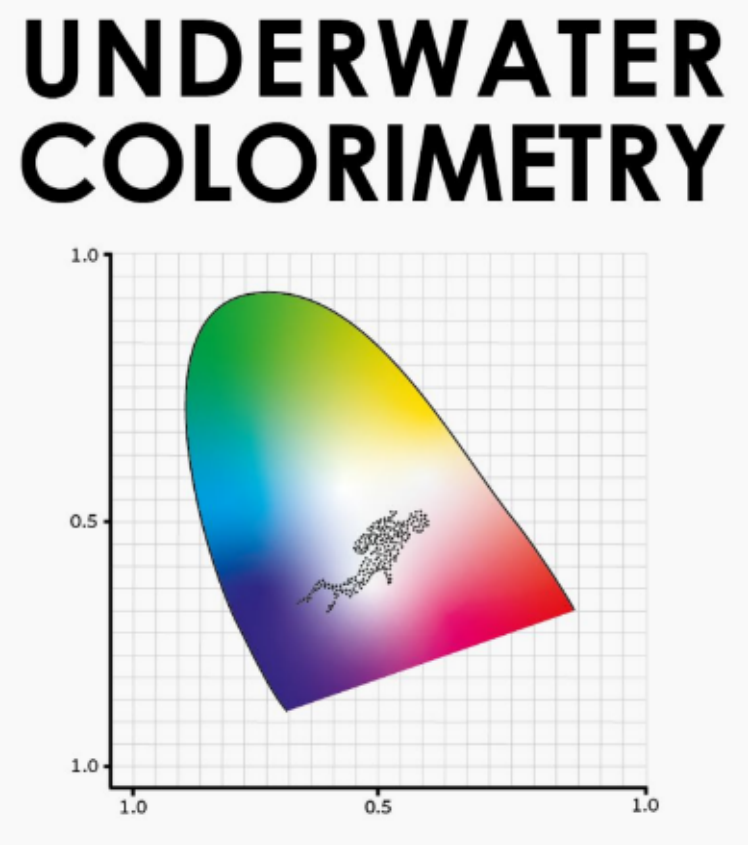
Underwater Colorimetry

Lab 3

IUI

January 2025



THE INTERUNIVERSITY INSTITUTE FOR MARINE SCIENCES IN EILAT

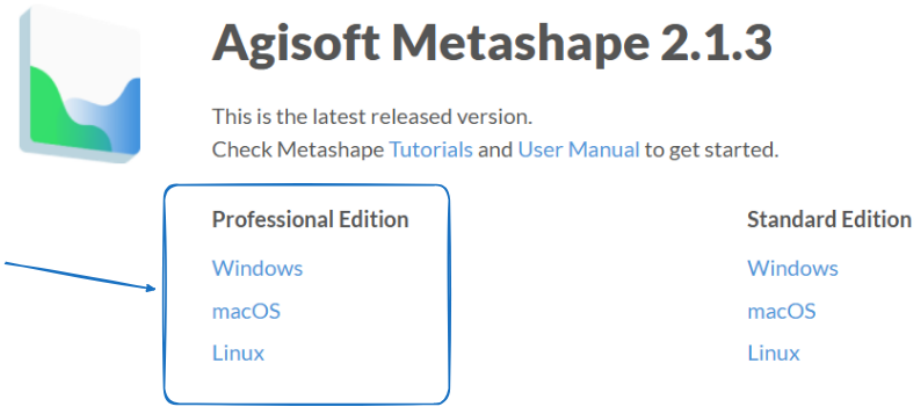
Basic Photogrammetry

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!



Required equipment

1. Laptop
2. MATLAB or Python
3. Agisoft Metashape PRO
4. Adobe DNG Converter
5. Camera able to capture RAW images

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. You have already collected images in the water. We will download these images to our computer to a dedicated folder.
   Each image type has its own folder, for more details go to:

   ```
   UWcolorimetry2025\Underwater-colorimetry-25\ ...
   Underwater-colorimetry-main\Lab1\Images\README.md
   ```

2. We will convert the images using *Adobe DNG Converter* and the same script from Lab 1 Exercise 1. Then we will upload our images to Agisoft.

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

Detailed Instruction

Step 0: 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!

Go to:

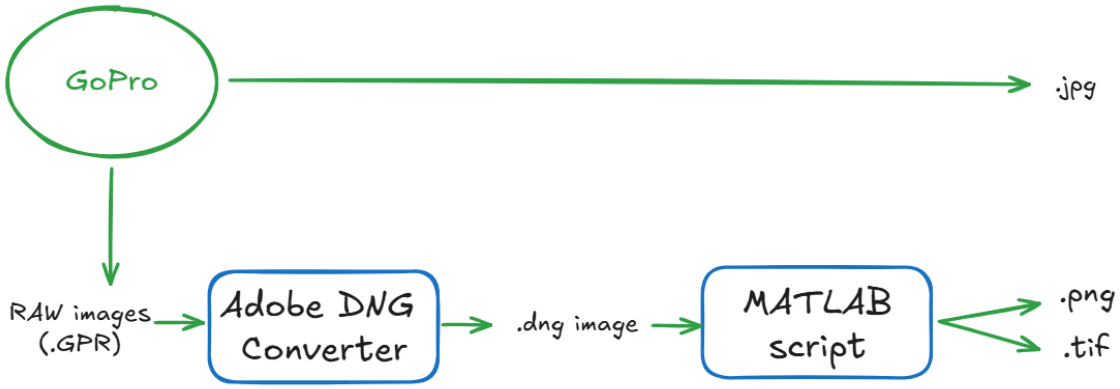
```
UWcolorimetry2025\Underwater-colorimetry-25\ ...
Underwater-colorimetry-main\Lab1\Images\README.md
```

In the README file you have detailed instructions where to save each type of image file. **DON'T** save your images anywhere else and double check that everything is where it should be!

Go quickly over the images for possible interferences such as fish or too blurry images and remove them

Step 1: Convert raw images to linear png format

This is similar to ***Lab 1 Exercise 3***.
Don't forget to resize them in the process because the computers in the computer lab may not handle large images.



Step 2: Build a 3D model in Agisoft Metashape Pro

We will guide you step by step, but, a $3D$ model construction tutorial provided by Agisoft can be found **HERE** for more details.
Note: All computers in the computer lab have the Pro license that allows to add scale to your models and measure a bunch of other stuffs (surface area, volume etc..).

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

Open up Agisoft

Load your .png images into the "Workspace" (you can drag and drop them on the "Chunk").

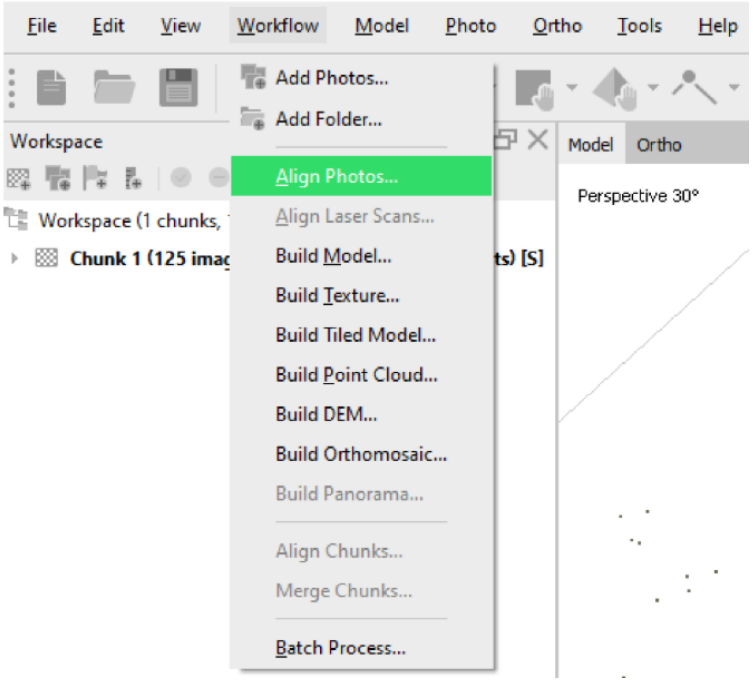
Set Brightness

As you learned in the lectures, raw (linear) images are notoriously dark and low-contrast. Therefore, you need to increase brightness by selecting all images and clicking in the half black half white circle in the toolbar.

Align Photos

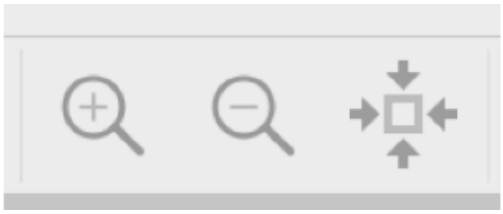
From the "Workflow" menu, select "Align Photos". The lab computers are not very powerful. In the interest of time, we will do this lab with the medium setting (if you do it on your computer and can handle more go for it). The resulting quality will be not to accurate. If you prefer, you can run your models overnight at higher quality.

Make sure all cameras are aligned



Reset View

After the alignment is finished, inspect your model. Sometimes, following the alignment, your model can disappear.... don't panic, just press the "Reset view" in the tool bar (the square with 4 arrows).

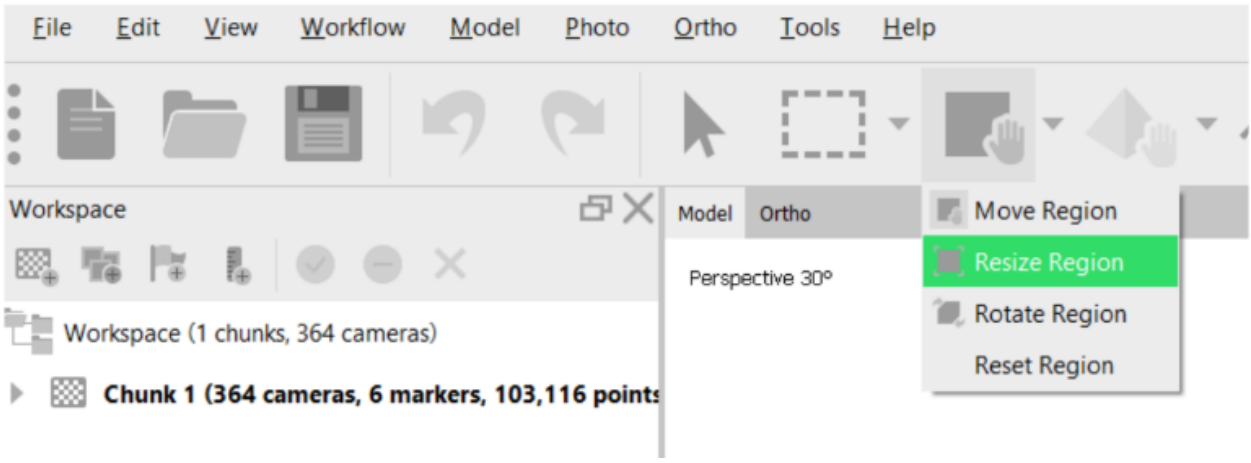


Inspect the Geometry

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.

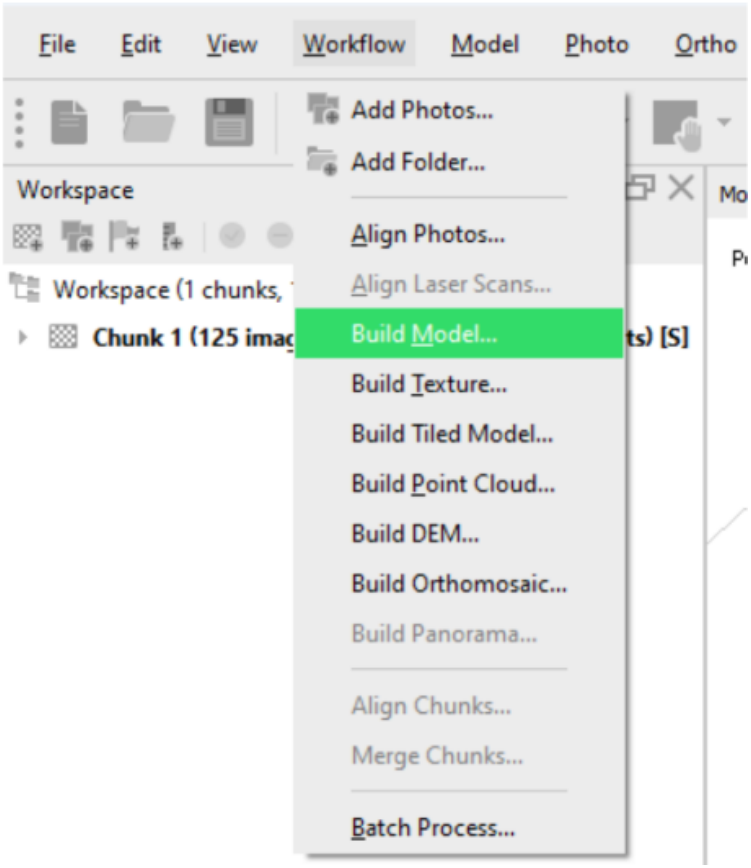
Resize Region

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. Once chosen move the region (make it bigger or smaller) toward the object of interest.



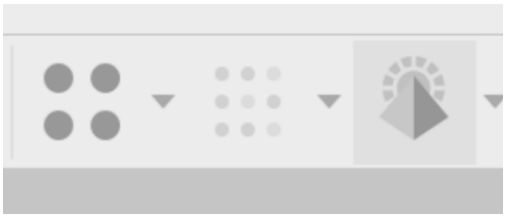
Build Model

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.



Inspecting The Model

Once the "Model" is finished you can look at it by clicking on the pyramid on the toolbar.



Step 3: Scaling

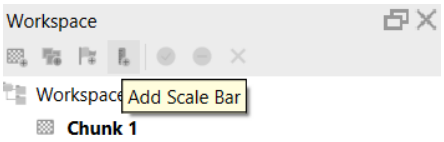
Before exporting a scaled depth map, i.e. with physical units of distance, we need to scaled our model based on a known sized object. Luckily enough, we have color chart in our model!

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.

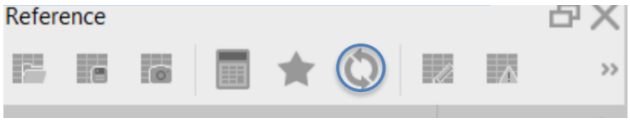
Scale Bar

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. Refresh by pressing in the circular icon ("*Update Transform*") in "reference".



4. Check how much error you have (we will guide you through this step).

Color chart dimensions

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 the course GitHub:

`GitHub\UWcolorimetry2025\Underwater-colorimetry-25`
`\Underwater-colorimetry-main\Lab3`

Now, call the script by using:

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

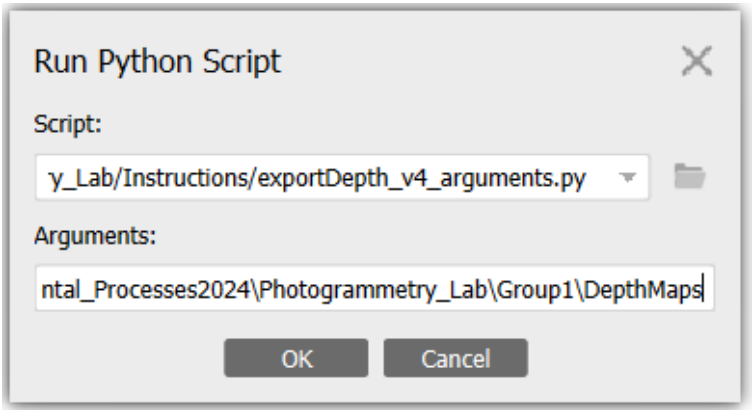
- In "Script" chose browse and select the python script in:

  `'Your_Path'\UWcolorimetry2025\Underwater-colorimetry-25`
  `\Underwater-colorimetry-main\Lab3`

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

  `'Your_Path'\UWcolorimetry2025\Underwater-colorimetry-25`
  `\Underwater-colorimetry-main\Lab3\DepthMaps`

BE SURE TO EXPORT YOUR DEPTH MAPS TO THE CORRECT FOLDER!



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

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.

Include In Your Report

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?
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?
4. Your cameras captured .GPR and .JPG images. Additionally, starting from the .GPR images, you obtained .PNG images. Pick one photo, and compare, side-by-side, the .JPG image and the .PNG image. What differences do you see and why? Discuss.

Lab Report Due

Sunday 26.1.25 at 9:00 am, by email to Giovanni

giovanni.giallongo1994@gmail.com