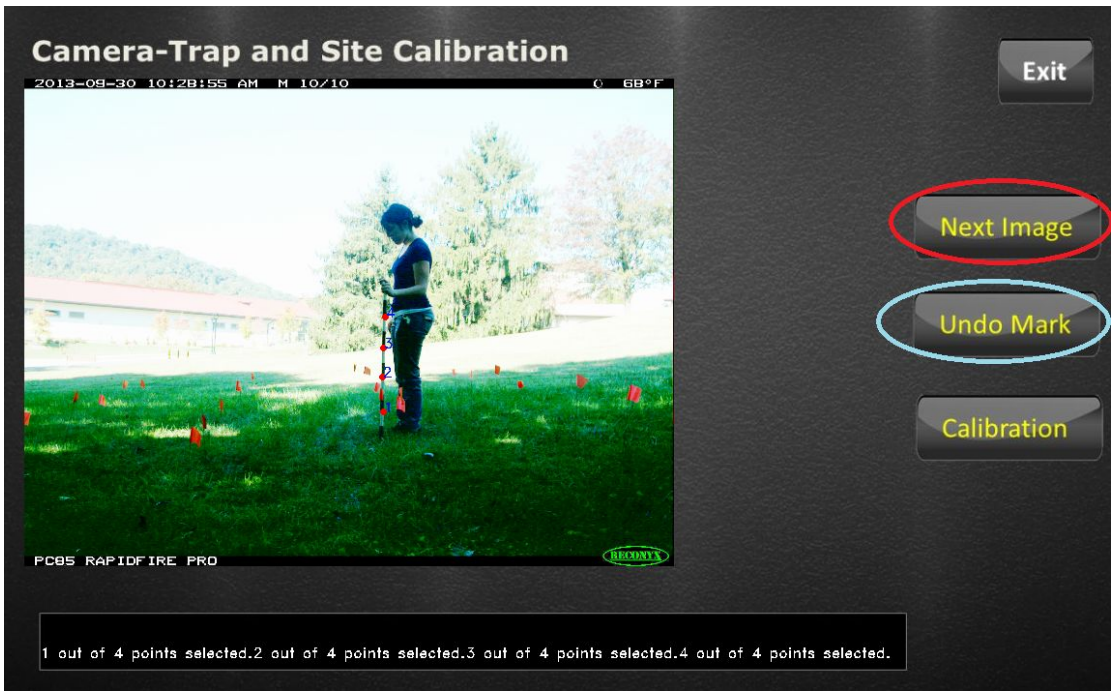
Here is how the work should be done:

(Fig. 6 How to collect positions)

Click the positions upwards. The blue number indicates the order, and the red number here indicates the positions are 2 grids from each other.

Note that the pole is 1 meter in length, with 10 grids.

Since the positions are not flexible, please follow the example when doing pole calibration.

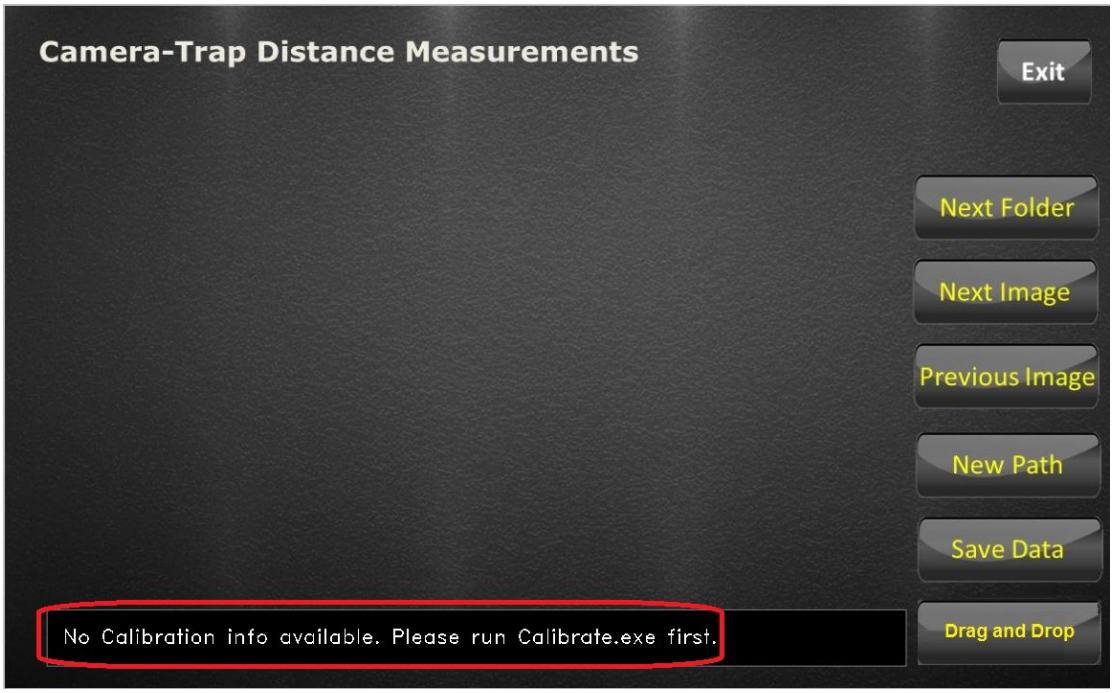


(Fig. 7 Press *Next Image* to go to next pole image. Press *Undo Mark* to do it again at this image)

Click Next to go to next image or click undo to do it again at this image. When enough pole positions are collected, you can click Exit to leave.

3.3 Run **Cal_dist.exe**

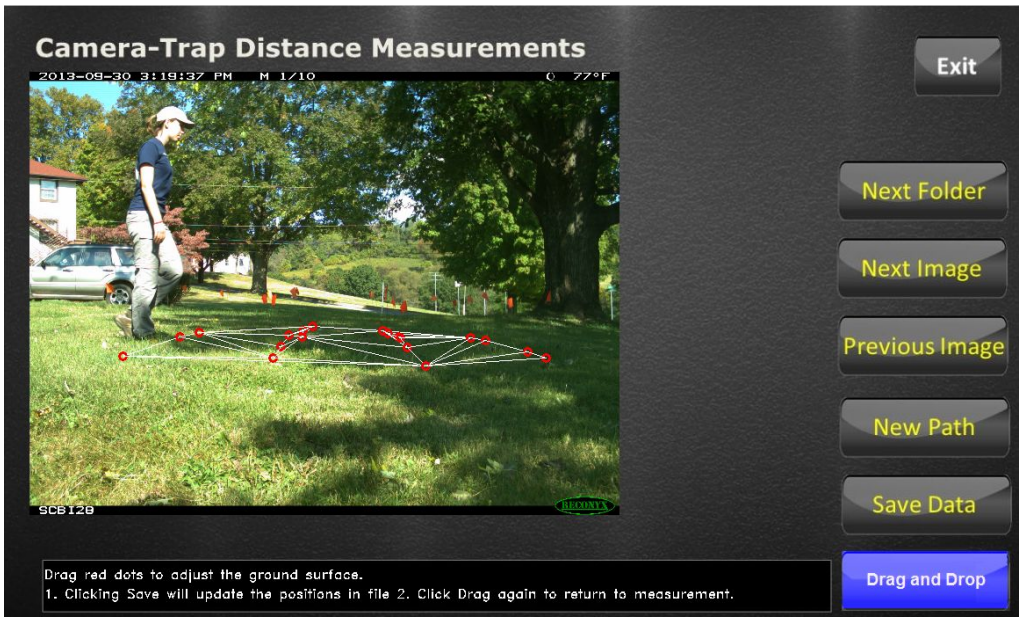
By running Cal_dist.exe, you can measure distances. Before running this program, please make sure that calibration is done for both boards and poles. Otherwise, you may see the window like Fig.8.



(Fig. 8 Calibration need to be done first.)

If successful, you should see this:

(Fig. 9 Distance Measurements)



(Fig. 10 Optional: Drag and Drop)

Optionally, you can click ***Drag and Drop*** button to drag the red circles, which indicates the positions where the poles touches the ground, to make sure that these positions are intuitively correct and that they can well represent the ground surface.

This helps discover pole calibration errors, which results from careless clickings. The distance measurement will be more accurate if wrong positions are fixed.

Once it is done, you can choose to click ***Save Data*** button to permanently change the pole calibration data in file so that the next time you will be automatically using the modified pole calibration data, otherwise, you can just click the ***Drag and Drop*** button again to go back to measurement mode.

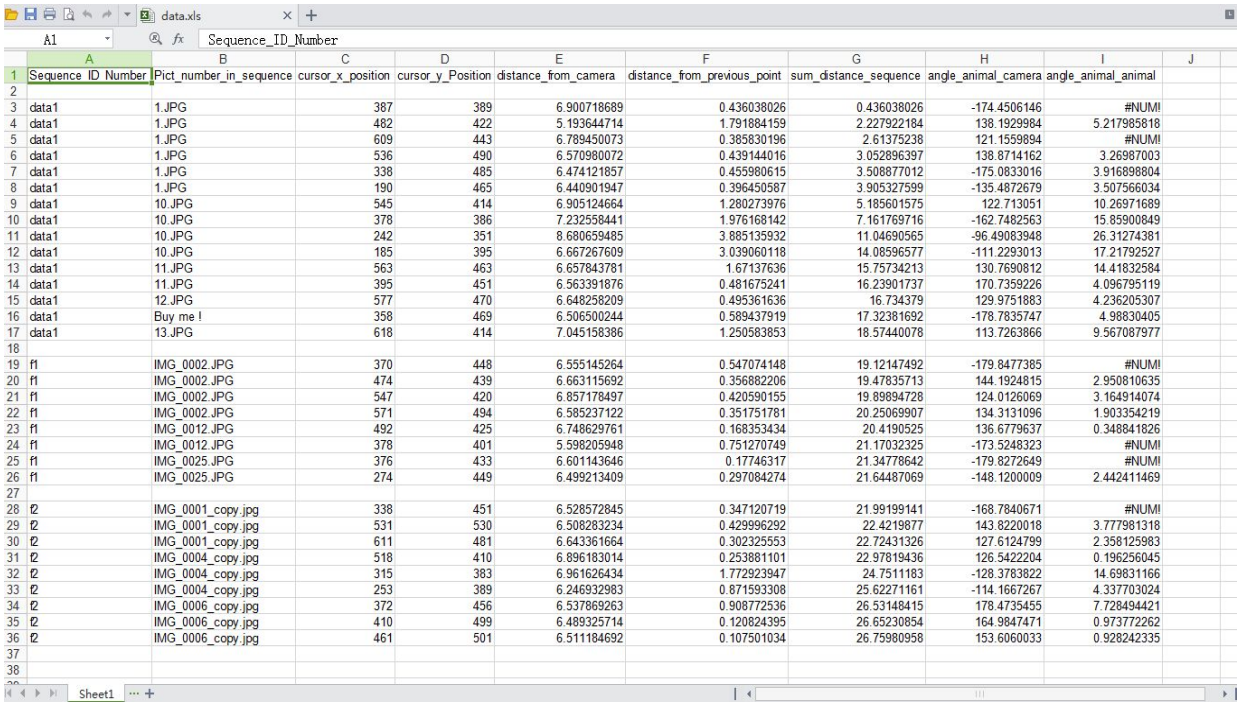
(Fig. 11 Distance Measurement)

When measuring the distances, simply click the position on the ground, the distance will be shown on the image as well as on the blackboard at the bottom of the window, where the sequence number and the frame number are also exhibited.

You can go to the ***Next Image*** or the ***Previous Image*** to measure, or you can go to the ***Next Folder*** to measure when this sequence is done.

If you want to start a new measurement, just click ***New Path*** to start from a new position at any frame.

(Fig. 12 New Path to start a new measurement.)



data.xls

A1 Sequence_ID_Number

	A	B	C	D	E	F	G	H	I	J
1	Sequence_ID_Number	Pict_number_in_sequence	cursor_x_position	cursor_y_Position	distance_from_camera	distance_from_previous_point	sum_distance_sequence	angle_animal_camera	angle_animal_animal	
2										
3	data1	1.JPG	387	389	6.900718689	0.436038026	0.436038026	-174.4506146	#NUM!	
4	data1	1.JPG	482	422	5.193644714	1.791884159	2.227922184	138.1929984	5.217985818	
5	data1	1.JPG	609	443	6.789450073	0.385830196	2.61375238	121.1559894	#NUM!	
6	data1	1.JPG	536	490	6.570980072	0.439144016	3.052896397	138.8714162	3.26987003	
7	data1	1.JPG	338	485	6.474121857	0.455980615	3.508877012	-175.0833016	3.916898804	
8	data1	1.JPG	190	465	6.440901947	0.396450587	3.905327599	-135.4872679	3.507566034	
9	data1	10.JPG	545	414	6.905124664	1.280273976	5.185601575	122.713051	10.26971689	
10	data1	10.JPG	378	386	7.232558441	1.976168142	7.161769716	-162.7482563	15.85900849	
11	data1	10.JPG	242	351	8.680659485	3.885135932	11.04690565	-96.49083948	26.31274381	
12	data1	10.JPG	185	395	6.667267609	3.039060118	14.08596577	-111.2293013	17.21792527	
13	data1	11.JPG	563	463	6.657843781	1.67137636	15.75734213	130.7690812	14.41832584	
14	data1	11.JPG	395	451	6.563391876	0.481675241	16.23901737	170.7359226	4.096795119	
15	data1	12.JPG	577	470	6.648258209	0.495361636	16.734379	129.9751883	4.236205307	
16	data1	Buy me !	358	469	6.506500244	0.589437919	17.32381692	-178.7835747	4.98830405	
17	data1	13.JPG	618	414	7.045158386	1.250583853	18.57440078	113.7263866	9.567087977	
18										
19	f1	IMG_0002.JPG	370	448	6.555145264	0.547074148	19.12147492	-179.8477385	#NUM!	
20	f1	IMG_0002.JPG	474	439	6.663115692	0.356882206	19.47835713	144.1924815	2.950810635	
21	f1	IMG_0002.JPG	547	420	6.857178497	0.420590155	19.89894728	124.0126069	3.164914074	
22	f1	IMG_0002.JPG	571	494	6.585237122	0.351751781	20.25069907	134.3131096	1.903354219	
23	f1	IMG_0012.JPG	492	425	6.748629761	0.168353434	20.4190525	136.6779637	0.348841826	
24	f1	IMG_0012.JPG	378	401	5.598205948	0.751270749	21.17032325	-173.5248323	#NUM!	
25	f1	IMG_0025.JPG	376	433	6.601143646	0.17746317	21.34778642	-179.8272649	#NUM!	
26	f1	IMG_0025.JPG	274	449	6.499213409	0.297084274	21.64487069	-148.1200009	2.442411469	
27										
28	f2	IMG_0001_copy.jpg	338	451	6.528572845	0.347120719	21.99199141	-168.7840671	#NUM!	
29	f2	IMG_0001_copy.jpg	531	530	6.508283234	0.429996292	22.4219877	143.8220018	3.777981318	
30	f2	IMG_0001_copy.jpg	611	481	6.643361664	0.302325553	22.72431326	127.6124799	2.358125983	
31	f2	IMG_0004_copy.jpg	518	410	6.896183014	0.253881101	22.97819436	126.5422204	0.196256045	
32	f2	IMG_0004_copy.jpg	315	383	6.961626434	1.772923947	24.7511183	-128.3783822	14.69831166	
33	f2	IMG_0004_copy.jpg	253	389	6.246932983	0.871593308	25.62271161	-114.1667267	4.337703024	
34	f2	IMG_0006_copy.jpg	372	456	6.537869263	0.908772536	26.53148415	178.4735455	7.728494421	
35	f2	IMG_0006_copy.jpg	410	499	6.489325714	0.120824395	26.65230854	164.9847471	0.973772262	
36	f2	IMG_0006_copy.jpg	461	501	6.511184692	0.107501034	26.75980958	153.6060033	0.928242335	
37										
38										

Sheet1

(Fig. 13 Output file: **data.xls**)

After the measurement, a file named **data.xml** will be generated in the root directory of this tool.

It will look like that shown in Fig.13. When sequence folder is changed, a blank row is intentionally left to distinguish the data.

The columns are:

Sequence_ID_Number,
Pict_number_in_sequence,
cursor_x_position,
cursor_y_position,
distance_from_camera,
distance_from_previous_point,
sum_distance_sequence,
angle_animal_camera,
angle_animal_animal.

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