Environmental Processes in the Gulf of Aqaba
Photogrammetry Lab

IUI

December 2024

THE INTERUNIVERSITY
INSTITUTE
FOR MARINE SCIENCES
IN EILAT

1 Lab goals

1.1 Convert a RAW image to a linear image.

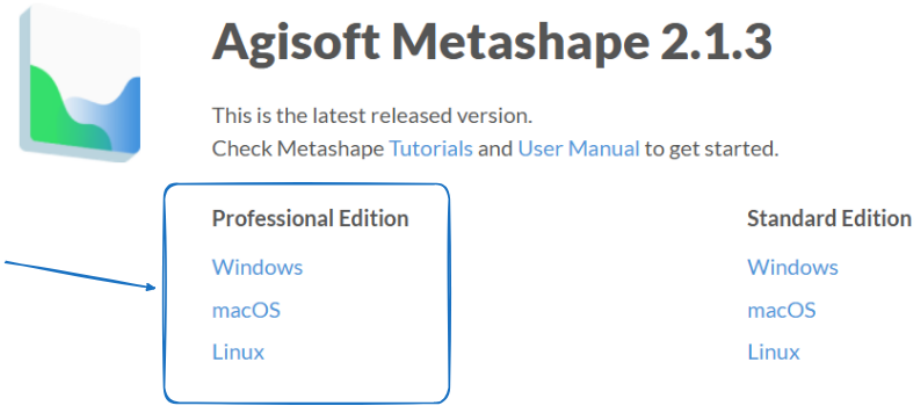
1.2 Becoming familiar with a photogrammetry software.

1.3 Gaining experience collecting images for a $3D$ model reconstruction in air and underwater.

1.4 Scaling a model and exporting scene depth from a $3D$ model.

All exercises take place in the Computer Lab using Agisoft Metashape Pro and MATLAB. Agisoft software is already loaded to the lab computers. If you wish to use your own laptop, you can download a 30-day trial version.

Be sure to get the PRO version!



2 Download the required data & tools

2.1 Course Github

Go to the **Course Github** and download the *LabProc* folder.

`(https://github.com/IUIamir/Photogrammetry_Lab/tree/main)`

2.2 Set-up

In the *LabProc* folder create new folder and cal it: **Images**.
In the **Images** folder (now we are in: *LabProc*/Images) create the following folders:

1. **raw** (to this file you will soon upload your images)
2. **dng**
3. **tiff**
4. **Cpng**

3 Converting a RAW image to a linear image

3.1 Download images from the camera

Do not leave a space in the folder name or use any special characters! Work on the local computer not in the network for the sake of time!
Download all your raw images to:

```
< your_path > \LabProc\Images\raw
```

3.2 Download & use Adobe DNG Converter

If you have Adobe DNG Converter skip to **3.3**.
In case you **Do not** have Adobe DNG Converter installed, download it for your operating system from **HERE**.
(https://helpx.adobe.com/camera-raw/using/adobe-dng-converter.html).

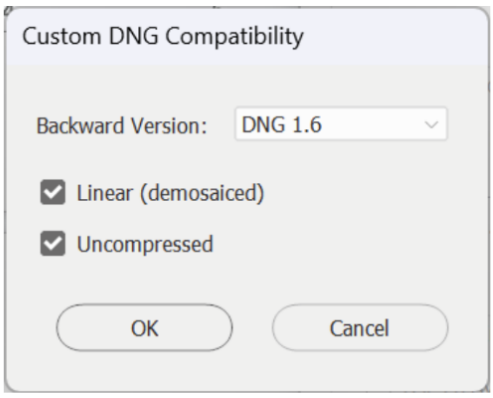
- Double click and open the program. In section 1, click the "Select Folder" button and point it to "raw" folder in the *LabProc* folder.

  ```
  < your_path > \LabProc\Images\raw
  ```

- In Section 2, click "Select Folder", and choose the destination folder to your .dng files.

  ```
  < your_path > \LabProc\Images\dng
  ```

- No need to do anything in Section 3.
- In section 4, click the "Change Preferences" button. In the next screen that opens up, click the "Compatibility" drop down list. Select "Custom" and check both "linear" and "uncompressed".
- Set JPEG preview to Medium Size.



- Leave "Lossy Compression" box UNchecked.
- Leave Embed Original Raw File UNchecked.
- Click OK to close the second window.
- Click "Convert" to start raw to dng conversion! The dng file(s) should appear in the output folder you specified.

3.3 Open Matlab

Run the:

`Converting.m`

script to create the tiff and png versions of the dng images you made with Adobe DNG converter in the previous step. This function relies on other functions in the folder named: "camera-pipeline-nonUI-master" in the repository. Make sure the repository, and all sub-folders are on your path.
Use *addpath*, *genpath* functions if needed.

4 Build a $3D$ model

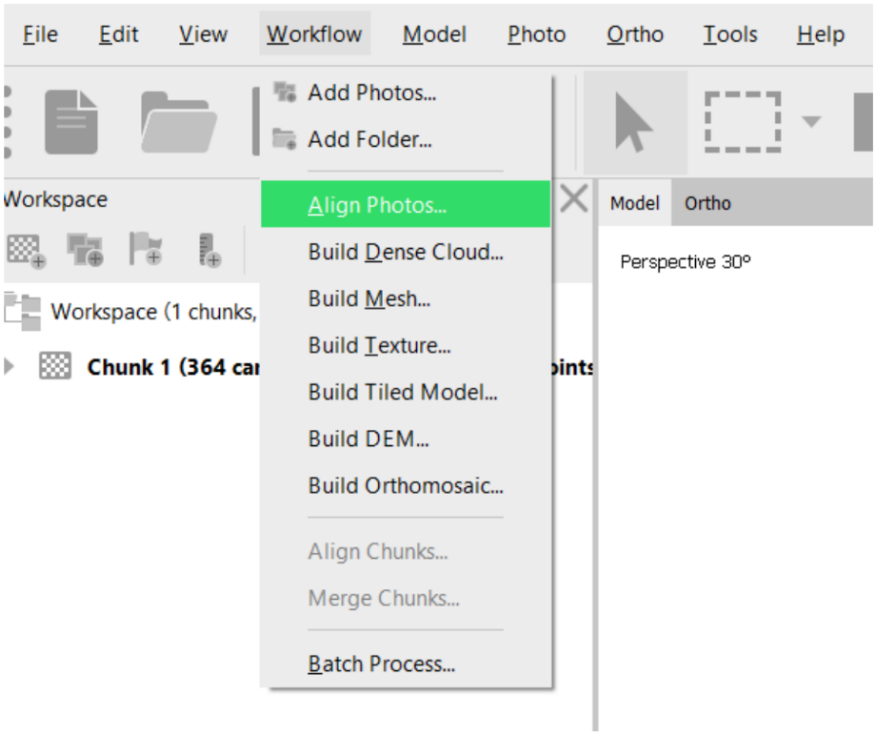
$3D$ model reconstruction tutorial provided by Agisoft can be found **HERE**

4.1 Upload images

- Load your png images into the "Workspace" (you can drag and drop them on the "Chunk").
- Increase image brightness by selecting all images clicking on "Tools" and clicking in the half black half white circle in the toolbar.

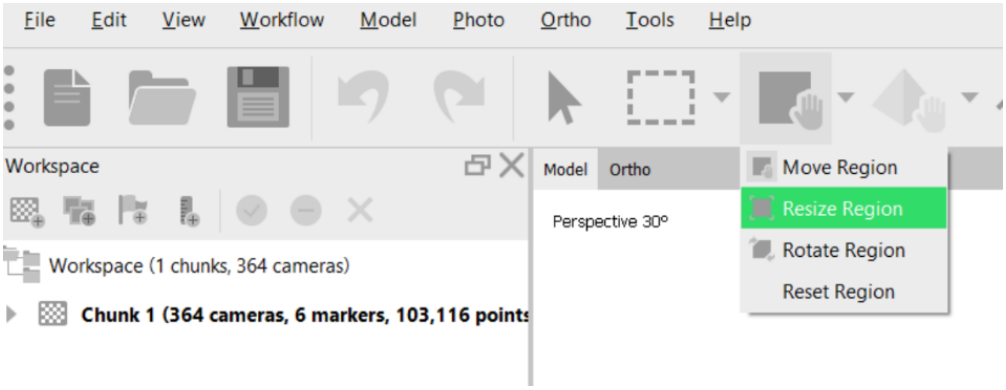
4.2 Align photos

- From the "Workflow" menu, select "Align Photos". The lab computers are not very powerful. In the interest of time, we will do this lab with the medium or low setting. The resulting quality will be low.

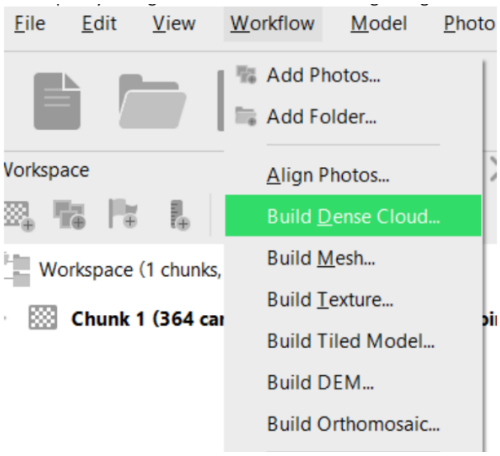


- After the alignment is finished, inspect your model. See if the geometry looks right (e.g., straight lines are straight, flat surfaces are not curved, etc.). If there are very obvious artifacts, align again. In an extreme case, you might need to re-collect a better dataset (with more overlap between images, aim for 70%), anyway talk to the TAs to help you out a bit.

- Resize and/or move the area. The aim is to remove the distal areas full of noise and holes focusing on the object of interest. It is done by clicking in the filled square with the hand in the toolbar and choose resize.



- Build a Dense Cloud (or build Point Cloud). Again, experiment with quality settings but only medium or low quality will finish quickly enough. You can also run it overnight to get better quality.



- Once the Dense Cloud is finished you can look at it by clicking on the left side of the toolbar, on the 9 dots.
- Now build a Mesh, or Model (you can find also in the "Workflow").
- Once the mesh is finished, to visualize it click the pyramid in the right corner of the toolbar (next to where you visualized the dense point cloud).
- Next step texture, "build texture" from "Workflow".

4.3 Scaling

4.3.1 Save the model

Be sure to save your model.

4.3.2 Add marker

Find images with a color chart in them. Mark (right click, add marker) the four corners of your color chart (or object you used for scale). It is recommended to do in the first 3-5 images of the series, placing the same marker in the same location.

4.3.3 Scale bar

Now in the workspace on the left select the two markers and click add the scale bar (little ruler on the top of the "workspace". To enter the measurements for all sides (in meters) go to "reference" (lower left) and add the value for each scale bar. Check how much error you have (we will guide you through this step).

4.3.4 Export depth map

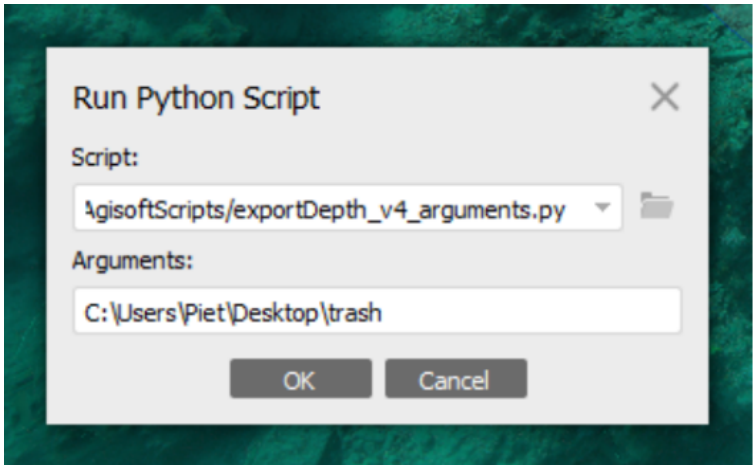
Now export "scene depth" or "depth map" for each image using the python script in *LabProc*:

`export_depth_v4_arguments.py`

Now, call by using

Tools→ Run Script from the user interface

In "Script" chose browse and select the python script in *LabProc*.
In "Arguments" section chose the "*DepthMaps*" folder in *LabProc*.
Note, if there are unaligned cameras in your chunk, the script will not fully run.



4.3.5 Inspect your depth map

To inspect your depth maps, load one of the .tiff files exported from Agisoft image into Matlab (you can do this by dragging and dropping the file into the Matlab command window), and then type:

```
imagesc(<<name of your depth map in the workspace>>);colorbar
```

into the command window to visualize it in false color. Check the colorbar to make sure the distances make sense for the scene you photographed.

5 Include in your report

1. Your name and institution
2. Include a screenshot of the model you made
   Inspect your model and discuss these points:
   (a) How do you think it came out?
   (b) What went wrong?
   (c) What could you have done better/differently?
   (d) Is the object of scale in your scene (e.g., color chart) rigid or distorted in your model? What does that mean for the geometry of the rest of your model?
3. Include, side-by-side, one photo from your dataset and its corresponding scaled depth map in a false coloration (together with a legend) that shows distances. Does the depth map seem accurate to the distance you remember taking the photo from? Why/why not?

6 Bonus challenge

1. In regard to underwater imaging, i.e. ***light - water*** & ***light - camera*** interactions, why is it important to know the depth map of the captured scene?
   Explain in **100 words or less**, try not to use online resources and think creatively!
2. Why *.jpg* image are generally not usable for scientific proposes?
   In our project of building a $3D$ with Agisoft, will using *.jpg* images have an effect on the results? How?
   Explain in **100 words or less**, try not to use online resources and think creatively!

7 Student presentation

Each couple will have up to **5 minutes** to present their results. Discuss your lab report and show model and findings, try to include the bonus challenge in your presentation.