Underwater Colorimetry Photogrammetry Lab

IUI

January 2025

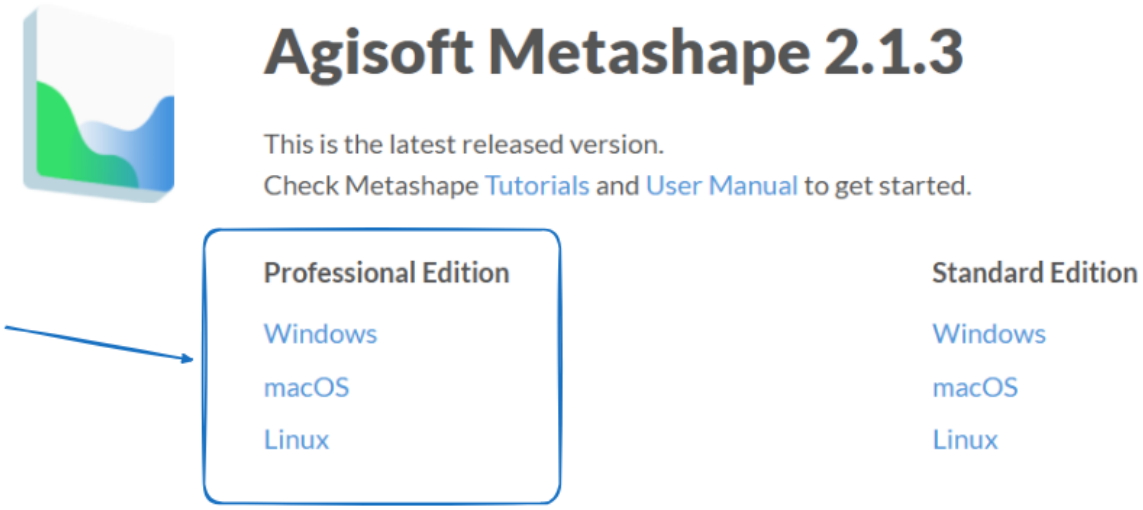
THE INTERUNIVERSITY INSTITUTE FOR MARINE SCIENCES IN EILAT

1 Lab goals

1. Becoming familiar with *Agisoft Metashape Pro*.
2. Gaining experience collecting images for a $3D$ model reconstruction in air and underwater.
3. Obtaining a scaled depth map from a $3D$ model.

All exercises take place in the Computer Lab using Agisoft Metashape Pro and MATLAB. Agisoft software is already installed on 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 Road map

WHAT ARE WE DOING?!

Before diving into the technical details of our photogrammetry lab, lets do a brief overview. In this lab our goal is to obtain a scaled "depth map" from a $3D$ model. We obtain this model from a Photogrammetry software which uses a method called **Structure From Motion**. More reading material about the method is available HERE.

1. Write your group number on the white board in the computer lab.
2. You have already collected images in the water.
   Download these images to the lab computer to the following path:

   `L:\Underwater_Colorimetry2025\Photogrammetry_Lab\Group1\Images`

   DON'T SAVE YOUR IMAGES ANYWHERE ELSE!

   Pay attention to your group number and save your images according to it. The "*Group*" folders are numbered from 1 to 12 (*Group1, Group2, Group3, Group4, ..., Group12*).
3. We will "Align" the images.
4. We will build a $3D$ model.
5. Finally, we will export a scaled depth map using a Python script.

Coming next: detailed instructions

3 Detailed instruction

3.1 Course folder

You can find the course folder in the L drive in the following path:

```
L:\Underwater_Colorimetry2025
```

Go to:

```
L:\Underwater_Colorimetry2025\Photogrammetry_Lab
```

In it you will find a folder dedicated to your group, for example, group 1 will use the folder:

```
L:\Underwater_Colorimetry2025\Photogrammetry_Lab\Group1
```

In your folder you have 2 folders:

1. *Images* - To this folder you will download your images.

   ```
   L:\Underwater_Colorimetry2025\Photogrammetry_Lab\Group1\Images
   ```

2. *DepthMaps* - To this folder your scaled depth maps will be exported.

   ```
   L:\Underwater_Colorimetry2025\Photogrammetry_Lab\Group1\DepthMaps
   ```

Additionally, in the *Photogrammetry Lab* folder you can find *Instructions* folder with:

1. The pre-Lab slides.
2. These instructions.
3. The Python script required to export the scaled depth maps from *Agisoft*

   ```
   exportDepth_v4_arguments
   ```

Do not leave a space in the folder name or use any special characters!
Work on the specified folders, NOT on the network for the sake of time!

3.2 Download your data (images) from your camera

Download your *.jpg* images to:

`L:\Underwater_Colorimetry2025\Photogrammetry_Lab\Group1\Images`

SAVE YOUR IMAGES IN THE DEDICATED FOLDER FOR YOUR GROUP !!!

Download only *.jpg* images!

3.3 Building a $3D$ model

We will guide you step by step, but, a $3D$ model construction tutorial provided by Agisoft can be found **HERE** for more details.

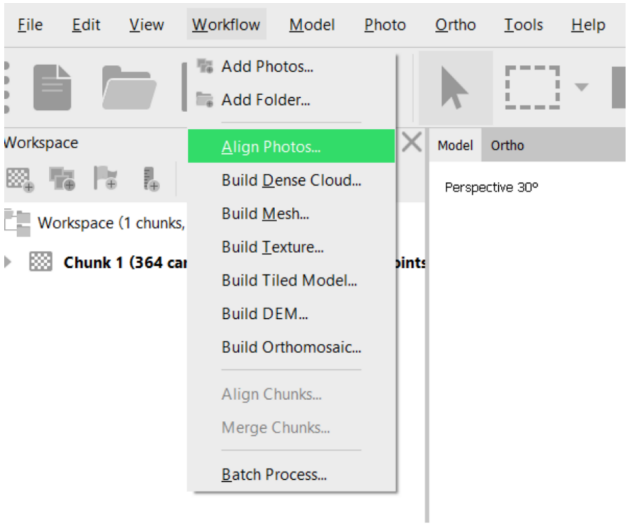
Pro tip: Be sure to save your model along the way!

3.4 Upload images to *Agisoft*

- 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.

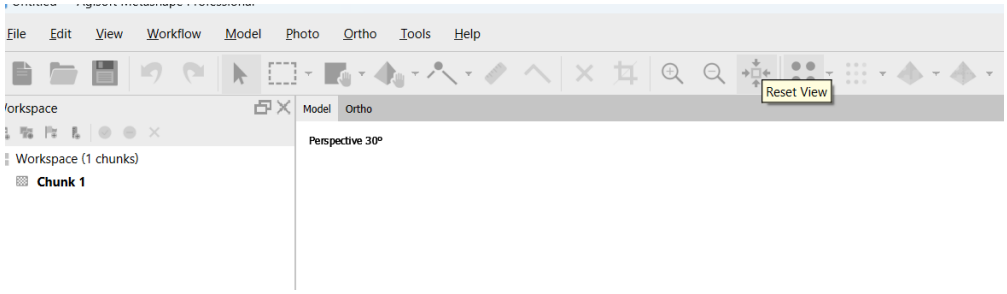
3.5 Align photos

1. 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.



2. After the alignment is finished, inspect your model.

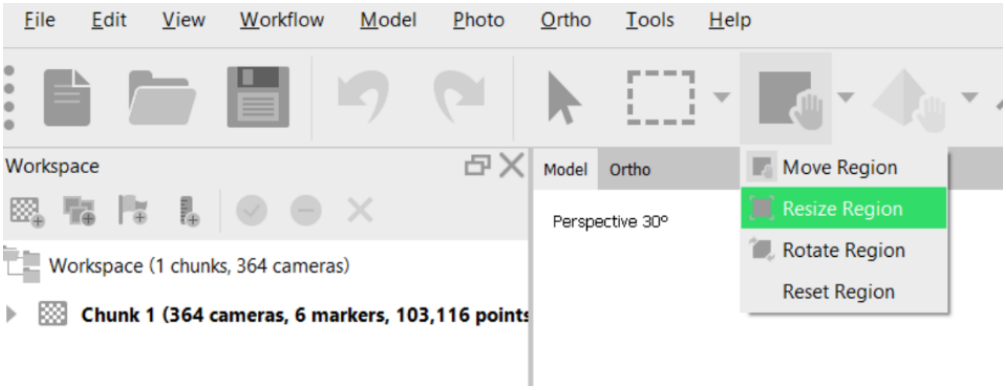
   - See if the geometry looks right (e.g., straight lines are straight, flat surfaces are not curved, etc.).
   - If you see nothing other then empty white screen, press "*Reset View*".



   - If there are very obvious artifacts, align again at higher quality.
   - 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.

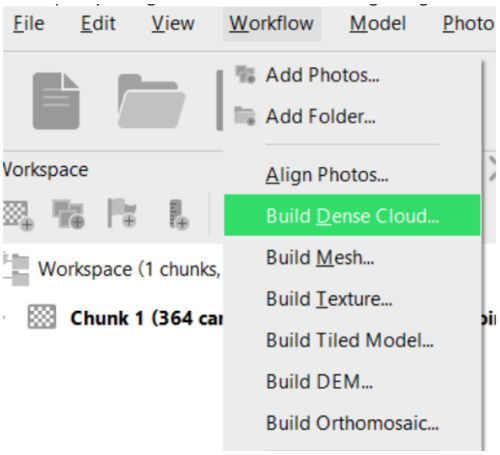
3.6 Resize Region

Resize and/or move the area of the bounding box around the Tie points. 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 choosing *resize region*.



3.7 Build Point Cloud

Build a Dense Cloud (or build Point Cloud). Again, experiment with quality settings but only medium or low quality will finish quickly enough.



Once the Dense Cloud is finished you can look at it by clicking on the left side of the toolbar, on the 9 dots.

3.8 Build Model

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).

Final step, *"build texture"* from "*Workflow*".

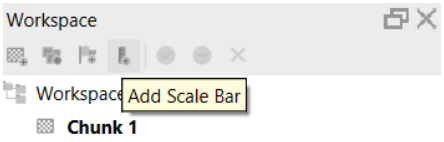
3.9 Scaling

3.9.1 Add Marker

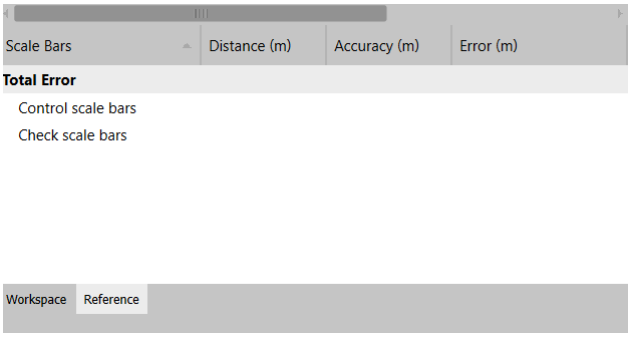
1. Find images with the object of known size you placed in the scene.
2. "*Add Marker*" to each of the **4 corners** of the known scale object. To "*Add Marker*", right click on a corner and choose "*Add Marker*".
3. *Agisoft* will propagate the markers to all images. **BUT** you have to check that they are in the correct place. Check markers positioning for **at least** 5 images.

3.9.2 Scale Bar

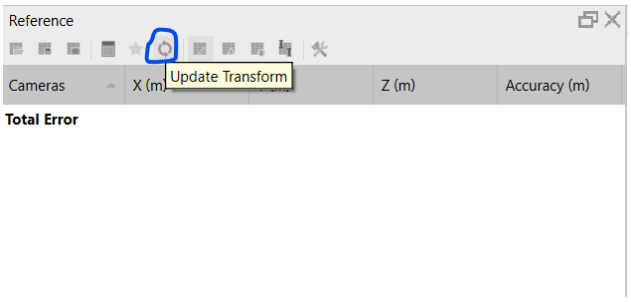
1. Now in the workspace tab on the left, select any two markers and click *add scale bar* (little ruler on the top of the "workspace").



2. To enter the measurements for all sides (in meters) go to "reference" tab (lower left) and add the "*Distance(m)*" value for each scale bar.



3. Check how much error you have by clicking on "*Update Transform*".



3.9.3 Color chart dimensions

3.10 Export depth map

Now export a scaled "depth map" for each image using the python script:

`export_depth_v4_arguments.py`

The script can be found in:

`L:\Underwater_Colorimetry2025\Photogrammetry_Lab\Instructions`

Now, call the script by using:

Tools→ Run Script from the user interface (or Ctrl + R)

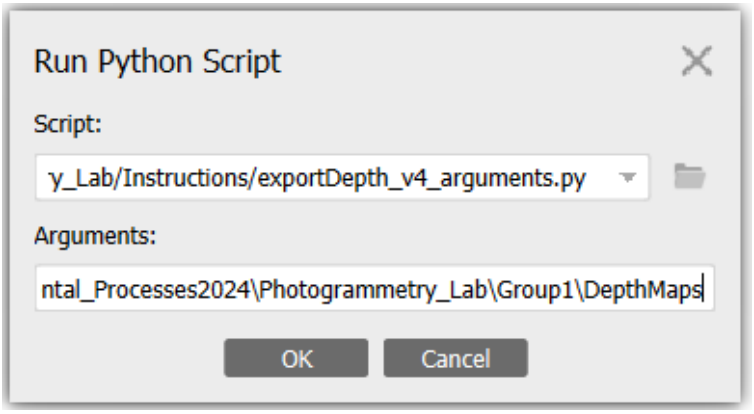
- In "Script" chose browse and select the python script in:

  `L:/Underwater_Colorimetry2025/Photogrammetry_Lab/Instructions/exportDepth_v4_arguments.py`

- In "Arguments" section chose the "*DepthMaps*" folder in your group's folder:

  `L:\Underwater_Colorimetry2025\Photogrammetry_Lab\Group1\DepthMaps`

BE SURE TO CHOOSE YOUR(!) GROUP FOLDER



Note, if there are unaligned cameras in your chunk, the script will not fully run.

3.11 Inspect your depth map

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

`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.

3.12 Include in your presentation

1. Name and institution of both partners.
2. A screenshot of the model you made. Discuss these points:
   (a) Inspect your model.
   (b) How do you think it came out?
   (c) What went wrong?
   (d) What could you have done better/differently?
   (e) 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?
   (f) 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?

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

3.13 Bonus challenge

Read about optical depth (HERE).
In underwater scenario, do you think its a function only of the viewing distance, z, or does it also have directional dependencies?

Think creatively based on what you learned in the lecture!