Stereo-Video-System (SVS) User Manual

Part I: Calibration

Introduction

This user manual is a guide for Operation Wallacea participants conducting fish community surveys using Stereo-Video-System (SVS) technology. The invention of SVS has revolutionised the way in which we evaluate the composition and health of fish populations, and it has enabled us to monitor how they are changing over time. Not only does this new technology provide us with a means of estimating abundance and diversity of reef fishes, but it also allows us to measure fish lengths and therefore accurately calculate biomass for the first time. The ability to measure biomass, both on individual and community scales, is essential for researchers interested in gaining an understanding of the functional ecology of coral reefs and the relative importance of different components of the biological community. The aim of this handbook is to put all the resources needed for successful SVS data collection into a single reference document that can be used by Operation Wallacea staff and students. It goes through the whole process, from initial camera set-up and calibration (Part I), to filming transects (Part II) and then analysing data in EventMeasure (Part III). If you have any questions about the content of this handbook, please contact Shannon Cameron (shannon.cameron@opwall.com) or Dr Dan Exton (dan.exton@opwall.com).

Further details on these can be found in the official user guides provided by SeaGIS, go to: Start | SeaGIS | CAL User Manual/EventMeasure User Manual (after the software has been installed).

Before you begin

Part I of this manual provides instructions on how to complete a successful calibration. This is an essential part of the process as it ensures that fish length estimates are accurate. If not done, or done incorrectly, any data collected can be considered unusable.

Before you begin, several steps should be taken to ensure all software and hardware requirements have been met prior to any practical application.

i. Download the Software

At the beginning of the season, it is essential to download the latest version of CAL, regardless of what version is currently installed. Please also download the latest version of EventMeasure, which is needed to verify the calibration. These can be accessed via the following link and password:

- https://www.seagis.com.au/download.php
- seagis_sd10

ii. Assemble the Calibration Files

A collection of specific files is required to complete a calibration in CAL, and it is essential to use the files that correlate with the research sites' own location and hardware. At the beginning of the season, you should be provided with the following:

1 x Housing instructions (pdf)	Document outlining how to use and properly care for camera housing
1 x Camera instructions (pdf)	Document outlining camera settings required for filming and instructions on how to mount and use cameras in housing
1 x Cube notes (pdf)	Document outlining how to assemble and care for a calibration cube
1 x Cube points (PtsCAL)	File providing known coordinates of each 'dot' on the corresponding calibration cube
1 x Left camera file (CamCAL)	File providing known settings for the **left** camera used during filming

1 x Right camera file (CamCAL)	File providing known settings for the **right** camera used during filming
1 x Species file (txt)	Contains a list of fish species found in the region

All seven files should be saved in a single folder titled with the location and date, for example Utila Calibration 01-06-20. If any of these files are missing or incorrect, please contact shannon.cameron@opwall.com.

iii. Update the License Key

CAL software can only be accessed with the use of a license key. These can be in the form of a USB, or as a series of codes to applied directly to the computer you are using.

If you have a USB license key

- Plug the key into a USB port and open CAL.
- Navigate to: Computer |C: | Program files | SeaGIS | CAL | Executables | hasprus.
- In the pop-up window, highlight the 'Collect Key Status Information' tab and click 'Collect information'.
- Rename this file with its unique alphanumeric code (e.g., HON6.c2v) and save it to the desktop.
- Email the file to info@seagis.com.au as an attachment. In the email give your name, request a CAL license, and state the number of days you wish for the license to run for. **N.B.** the minimum license for CAL is **7 days** - this should be more than enough to complete the calibration.
- SeaGIS will respond with a new file (e.g., HON6.v2c) - save this to the desktop.
- Reopen hasprus (as above) and highlight the 'Apply License Update' tab.
- Browse to the newly provided v2c file, open and click 'Apply Update'.
- The license will automatically expire 7 days after you apply the update, so please do not do this until the day you need to use CAL.

If you do not have a USB license key

- Open CAL. A dialogue box will pop up to tell you there is an 'Error with software license'. This error message will be automatically copied to your clipboard when it pops up – this is what you need to obtain a license.
- Paste the error message text into an email (please **do not** screenshot it) and send to info@seagis.com.au. In the email give your name and note that you are working with Operation Wallacea. Request a CAL license and state the dates for which you want the license to be active (e.g., 1st June – 7th June). **N.B.** the minimum license is **7 days** - this should be more than enough to complete the calibration.
- You will receive an email back with a series of codes that will unlock CAL.
- Run the software and copy and paste the keys as prompted. If there is an 'Options' key included, in CAL go to About | Install Options and copy and paste the supplied options key.

To obtain a license for Eventmeasure

- An EventMeasure license is required to check the calibration, but also to analyse transect videos. If you are only completing a calibration, you will require 7 days.
- If you plan to analyse the transect videos, a longer license is required. Please check with the head scientist for your site regarding the length of license you need.
- EventMeasure licenses can be obtained using the methods above – simply replace 'CAL' with 'EventMeasure' in the instructions provided.

Filming the Calibration Video

A stereo video system (SVS) uses two high-definition cameras in underwater housings, mounted on a precision-engineered aluminium base bar. The cameras are carefully calibrated using a calibration cube like the one pictured below. The white dots on a black background provide clearly marked points, each of which has known coordinates. During calibration, the cube is filmed in a sequence of rotations and the position of these dots are used to determine

the exact position of each camera. By knowing the distance and angles between the two cameras, they essentially work like a pair of human eyes, giving depth perception and allowing the size of objects to be estimated accurately.

i. Site Selection

The calibration video must be filmed underwater, but the location of filming will vary from site to site depending on the resources available. If possible, it is always preferable to film in a swimming pool which guarantees good visibility, still water and a solid substrate to work on. If a swimming pool is not accessible, a site should be selected that will meet those three criteria as fully as possible. During filming there is a lot of movement which, combined with sandy sediments, can create poor visibility and in some circumstances render the calibration void. This can be combatted by taking additional steps such as placing a temporary 'floor' (e.g., weighted yoga mat) on the sediment, removing fins and wearing extra weights to improve control of movement. It is also prudent to take multiple recording and then select the one with the best visibility throughout.

ii. Equipment

The following equipment should be assembled and organised prior to filming:

 Calibration Cube	- The calibration cube presents a black background with a series of white dots, each of which has known coordinates (stored in corresponding Cube Points file. - One side has a single, white reflective bar important for positioning during filming. - Remove from storage and check for signs of physical damage, particularly to dots which may affect calibration success. - Rinse in freshwater after filming to ensure future integrity.
 Stereo Video System (with cameras)	- Check and care for housing by following instructions outlined in the SeaGIS 'Housing Instructions' document. - Adjust camera settings (both must have the same settings) and mount to SVS by following instructions in the 'Camera Instructions' doc. - Cameras should be labelled as left or right, and only be used in that side of the SVS throughout.
 Distance Bar	- Three dots are arranged across the bar - the distance between each can be found in the associated Cube Notes file. - This is used post-calibration to test that the calibration has been successful and ensure that accurate measurements will be made.
 Underwater Torch/Flashlight	- Required for camera synchronisation. - Ensure in working order and with sufficient battery.

iii. Filming the Calibration Cube

In the water, a minimum of two divers are required to complete the calibration, however three are preferred: one to control the SVS and two to manoeuvre the cube. When all divers and equipment are in position (see title page photograph), the calibration should be filmed as follows:

- Diver 1 switches on both cameras and positions SVS to ensure the calibration cube is visible in both frames and fills a large portion of the field of view.
- Diver 2 moves in front of calibration cube, points torch/flashlight at cameras and flashes on/off three times.
- Divers 2 and 3 manoeuvre the calibration cube through a series of 20 positions as depicted in **Figure 1**. Between each rotation, the cube must be held as still as possible and the dots should not be obstructed by divers, sediment or debris.
- Please see video '**Calibration Cube Poses**' for further demonstration. Note that this video is taken from one of two stereo cameras therefore the initial pose appears to be at a slight angle, however this is not the case.

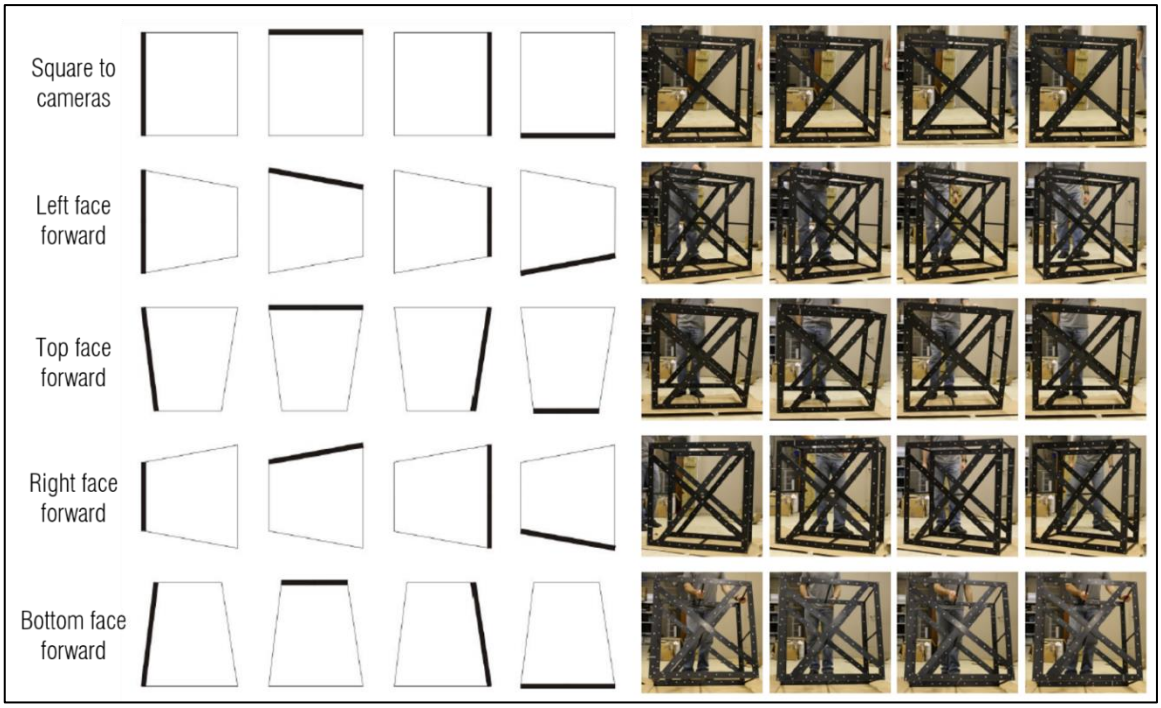

Figure 1. Schematic and pictorial diagrams of calibration sequence. The emboldened edge refers to the side of the calibration cube that contains a reflective bar which can be used for rotational reference throughout filming.

After filming, the resultant left and right videos should be uploaded and stored as .MP4 files in the previously created calibration folder (e.g., Utila Calibration 01-06-20) in preparation for calibration. Appropriate names should be allocated for the left and right videos (e.g., Utila Calibration 01-06-20 LEFT and Utila Calibration 01-06-20 RIGHT).

iv. Filming the Distance Bar

After the calibration cube video is done, a second video should be recorded of the distance bar. The distance bar contains three white points, and the distance between each pair of points is pre-defined. This video can therefore be used at the end of calibration to verify it is successful and that accurate measurements are being made.

- Diver 1 switches on both cameras and positions SVS.
- Diver 2 moves in front of the SVS, points the torch/flashlight at cameras and flashes on/off three times.

- Diver 2 picks up and moves the distance bar, presenting the points to the cameras from multiple angles and from multiple distances. It may be useful to begin at some distance, and swim towards the cameras while holding the distance bar and changing the angles (Figure 2).

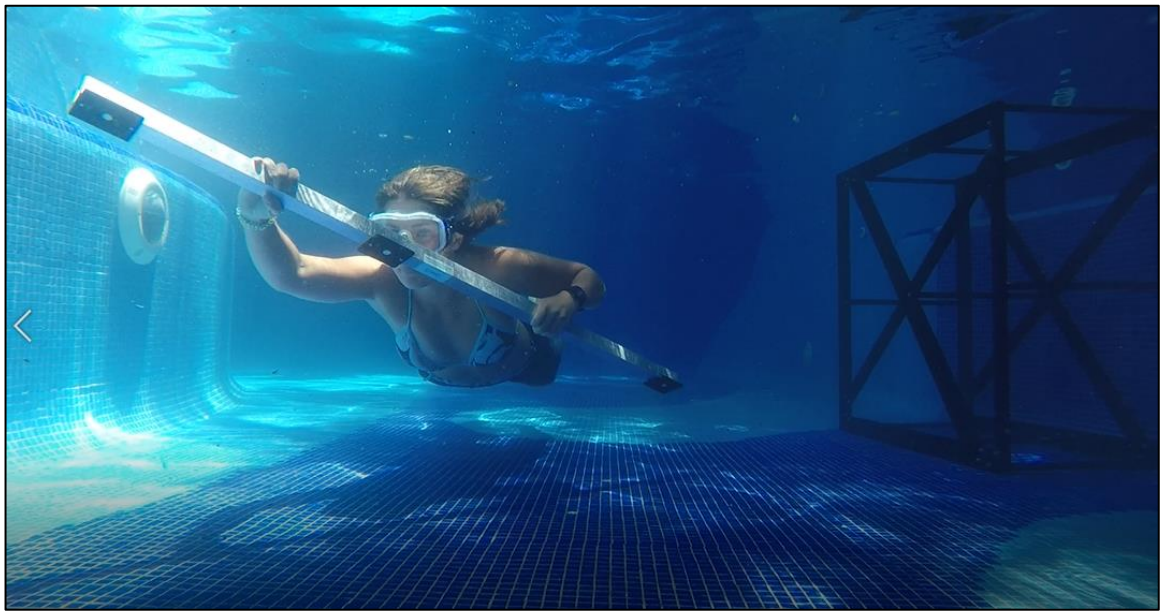

Figure 2. Screenshot from a 'distance bar' video. The points along the length of bar are presented to the camera from a range of distances and angles.

As with the calibration cube videos, please uploaded the left and right distance bar videos as .MP4 files in the previously created calibration folder. Appropriate names should be allocated for the left and right videos (e.g., Utila Calibration 01-06-20 DISTANCE LEFT and Utila Calibration 01-06-20 DISTANCE RIGHT).

Troubleshooting: If the distance bar is missing or you did not receive one, don't worry. Find another object that you can use to take measurements from, for example a metre-stick or a length of PVC piping that has been marked with three distinct points. If using the latter, take measurements and record the distances between points 1 and 2 (Length 1), points 2 and 3 (Length 2) and points 1 and 3 (Length 3).

Calibration in CAL

i. CAL Setup

CAL is the software used to calibrate the stereo-video system and ensure that all measurements taken from video transects are as accurate as possible. To use CAL, an updated license key must be added before using the software.

Create a new project:

- Open CAL.
- Navigate to toolbar and select Project | new project…
- A dialogue box will appear asking you to 'Select name for NEW project file'. Click OK.
- Find and select calibration folder and allocate appropriate name to project (e.g. Utila Calibration 01-06-20). Click Save – this will save as a PrjCAL file.

Load the calibration files:

- A dialogue box will appear asking you to 'Select the left camera file'. Click OK.
- Navigate to calibration folder (this may happen automatically) and select the left CamCAL file.
- Repeat for right camera (CamCAL) file.
- Another dialogue box will appear asking you to 'Select the calibration cube file'. Click OK.
- Navigate to calibration folder and select the PtsCAL file. Click Open.

Set the picture directory:

- A dialogue box will appear asking you to 'Set the picture directory'. Click OK.
- Navigate to the calibration folder (where left and right calibration videos are saved). Click OK.

Save the measurement file:

- A dialogue box will appear asking you to 'Save the measurement file'. Click OK.
- Navigate to calibration folder and allocate appropriate name to measurement file (e.g., Utila Calibration 01-06-2020). Click Save – this will save as an ObsCAL file.

Load the calibration videos:

- A dialogue box will appear asking you to 'Load the left picture'. This refers to the recording of the calibration cube (see 'Filming the Calibration Video') taken from the left camera. Click OK.
- Select the left calibration video (e.g., Utila Calibration 01-06-20 LEFT). Click Open.
- A 'Movie sequence configuration' box will appear. This is useful when you must add more than one video to the project (e.g., if the left video is very long and has been broken down into multiple files). However, this is unlikely during calibration as the videos are short. Click OK.
- Repeat for the right calibration video (e.g., Utila Calibration 01-06-20 RIGHT).

Final check:

- A dialogue box will appear to show the location of each of your project files. Double check that each of these have been saved to the appropriate calibration folder. Close dialog.

ii. Synchronising the Calibration Videos

Before proceeding with the calibration, we must first ensure that both videos are synchronised i.e., the left and right cameras are locked on the same frame and will play at the same rate. We do this using the torch flashes recorded at the beginning of the calibration video and matching the frame in which the light comes on in both videos.

- In CAL, ensure the 'lock' checkbox is unchecked.

- Select ‘Play movie’ above the left-hand video. A dialogue box will appear asking whether you want to ‘Disable sound for ALL movie playback in this session?’. Click Yes.
- A movie player will appear where you can play and pause the left-hand video, or step through it frame by frame. Play the video until you reach the first frame in which the torch light appears. Look closely for this – the cameras are filming from different angles so the light may appear fainter on one side. Close player and update position.
- Repeat the process for the right-hand image.
- Check that both videos are aligned by using the arrows directly above each (left and right) to step through the frames one by one. When confident they are aligned (i.e., both showing the frame in which the torch comes on for the first time - Figure 3), check the ‘lock’ box to ensure they will remain synchronised for the rest of the calibration process.
- Use the arrows to the left of the ‘lock’ box to skip the images through the second and third torch flashes, ensuring that the light appears and disappears in both videos simultaneously each time.
- N.B. The calibration will not work if the synchronisation is not perfect, so spend some extra time here.

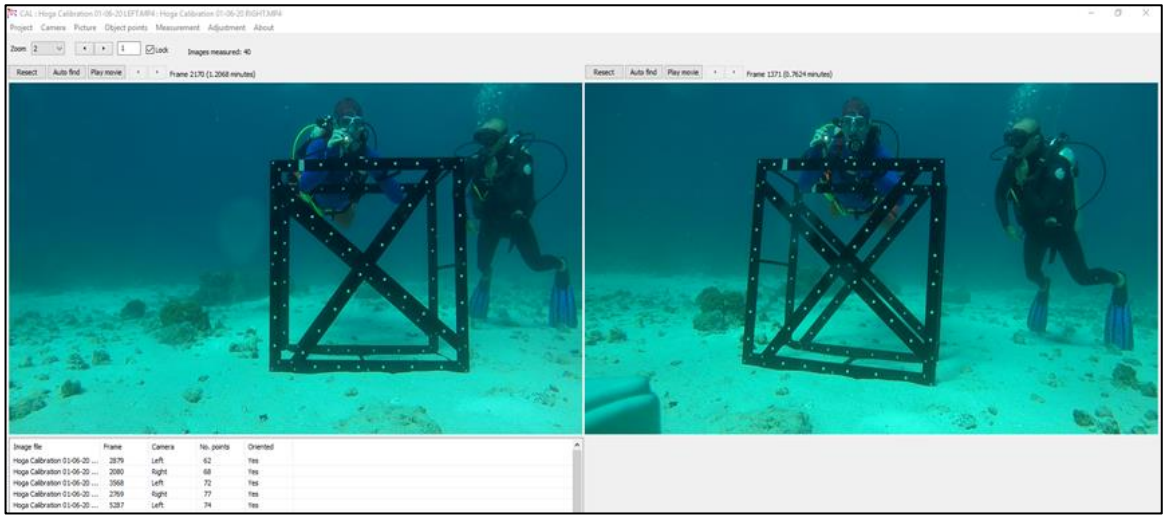

Figure 3. Screenshot from CAL showing left and right videos which have been synchronised using the appearance of light from a torch.

Troubleshooting: If you are having trouble synchronising the videos, for example you can synchronise the first flash but not the second or third, this tells us there may have been an issue during filming. In this case, double check the camera settings are correct and that the cameras are stored in the correct side of the SVS. Re-film if necessary.

iii. Identifying and Measuring Resection Points

We can now begin taking measurements from the cube’s resection points in the left and right images. These are the white dots that allow us to determine the position of each camera within the stereo-video system - those on the front surface are depicted in Figure 4a and labelled 100 to 167. Of these, there are five key points which are most useful to us during calibration - 100 to 104. To determine the location of point 100, and therefore the location of points 101 to 104, a white line known as an ‘index mark’ is located to its right-hand side (Figure 4b).

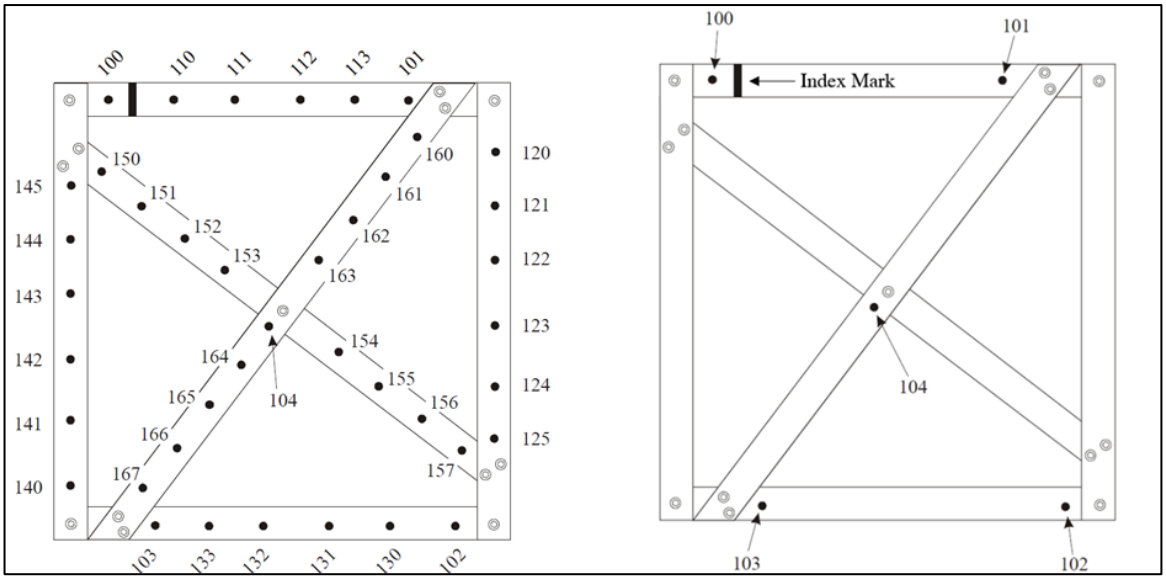

Figure 4a (left): Schematic of calibration cube outlining the location of all resection points on the forward-facing cube surface. Figure 4b (right): Highlighting the location of points 100 to 104 and the index mark.

The video will show the calibration cube in a series of 20 different orientations (see Figure 1) and measurements must be taken during each one.

- Skip through the locked calibration videos until the divers are in place, and the cube is in the first position (square to camera). Ensure the cube and resection points are completely unobstructed by divers or sediment.
- Locate point 100 (next to index mark) and take first measurement. This is done by holding the 'Shift' key and hovering over point 100. When a box appears around the point (centroiding), click the left mouse button. You may have to zoom in for this – do so by holding the 'Ctrl' key and moving the mouse over the point.
- A blue '100' should appear next to the point in the left image (Figure 5).

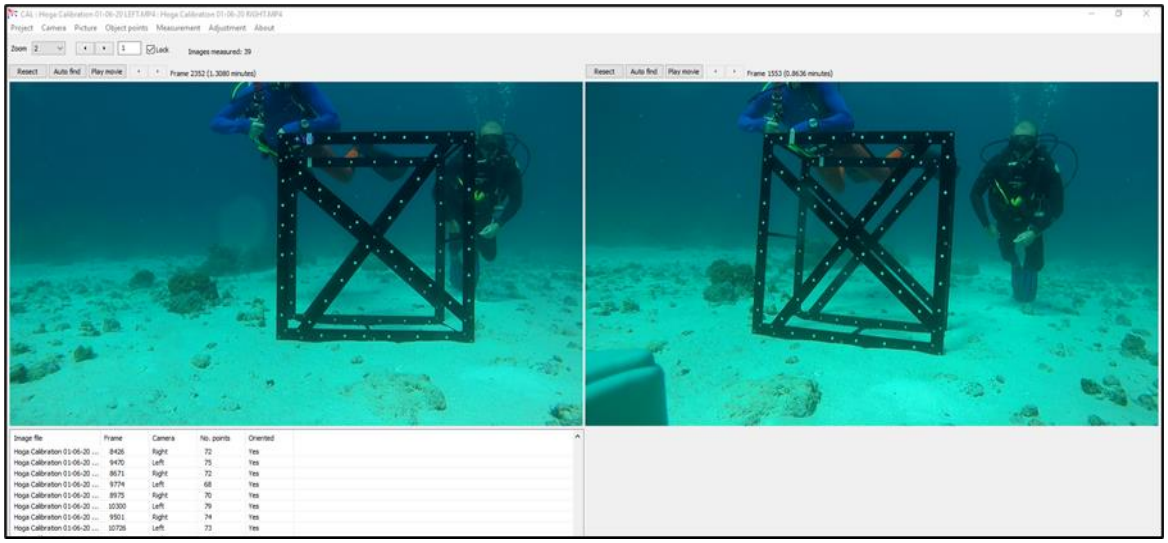

Figure 5. Screenshot from CAL. In the left image, point 100 has been measured using Shift + click (centroiding).

- Repeat this for points 101, 102 and 103 (in order), in the left image.
- Repeat for points 100-103 in the right image. These eight points should now all appear green, and the others blue (Figure 6). Check that 104 (the central point) is also correct.

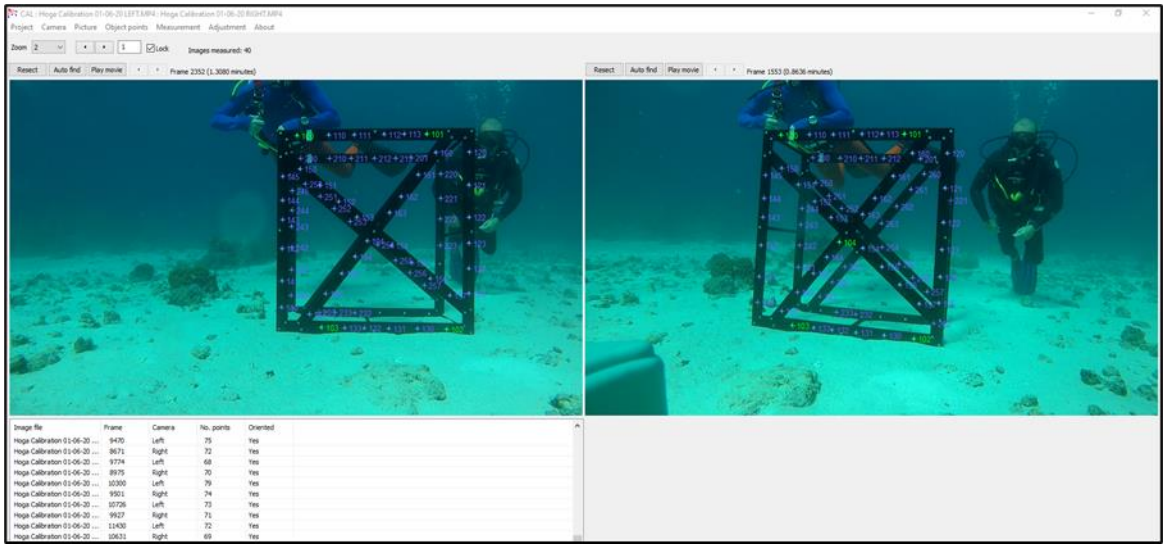

Figure 6. Points 100-103 (green) have been successfully measured in the left and right images. Point 104 and the others (blue) have been automatically detected.

The first measurement is now complete. As before, skip through the locked videos until the cube is in the second position. You can do this by using the frame stepping buttons (arrows) or by playing the movie until the cube is in the correct place then clicking 'Close Player and Update Position'.

- Locate point 100 in the left image using the index mark (from your perspective, it may now be on a different side of the cube) and measure using Shift + click. Measure the remaining points 101-103 in the left image, followed by points 100-103 in the right image.
- Repeat this process until measurements have been taken for all 20 cube positions. As you progress, you will find that more and more points are being automatically detected, so fewer manual measurements are needed.

Troubleshooting: If you accidentally put a point in the wrong place, you can delete it by deleting the whole row of data from the data window and then start that cube position over.

It is also unusual for every point in every image to match up perfectly so don't be alarmed if you see a few red points here and there - the calibration should work just fine. Failed measurements will be removed later.

iv. Finalising the Calibration

After measurements have been taken in all 20 rotations of the cube, we can finalise the calibration via a series of steps. These are simple and often repetitive but must be followed to the letter if the calibration is to work:

- In CAL, navigate to Adjustment | Adjustment Settings. A dialogue box will pop up and display a long list of settings. These should not have to be changed, but please check them against those listed in Figure 7.

Compute the bundle adjustment:

- Adjustment | Compute Bundle Adjustment.
- Another dialogue box will open and state if the bundle adjustment SUCCEEDED or FAILED.
- If successful, click 'Accept Results'. If failed, you may have to resynchronise the videos or re-film the calibration.

Remove unsuccessful measurements:

- Measurement | View/delete image measurements.
- Double-click on the 'Rejected' column heading to bring unsuccessful measurements to the top. These will read 'x Excluded', 'y Excluded', or both. Highlight all Excluded rows and hit Delete. Close Dialogue.
- Measurement | Find targets in all images.

Adjustment and photogrammetry settings

File

Name	Data	Units	Extra Info
Values for measurement rejection			
Critical value for resection rejection	✔3.00	Pixels	Image measurements with residuals exceeding this value are rejected
Critical value for intersection rejection	✔3.00	Pixels	Image measurements with residuals exceeding this value are rejected
Critical value for bundle rejection	✔2.50	Pixels	Image measurements with residuals exceeding this value are rejected
Rejection factor for object space distances	✔5.00	Dimensionless	Critical value = Rejection factor x measurement SD
Rejection factor for coordinate constraints	✔5.00	Dimensionless	Critical value = Rejection factor x measurement SD
% of critical value for warning point colour	✔80.0	%	
Image measurement precision			
Image measurement standard deviation	✔0.50	Pixels	
Re-weight image observations using sigma zero	✔True	Boolean	
Stereo constraints			
Use stereo constraint	✔False	Boolean	Stereo configuration is constrained in bundle adjustment
Critical value for base rejection	✔5000.0	micron	Stereo base separations exceeding this value are rejected
Critical value for orientation rejection	✔1800.0	Seconds	Camera orientations exceeding this value are rejected
SD for stereo base constraint	✔100.0	micron	Precision to which the stereo base is constrained
SD for stereo orientation constraint	✔100.0	Seconds	Precision to which the stereo orientation is constrained
Use stereo for automatic resection/measurement	✔True	Boolean	Second image of a stereo pair is automatically measured
Adjustment			
Maximum iterations	✔200		
Apply scale constraint	✔False	Boolean	

Figure 7. Default adjustment and photogrammetry settings.

And repeat…

- Adjustment | Compute Bundle Adjustment. Accept if successful.
- Measurement | View/delete image measurements. Highlight all Excluded rows and delete. Close Dialogue.
- Measurement | Find targets in all images.
- Adjustment | Compute Bundle Adjustment. Accept results.

The final part of this process is pairing the remaining left and right measurements and exporting the newly calibrated camera files:

- Measurement | Stereo Constraints | Configure Stereo Constraints.
- A dialogue box will open. Under the heading 'Pairings', click 'Automatic'.
- The left and right measurement files will appear 'paired' in the bottom window. Click OK.
- Measurement | Stereo Constraints | Estimate Constraints. Close Dialogue.
- Measurement | Stereo Constraints | View Stereo Constraints. Close Dialogue.
- Measurement | Stereo Constraints | View Relative Orientation. Close Dialogue.
- Measurement | Stereo Constraints |Export Stereo Camera Files. Close Dialogue.
- A dialogue box will open asking if you would like to save the new **left** stereo camera file. Click Yes and save to your calibration folder with an appropriate name (e.g., Utila Calibration 01-06-20 **LEFT**). Close the 'Camera Parameters' box that appears.
- A second dialogue box will open asking if you would like to save the new **right** stereo camera file. Click Yes and save to your calibration folder with an appropriate name (e.g., Utila Calibration 01-06-20 **RIGHT**).
- If you navigate to your calibration folder now, you will find two new files with the extension 'Cam'. These are the main outputs of the calibration and will be required to analyse all data collected during the season.

v. Saving and Exporting the Calibration Project

Although the .Cam files are the main outputs, it is important to save the full calibration project so we can come back and check it later if needed (i.e., if we are having issues with analysis later down the line).

Save the calibration project:

- Navigate to Project | Write to File. Save over the top of the existing 'PrjCAL' file.
- A dialogue box will open asking if you would like to save the Orientation and Observation data. Click Yes and save over the top of the existing 'ObsCAL' file.
- A dialogue box will open asking if you want to save the Left Camera Data. Click yes, save over existing.
- A dialogue box will open asking if you want to save the Right Camera Data. Click yes, save over existing.

As an additional safety measure the calibration files should be sent back to Opwall HQ for verification before any transects are complete or data is collected. From prior experience, this can save a lot of wasted time.

- In your calibration folder, create a new folder and name it (e.g.) 'Utila CALIBRATION JPEGS'.
- In CAL, navigate to Measurement | Convert Movie to JPEG.
- A 'Movie to JPEG Conversion' dialogue box will open. Double-click on each row in turn and specify the following:
  a) Input measurement file – locate and select the measurement file (ObsCAL) for your calibration.
  b) Output JPEG picture directory – locate and select the new 'CALIBRATION JPEGS' folder you just created.
  c) Output JPEG measurement file – this will generate a new file, save it in the 'Calibration JPEGS' folder with an appropriate name e.g., 'Utila CALIBRATION JPEG Conversion'.
- Click Process.

If you navigate to your 'CALIBRATION JPEGS' folder you should now see a series of images that have been generated from the left and right videos, alongside the new 'ObsCAL' files. This means the conversion has been successful and the files can be sent to Opwall HQ for verification:

- Add the following files to your CALIBRATION JPEGS folder (for those not already in there, use copy and paste - do not remove any files from their original location):
  1. All the newly generated JPEG images.
  2. The new 'ObsCAL' measurement file ('Utila Calibration 01-06-20 JPEG Conversion').
  3. The Cube Points (PtsCAL) file.
  4. The original left and right camera (CamCAL) files.
- Right-click the folder and select Send To | Compressed (zipped) folder.
- Email the new zipped folder to shannon.cameron@opwall.com.

Checking the Calibration

i. Taking Measurements in EventMeasure (EM)

If everything has gone well so far, chances are the calibration has been successful. To check this, we can take measurements from the recording of the distance bar, and then compare those with known measurements of the real distance bar. We will have to use a second piece of software for this, EventMeasure, so please make sure it has been downloaded and a license obtained and activated.

Create a new measurement file:

- Open EventMeasure. If you are using it for the first time, ensure 'Toggle View' is enabled so there are two pairs of stepping arrows – one each for the left and right videos.
- Measurement |New Measurement File.

Set the picture directory:

- Picture | Set Picture Directory. Navigate to the calibration folder (where the distance bar videos are saved). Once set, you can only load videos specifically from this folder.

Load the distance bar videos (this is slightly different for left and right):

- Picture | Load Picture. Select the left distance bar video.
- A 'Movie Sequence Configuration' dialogue box will open. Click OK to close.

- Load the right video: **Stereo** | Load Picture. Select the right distance bar video and close the dialogue box.

Now that both videos are loaded, we can load the two newly created calibration files:

- Stereo | Cameras | Left | Load Camera File… Select the Left 'Cam' file.
- Stereo | Cameras | Right | Load Camera File… Select the right 'Cam' file.

Complete the information fields:

- Measurement | Information Fields | Edit Field Values. Complete the three top rows:
  a) OpCode – give the measurement file a name (e.g., Utila Calibration-Check 01-06-20).
  b) TapeReader – this is the name of the person taking the measurements – add your name.
  c) Depth – NA.

Load the species file:

- Measurement | Attributes | Edit/Load Species File. Navigate to calibration folder and select the Species File.

Synchronise the videos:

- This is done exactly the same way as before (see **Synchronising the Calibration Videos**).

Take measurements from the distance bar:

- Skip through the locked videos until the diver presents the distance bar to the cameras.
- Open the 'Cube Notes' PDF and scroll to the final page where you will find a diagram and small table indicating Length 1, 2 and 3 and their corresponding lengths in millimetres.
- In Eventmeasure, hover over the point on the far left of the distance bar in the left image, hold Shift so a box appears around the point, and left click. A red + will appear over the point.
- Do the same for the central point in the left image and a line should be drawn between the two points.
- Repeat the above two steps in the right image (see Figure 8).
- Two dialogue boxes will appear. In the 3D information box, the top row of information is the length. Does this match the length listed for Length 1 in the 'Cube Notes' document? (this should be close but may not be exact).
- In the Attributes box, select any species from the dropdown list and click OK to save the measurement.
- Make measurements as above for Length 2 and Length 3.
- Skip the videos forward until the distance bar is in a different position and take additional measurements for Length 1, 2 and 3.
- Save the Measurement File: Measurement | Save… (e.g., Utila Calibration-Check 01-06-20).

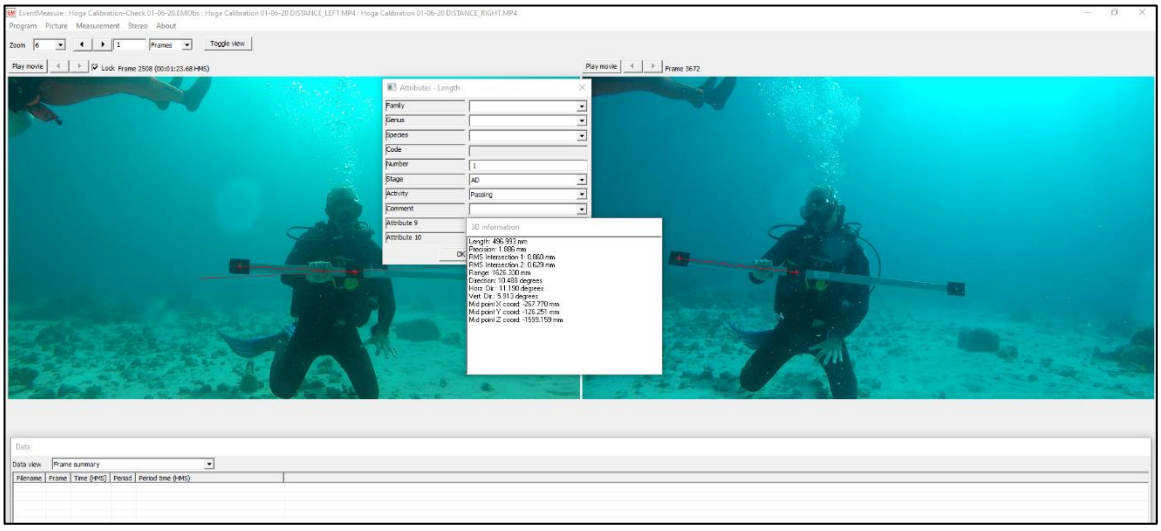

Figure 8. Screenshot from EventMeasure showing a 3D Measurement of the distance bar.

Troubleshooting: If you accidentally place a point incorrectly, simply click around the screen until you see the error message 'Invalid length measurement sequence'. Click OK. The point is deleted, and you can start over.

ii. Exporting Measurements from EventMeasure

As with the calibration files, a copy of the distance bar measurements should be sent back to Opwall HQ for verification, as well as to keep as a permanent record.

- In your calibration folder, create a new folder and name it (e.g.) 'Utila DISTANCE JPEGS'.
- In EventMeasure, navigate to Measurement | Convert Movie to JPEG.
- A 'Movie to JPEG Conversion' dialogue box will open. Double-click on each row in turn and specify the following:
  a) Input measurement file – locate and select the measurement file (EMObs) for the distance bar.
  b) Output JPEG picture directory – locate and select the new 'DISTANCE JPEGS' folder you just created.
  c) Output JPEG measurement file – this will generate a new file, save it in the 'DISTANCE JPEGS' folder with an appropriate name (e.g., 'Utila DISTANCE JPEG Conversion').
- Click Process.

If you navigate to your 'DISTANCE JPEGS' folder you should now see a series of images that have been generated from the left and right videos, alongside the new '.ObsCAL' files. This means the conversion has been successful and the files can be sent to Opwall HQ for verification.

- Add the following files to your DISTANCE JPEGS folder (for those not already in there, use copy and paste - do not remove any files from their original location):
  1. All the newly generated JPEG images.
  2. The new 'EMObs' measurement file (e.g., 'Utila DISTANCE JPEG Conversion').
  3. The Cube Points (PtsCAL) file.
  4. The original left and right camera (CamCAL) files.
- Right-click the folder and select Send To | Compressed (zipped) folder.
- Send the new zipped folder to shannon.cameron@opwall.com.

You will shortly receive an email response, hopefully confirming that the calibration is good, and the stereo-video system is ready to start collecting data. If there is an issue with the calibration, further instructions will follow.