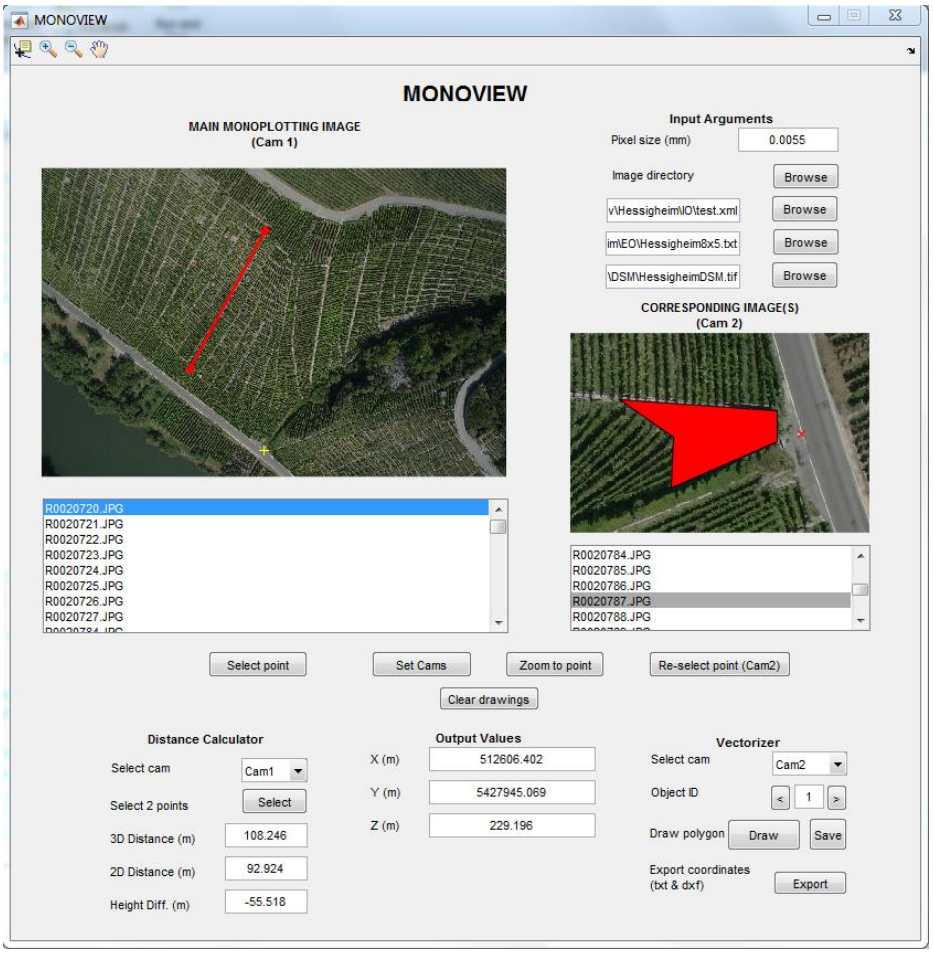
# MONOVIEW – User Manual

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## Contents


1 Description of application ..... 2

2 Obtaining the necessary input files ..... 2

3 Setting up the tool ..... 3

4 Other secondary tools ..... 5

5 Annexes ..... 8

# 1 Description of application

The tool is a simple interface written in Matlab using its graphical user interface (GUI) module, GUIDE. The tool enables the user to click on one main image (Cam1) and to be immediately directed towards other photos where the clicked point is visible (Cam2). Furthermore, by using the monoplotting concept, the user will also be able to inquire the 3D coordinates of the selected point. Other features of the tool include a distance calculator between two points in one image, and a vectorizer which can be used to digitize polygonal features from an image.

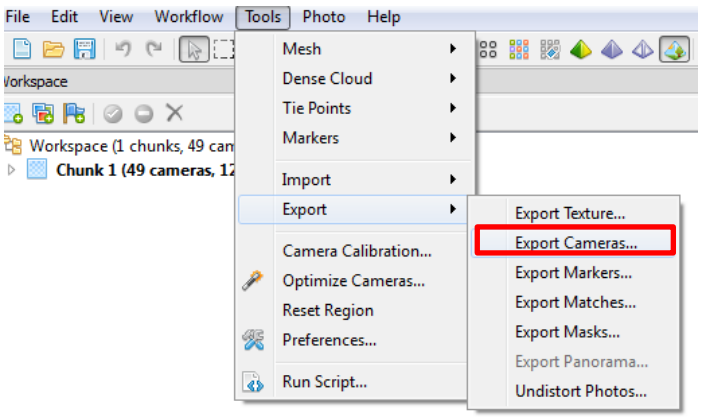
The principal inputs for this program are:

1. Aerial photos in .jpeg format placed in the same folder,
2. Initial or calculated exterior orientation (EO) parameters in a .txt file with the Omega Phi Kappa format, directly exportable from Photoscan,
3. Internal orientation (IO) parameters obtained from camera calibration and stored in an .xml file with Photoscan calibration format,
4. A DEM (Digital Elevation Model) of the area in .tif format, alongside its world file .tfw, and
5. The size of the pixel of the camera's CCD in millimeters.

# 2 Obtaining the necessary input files

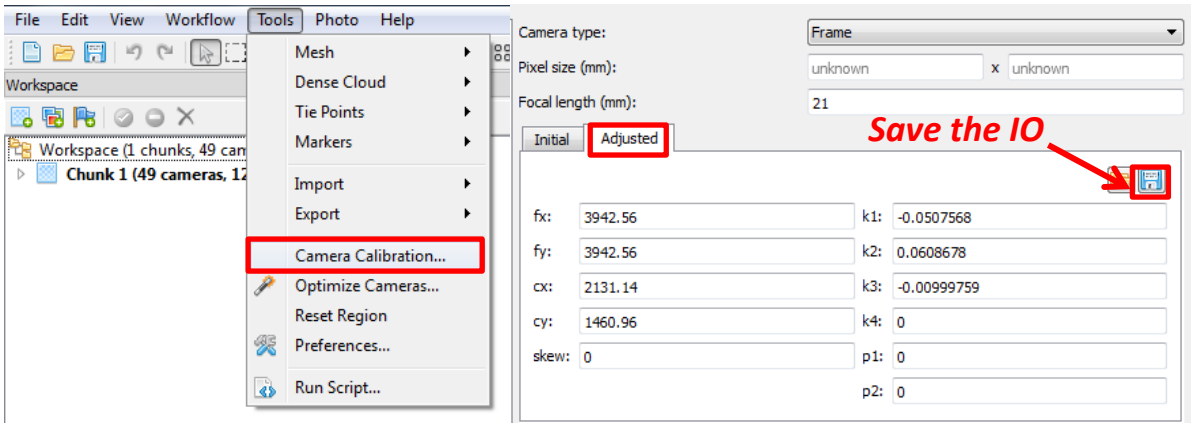
The program is designed to be able to receive input directly from Photoscan exports, therefore making its use compatible with this software. Both the EO and IO parameters for this tool should be in the Photoscan format, with the procedure of obtaining them as follows:

1. **EO parameters**: The EO parameters can be generated by Photoscan right after the "Align photos" stage. This can be done by selecting the "Export Cameras" feature in the "Tools" menu.




   The format of the file should be the Omega Phi Kappa text file.

2. **IO parameters**: The IO parameters can also be acquired from Photoscan after the "Align photos" stage. The user should select the "Camera Calibration" sub menu in the "Tools" menu, and then select the "Adjusted" tab. Click on the disk icon to save the IO parameters.



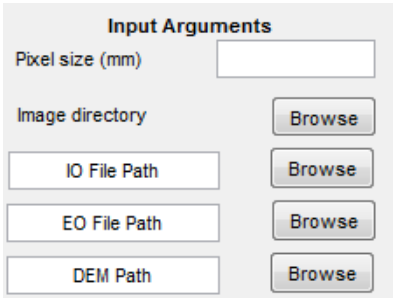

The IO parameters should be saved in an .xml file with the Photoscan Calibration format.

3. The DEM file can be obtained from any source as long as it's in the .tif format. It must also be accompanied by its world file with the same name and a .tfw extension.

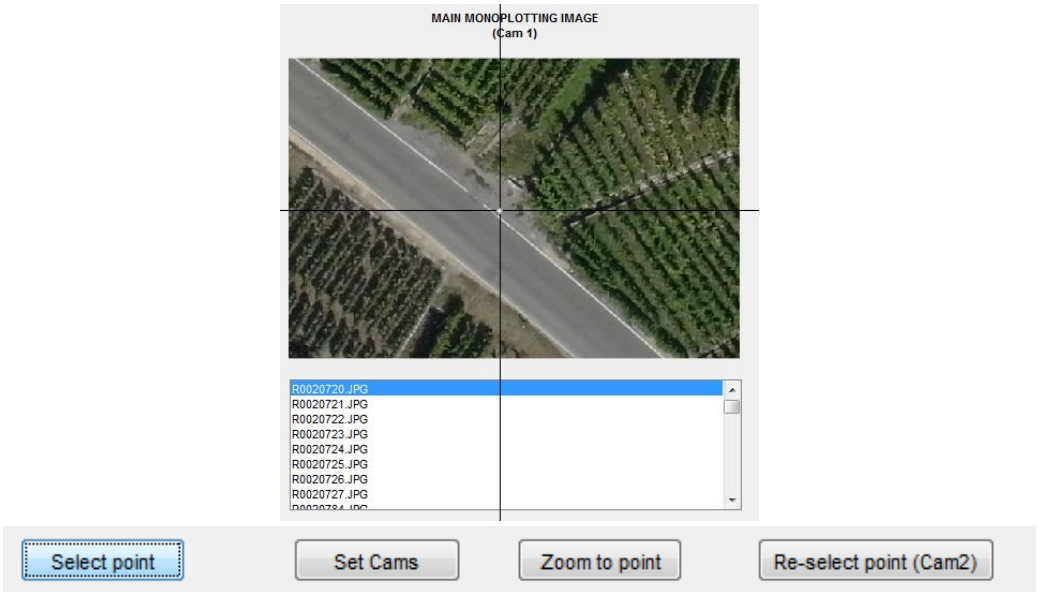
4. The pixel size of the CCD can be obtained by referring to the camera's specifications.

# 3 Setting up the tool

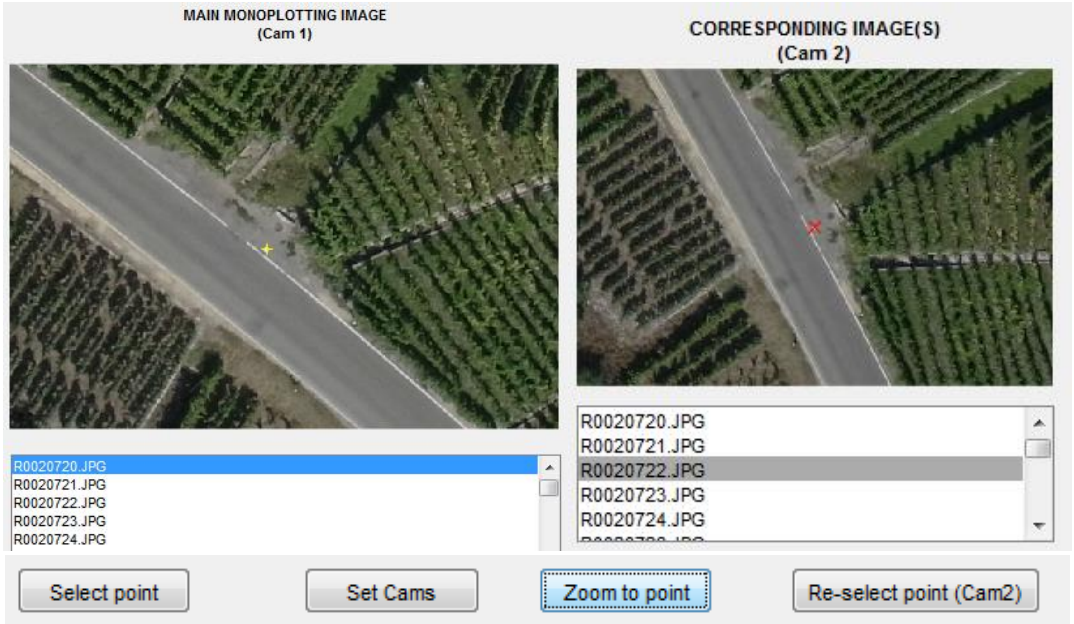
1. The tool can be launched by running the MONOVIEW.m file on Matlab.
2. Input the pixel size in millimeters. Afterwards, browse for the image directory. All images should be put in the same folder. At this stage, the images within the selected folder will be listed in the listbox below the "Cam 1" figure. The user can select which image to show in the figure by simply clicking the filename in this listbox. Browse also the IO files (.xml), EO files (.txt) and the DEM image (.tif with .tfw). See Annexes for examples of IO and EO file format.



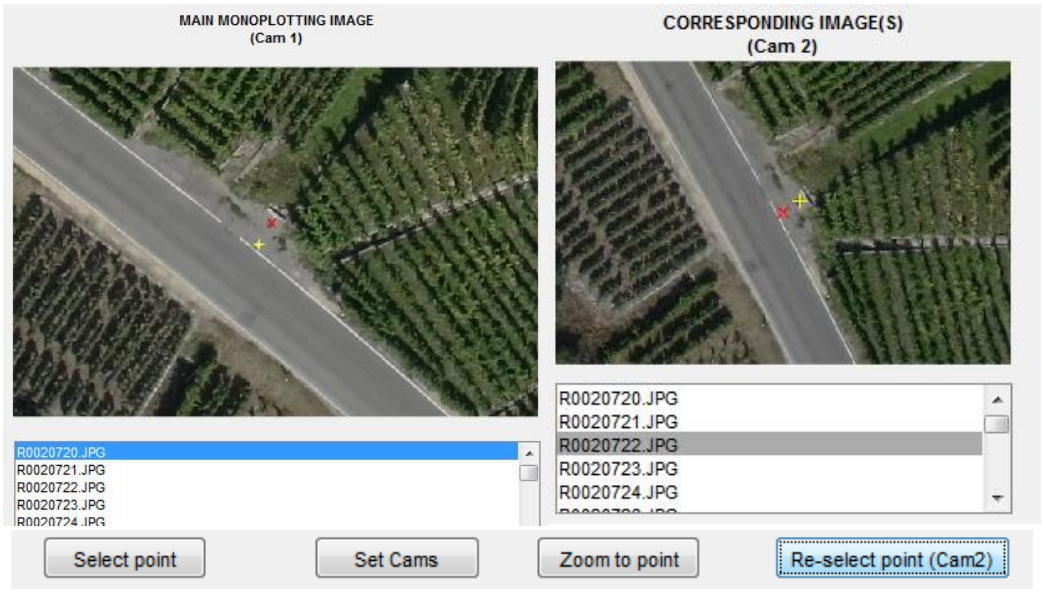

3. After inputting all the necessary data, push the "Set Cams" button. This will load the data (EO, IO, and DEM) into the program. After a few seconds the "Select Point" button will then be available to use. The user may then click on this button, whereas a crosshair would appear to allow them to click on any point on "Cam1". Several default Matlab figures tools such as zoom and pan as well as data cursor tool which enables the user to inquire the image coordinate (with pixel coordinate system) of a particular object are also available on the upper menu of the interface.



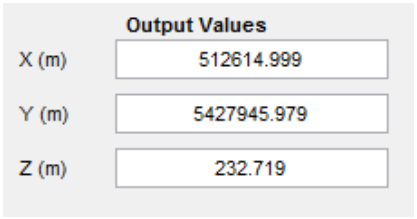

4. Once clicked, the selected point will be marked by a yellow cross ( + ). This symbol denotes a measured point. Afterwards the listbox below the "Cam2" figure will show all the images in the directory which contain the selected point within their borders. The user can then choose from which listed image the point will be shown, and press the "Zoom to point" button to zoom into this point. Also by clicking on this button, the projected point will be marked by a red X ( x ) on the "Cam2" figure.




5. If required, the user can then perform another measurement from a different point of view by clicking the "Re-select point (Cam2)" button and selecting a point from "Cam2". In this case, the + sign will show on "Cam2" to denote a measured point, while on the other hand x will appear at the appropriate location on "Cam1" to signal the projected point.




6. The coordinates of the selected point (either by the button “Select point” on “Cam1” or “Re-select point (Cam2)” on “Cam2”) will be shown at the “Output Values” section below the image figures. The coordinate system will naturally follow those used by the EO and DEM files.

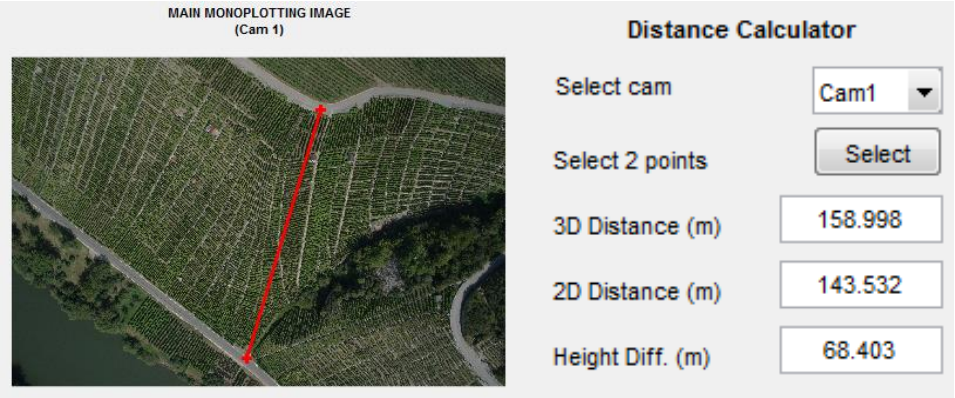



7. The markers can be erased from all images by clicking on the “Clear drawings” button.

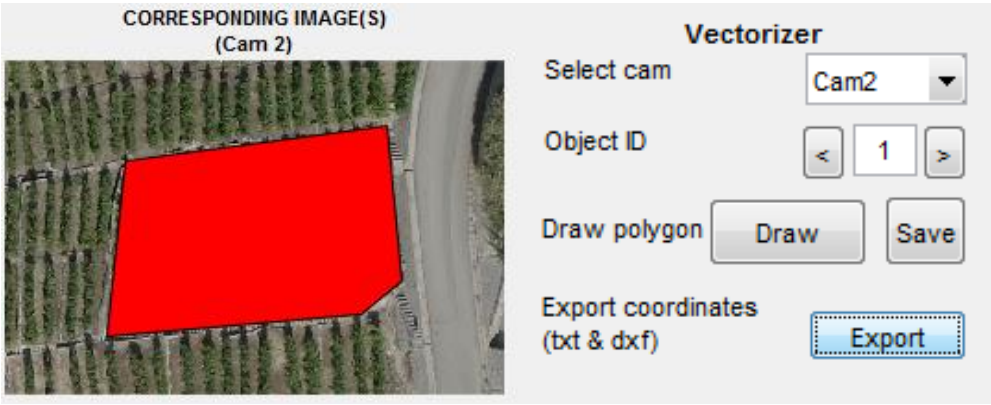
# 4 Other secondary tools

Two secondary tools are featured in this program: the distance calculator and the vectorizer.

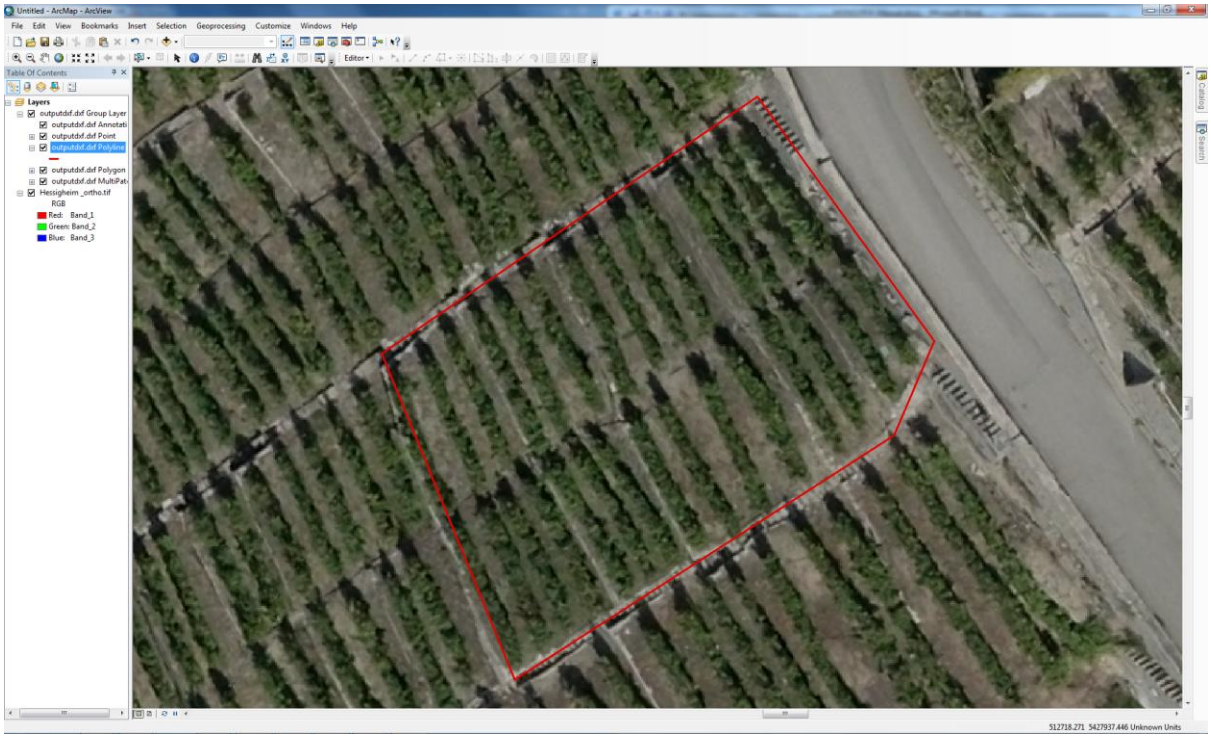
1. **Distance calculator**: this tool calculates the distance between 2 points on the same image. The user first selects the appropriate camera to use, either “Cam1” or “Cam2”. Afterwards, two points on the image are selected. Three types of distances will be shown on the text boxes below: 3D distance (diagonal distance), 2D distance (projected plane distance) and height difference. A red line will be plotted on the image to mark the two points selected. Again, the user can click on the “Clear drawings” button in order to erase these lines.




2. **Vectorizer:** this tool is a simple digitizing tool. In this tool, the user first selects the camera where the digitization will take place. The object ID must also be determined to differentiate between one structure to another. Then the user may start drawing polygons or lines by clicking on the "Draw" button. To finish the drawing, click again on the "Draw" button and then right click with the mouse cursor on the figure. It is obligatory that the user click on the "Save" button after each drawing, otherwise the last drawing will not be included in the output file. The user has the possibility to perform the digitization from more than one image before exporting them. When all the drawings are finished and saved, the user may click on the "Export" button to have a text file created (named "output.txt" and located in the workspace folder) as well as a .dxf file (named "outputdxf.dxf") listing all the polygons. In the text file, the first column denotes the ID of the points digitized in order of the clicking. They are in hundreds as the first digit refers to the object's ID e.g. 101 for Object 1 first click and 304 for Object 3 fourth click (See Annexes for example and graphical explanation). The polygons are separated by an empty line. Finally, the user may click on the "Clear drawings" button to clear all polygons (as well as point markers and lines previously plotted).

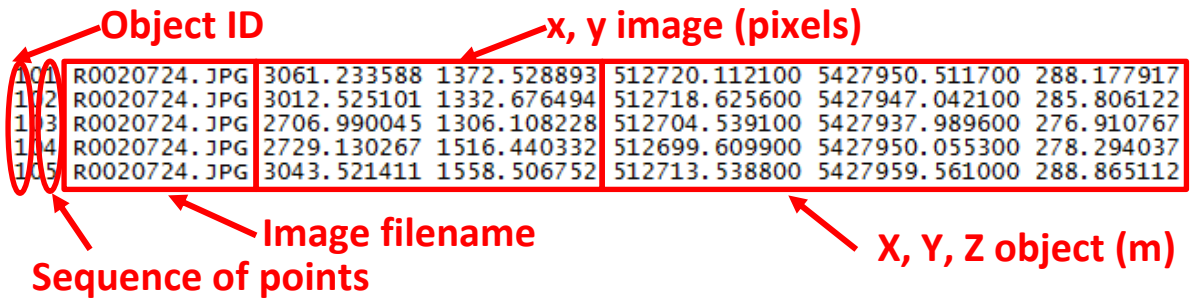



The outputdxf.dxf file is directly readable in CAD or GIS software, where the objects will be represented as closed polylines. The following is a screen capture of the same example above loaded into ArcMap, superimposed on the orthophoto:


Untitled - ArcMap - ArcView
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
Table Of Contents
Layers
outputdxf.dxf Group Layer
outputdxf.dxf Annotati
outputdxf.dxf Point
outputdxf.dxf Polyline
outputdxf.dxf Polygon
outputdxf.dxf MultiPat
Hessigheim _ortho.tif
RGB
Red: Band_1
Green: Band_2
Blue: Band_3
512718.271 5427937.446 Unknown Units

# 5 Annexes

Example of the output.txt file and its explanation:




Example of IO files (.xml, Photoscan Calibration format):

```
<?xml version="1.0" encoding="UTF-8"?>
<calibration>
  <projection>frame</projection>
  <width>4288</width>
  <height>2848</height>
  <fx>3.9425639796525184e+003</fx>
  <fy>3.9425639796525184e+003</fy>
  <cx>2.1311438207398733e+003</cx>
  <cy>1.4609553267425395e+003</cy>
  <skew>0.0000000000000000e+000</skew>
  <k1>-5.0756810137309441e-002</k1>
  <k2>6.0867759165481802e-002</k2>
  <k3>-9.9975854275248677e-003</k3>
  <k4>0.0000000000000000e+000</k4>
  <p1>2.85e-005</p1>
  <p2>1.68e-005</p2>
  <date>2015-06-29T10:08:52Z</date>
</calibration>
```

Example of EO files (.txt, Omega Phi Kappa format):

```
# Cameras (49)
# PhotoID, X, Y, Z, Omega, Phi, Kappa, r11, r12, r13, r21, r22, r23, r31, r32, r33
R0020720.JPG    512612.1941558883400000 5428023.2517461460000000    519.3572727319774500    1.0364520839360809  -1.3024255052961573 -4.5004177528893532
R0020721.JPG    512614.9368490506300000 5427994.6055764891000000    521.6884029728503300    -11.0770123778575640    30.2762810020205000 5.75872729599893
R0020722.JPG    512622.9663311373400000 5427965.9372129943000000    518.5368640409672000    4.0108749539173898  22.8046877631640900 16.9799264291951420
R0020723.JPG    512637.8162852266100000 5427936.3482295107000000    516.4280791445452200    -9.6276238078290550 3.7597103776438288  27.7503356711723620
R0020724.JPG    512654.7959363971600000 5427910.6987935184000000    517.0281756907779700    3.6236258756785888  -3.7369738877200036 27.5963444352104010
R0020725.JPG    512670.4549269858400000 5427884.4826202169000000    516.9575517113406700    -7.6422368099267333 -0.9505725006681189 23.1941585141898300
R0020726.JPG    512684.5626236068200000 5427860.1943385387000000    518.9041020803279000    1.5005842515471286  2.7585521017460670  28.1096865687182780
R0020727.JPG    512699.6790324532200000 5427834.8792667435000000    516.3239520870794200    0.6290616008644798  -1.3044222520846136 25.9206792355829800
R0020784.JPG    512715.9450654942800000 5427908.5333833247000000    516.6986006206303700    2.2934663425353299  -1.2527305336918353 -148.876182279382450
R0020785.JPG    512700.7181925171800000 5427931.9959260756000000    516.7778385807115500    -2.4451814203511253 1.0969945547827229  -148.413853620610550
R0020786.JPG    512685.5491690140300000 5427956.5074746916000000    516.1796055436186600    -0.5342149094352294 3.2730806441939850  -146.705936124780040
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R0020790.JPG    512628.0113199696600000 5428049.0235735821000000    515.4020313754053900    4.3339131572416534  -4.0135396348985131 -149.208769578204140
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R0020797.JPG    512679.6988884073200000 5428073.5786721008000000    514.0394625108588100    -3.7616075947267507 -3.4759557028744639 25.1283852657990710
R0020798.JPG    512692.5326695208800000 5428050.9200104419000000    515.2680675132963900    -3.6457512905732741 2.7783848469955359  24.0987872542113630
R0020799.JPG    512706.2948322917800000 5428027.9841578240000000    515.4660877403557600    -0.3961386742485504 -0.7458882778342895 26.2135703148318560
```