USING PHOTOMODELER TO MEASURE MARINE CANVAS

Version 0.7 – Feb. 17, 2021

TABLE OF CONTENTS

INTRODUCTION

This document outlines techniques for using PhotoModeler and a camera to measure boats for canvas replacement and similar tasks. This is a 3D direct measurement technique that does not use template material. PhotoModeler can be used to photo-digitize 2D templates as well, but that is described elsewhere.

The concept is to measurement the boat in full three dimensions, do the canvas design in full 3D, and then use CAD flattening to create the required canvas patterns.

Please note that this document is not a 'step by step', or a 'how to'. More of those resources will be published over time. Instead, this document shares several concepts and things to consider when using PhotoModeler for 3D canvas measurement.

Notes and Prerequisites.

1) The procedures described here are for PhotoModeler customers that already have a digital CAD/CAM workflow for canvas design and fabrication and are familiar with PhotoModeler. We suggest that you or somebody on your team has some 3D CAD background.

If you do not yet use CAD nor do CNC fabric cutting, feel free to read, learn, and wait for later releases of this document and videos.

2) This document outlines several approaches; you do not need to use all of them - as one might fit your needs better than others.

3) Do not try a new technique for the first time on an actual job with time constraints and an expectant customer. Please test the techniques in-house for a while first.

WHY USE PHOTOMODELER FOR CANVAS

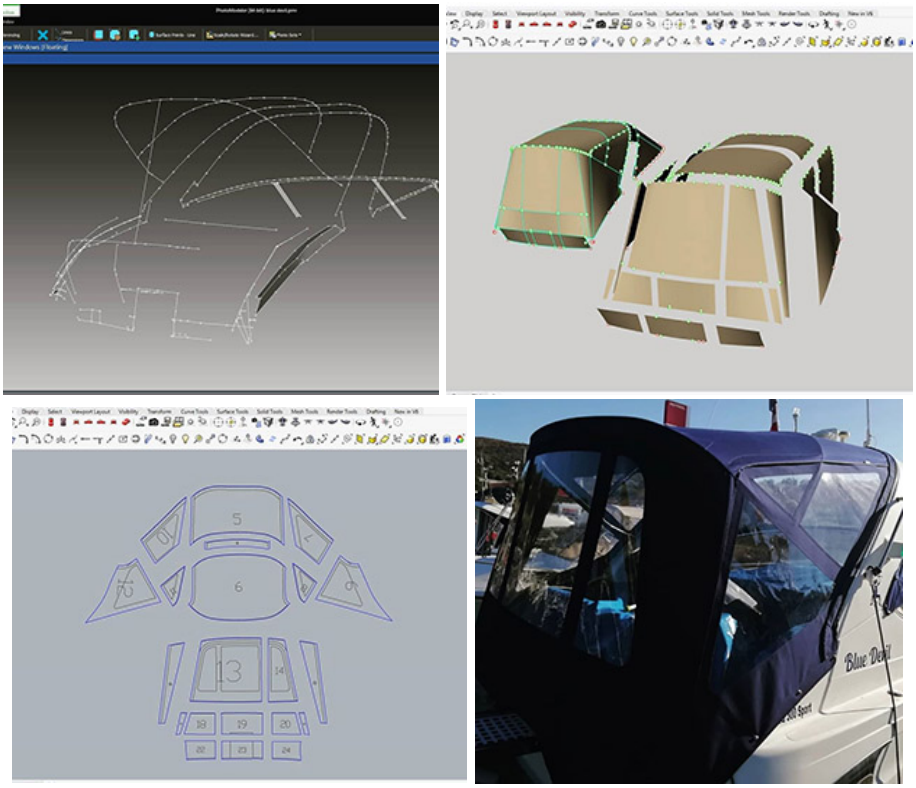
There is a long history of measuring boats (structure, decks, and rails/tubes) using templates, triangulation, and modern tools to produce well-fitted replacement canvas. Using a digital workflow for this task involves digital measurement, CAD, CAM, and CNC cutting. A digital workflow has several advantages: reduced costs, reduced labor,

higher quality, better material utilization, higher customer satisfaction, and ease of hiring new computer-literate talent into the business.

There are several measurement tools that fit into the recent trend of using CAD/CAM/CNC for canvas and fabric production. Most of these new tools perform 3D measurements on the boat, compared to templates and triangulation which are 2D techniques.

Some of the advantages to transitioning to a modern measuring technique are ease of use (no template material blowing in the wind!), a reduction of time on the boat, increased accuracy, increased flexibility, easier remote work, and lowered costs.

Some of the technologies for doing these measurements are laser pointer systems, laser scanners, string-based length/angle systems, and photogrammetry. The PhotoModeler software is a photogrammetry system (using a camera to do measurements). PhotoModeler has these potential advantages over other 3D measurement systems: lower cost (capital and labor), easier capture of larger areas, higher accuracy, the ability to use when the boat is floating at dock (as well as when dry), easier 'revisit' to get more measurements, and typically less time on-boat. The other techniques have their unique strengths, and you may find you need to use more than one system to meet your canvas measurement needs.



Complete PhotoModeler Canvas project courtesy of *Dustom d.o.o. (Dustom Covers)*

OVERVIEW OF THE MAIN STEPS

The main components and steps of a PhotoModeler 3D canvas measurement project are:

- Choosing equipment and a method
- At the boat:
  - Prepare boat
  - Take photographs
- At the office:
  - Set up the project and process the photos
  - Mark points, surfaces, tubes, etc. on the photos
  - Export 3D data to CAD
  - CAD/CAM work such at flattening, layout, enhancing

These components are described in sections below.

EQUIPMENT

The following outlines the required equipment. See the *CHOOSE A METHOD* section for additional detail and why you might use the recommended and optional equipment.

REQUIRED EQUIPMENT

- PhotoModeler Standard software and a suitable computer †
- A digital camera
- A tape-measure

† almost any modern Windows computer will suffice (not Windows 10 s-mode computers)

RECOMMENDED EQUIPMENT

- A digital camera with 24MP+ resolution, a prime (non-zoom) lens, and remote trigger.
- A long camera mount pole or monopod
- PhotoModeler Letter Sheet Rubber-backed targets
- PhotoModeler Dot Tape

OPTIONAL/ADVANCED EQUIPMENT

- A small drone
- PhotoModeler Premium

CHOOSING A METHOD

There are several approaches for modeling boats with PhotoModeler for canvas replacement tasks. The approach you use will depend on the boats you model, your time constraints, access constraints, and your budget. You would typically choose an approach once and get used to using it – you would not go through these decisions for every project.

The choices that must be made are:

- Which type of PhotoModeler to use
- Which camera to use
- How to get suitable photos and best locations
- Whether you use targets, dot tape, manual points, and/or Bent Tubes
- How to get accurate scale

The follow sections deal with these in more detail.

CHOOSING A CAMERA

PhotoModeler has the flexibility to use images from almost any digital camera. Some cameras are better than others for this task.

We recommend a high-resolution camera with a non-zoom (prime) lens as the preferred choice. Mobile phone cameras are not recommended due to lower resolution and issues with OIS and other interventions. While mobile phone cameras can be used for some projects, and have been successfully used for deck modeling, the extra accuracy requirements of doing canvas measurement means a higher quality camera is recommended. The camera can be a DSLR, a mirror-less, or a high-quality point-and-shoot type. There may be some lower accuracy project (a loose small cover) that will work with some mobile phone cameras – you will need to experiment in this case.

A wider-angle lens (that is not fisheye and not too distorting) will help capture larger areas of the boat in one photo. This is especially important in tight spaces around marinas and boat sheds. A lens between 15mm and 25mm (35 mm equivalent) work well. PhotoModeler does fully compensate for lens and camera distortions for maximum accuracy.

Often photos from high vantages are needed, and if you are using a camera on a long pole, then a camera with remote viewing and remote triggering can be helpful. Some cameras have built in wifi that can connect to your mobile phone for these functions.

Lastly, it is important that the camera be calibrated by the PhotoModeler software. This can be done using the multi-sheet calibration method, and/or a field calibration if

appropriate photos are taken on site. It is important that the camera parameters are stable over time to give good consistent results. If a drone is used, ensure its camera is also of good quality and it is calibrated (usually with an automatic or field calibration in the software).

CHOOSING THE SOFTWARE

Two main pieces of software are required: PhotoModeler and a CAD program. PhotoModeler comes in two variations: Standard and Premium. Many people in the marine industry use Rhino 3D for CAD as there are several tools to help with canvas work and it is reasonable cost. In addition, you may need software (separate or add-ons) to help with flattening 3D canvas designs to 2D panels, layout and stitching assistance, and control of a CNC cutter. See Resources below. Here we discuss just the PhotoModeler software choice.

Standard

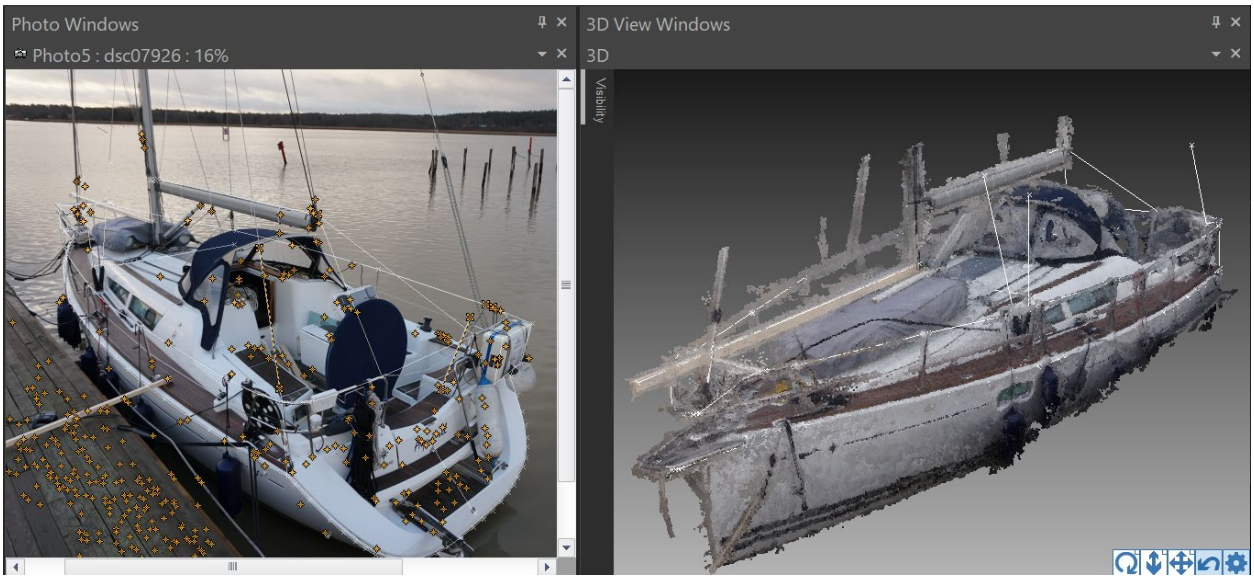
- Standard includes all the tools you need to measure a boat for canvas replacement, such as camera calibration, photo orientation, Coded Target support, Bent Tube support, and CAD export.

Premium:

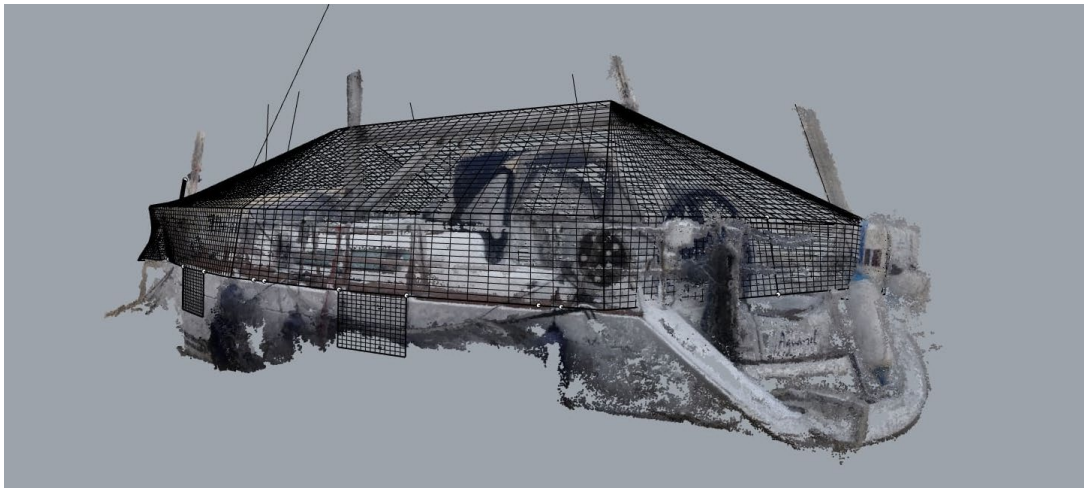
- Premium adds SmartMatch and dense point cloud capabilities.
- Pro: Superset of Standard (has all its features), and includes 3d scanning of existing canvas, with potential for targetless and faster setup.
- Con: more expensive, automated orientation requires more photos and may not work in all cases (such as a boat floating surrounded by docks, or a clean/new boat), and needs a more powerful computer.

You can do most canvas work with Standard, but there is a place for using Premium if you have the budget and have the need. We strongly suggest trying the free evaluation of Premium first to see if it helps.

Here is an example of some boat cover work done using PhotoModeler Premium and dense point scanning. Note that this project worked well for several reasons (that may not always be true): waveless day, boat was not newly painted and shiny/clean, and only a rough shape was needed as this was a full cover where accuracy requirements are not quite as high.



Example of a PhotoModeler Premium SmartMatch and dense point cloud of a sailboat *

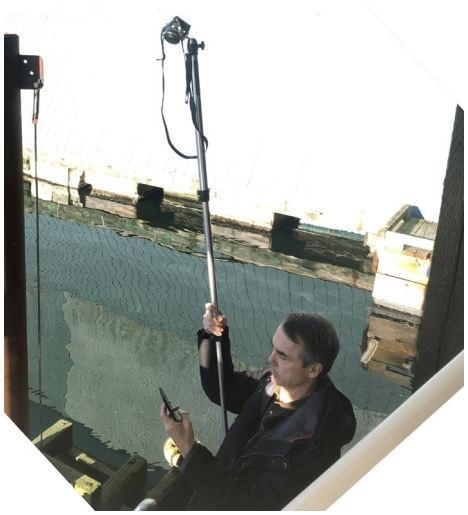


An example export of the point cloud into Rhino 3D and the creation of a cover over the cloud *

* Data courtesy of Dragan Durbaba of *Workshop Boat Cover*

CHOOSING A METHOD FOR GETTING SUITABLE PHOTOGRAPHIC ANGLES

Capturing photos for canvas work sometimes involves getting to positions not possible by standing on a dock, the boat, or neighboring boat and hand-holding the camera at eye level. Quite a few photos can be done this way, but often you will need photos taken from a higher vantage point. The main way to do this is to use a long pole (such as an extensible monopod) and a camera that can be remote triggered (several modern cameras can be triggered from your smart phone). With some of these smart phone apps you can see the view of the camera and trigger it.



Camera on a long monopod while using remote viewing and trigger on a phone.

A second way to get high shots is with a drone. Note there are several caveats with using a drone. First is the licensing issue. For many places you need a license to fly a drone (in North America a license is needed for any drone over 250 grams). Do note that these drone regulations can change, and this is the situation as of early 2021. There are some models available currently that meet this 250 g limit and have a reasonable camera and can be flown without a license in some jurisdictions.

A second caveat is that if the boat is in a marina there can be restrictions from the government or the marina on flying drones. Third, there can be many obstructions (e.g., stays and halyards on a sailboat) which make safe flying difficult. And if you crash the drone it may end up in the water! One advantage of a drone camera is that you have more freedom to take photos from where you want. If the boat is not in a marina, but on your own property, you may have more control over these variables.

A remote triggered camera on pole with a wider lens (for capture of bigger areas) is suitable for many cases.

The needs of camera positioning and coverage depend on boat type, shape, height, and desired outcome. Photos for a full canvas cover for a 30 m motorboat are different than a bimini or a spray hood for a 10 m sailboat. More on this later.

CHOOSING THE METHOD FOR ORIENTING PHOTOS

One of the first steps PhotoModeler must take to solve a project is to locate the camera in 3D space for each photo you took. With this position and angle data, PhotoModeler can use 'triangulation' to determine where 3D points are for the modeling. This step of locating the camera's positions and angles is called "orienting the photos or camera stations." To successfully orient the photos, PhotoModeler needs a good camera calibration and a minimum number of points marked and referenced across the photos.

These initial set of points used for orientation can come from Coded Targets, manual marks, manually marked and referenced sub-pixel dots, or SmartMatch (Premium only). The points used for orientation do not need to be the same set of points used to model the boat for canvas.

While most projects will use between 10 and 50 photos, taking 100+ photos at the site is not unheard of. With more photos you are less likely to miss anything. If your project needs many photos (more common with SmartMatch), it is good to do the orientation stage with the automated tools (Coded Targets or SmartMatch).

USING CODED TARGETS

Coded Targets are a good way to get enough points to form the orientation. Coded Target support is available in both PhotoModeler Standard and Premium. These targets can be paper and be taped on, or the rubber-based PhotoModeler Letter Sheets.

a) use of sheets of Coded Targets to place multiple targets easily, b) example of taped Coded Targets in a cockpit area. Project data courtesy *Dustom d.o.o. (Dustom Covers)*.

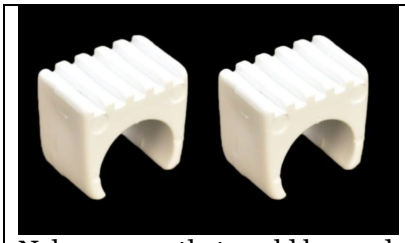
Depending on your potential camera views you may also want to have targets on both horizontal and vertical surfaces or a more complex system with jigs on tubes.

Note that Coded Targets can also be used to help with the automated set up of scale (see below in Scale section).

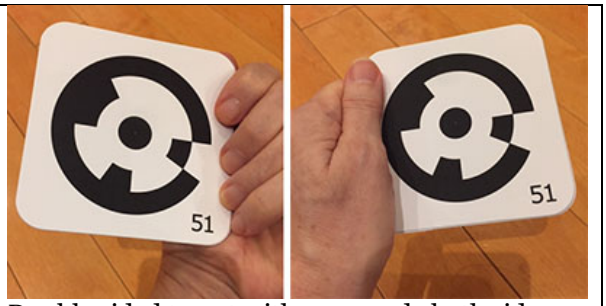
To get the best out of a Coded Target project there needs to be enough targets of the correct size, enough photos, and enough photo overlap. For example, the most common mistakes people make with their first Coded Target project are:

1. Not enough targets detected on each photo (aim for 15+ spread across the photo)
2. Not enough connection between photos. Make sure there is overlap between each photo. E.g., If photo A can see targets 1-15, photo B should see 5-20, photo C should see 10-25, etc.

While targets can be placed on flat surfaces (weighted ones on any flat surface or taped-down paper targets on any angled surface), there are cases where it can be useful to have targets attached to and stick up from the canvas steel support tubes. This can be helpful if your photography positioning is limited (esp. if photos are all lower down). You can also use a trick where the targets are double sided. That is, you have the same target id on both sides of a thin sheet. You align the two center dots and PhotoModeler will treat these as one code (but that can be seen by photos on opposite sides). You can use some attachment on a stiff and thin board to attach them to your tubes (or rest on other places such as on top of booms). Clips or nylon spacers might be an option for attachment. Do beware of windy conditions – you do not want these targets to rotate or move on the tube during photography.



Nylon spacer that could be used to attach a stiff double-sided target to a tube.



Double sided target with same code both sides aligned.

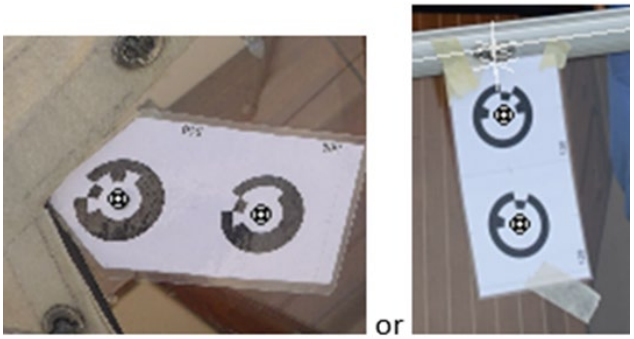
CHOOSING HOW YOU WILL PICK UP POINTS / OBJECTS / TUBES ON THE BOAT

Once the project is oriented, you will need additional 3D points and objects to model the boat. Depending on what you are creating (a full cover, a bimini, a spray hood / dodger, or some enclosure) you will need to measure different parts of the boat. A cover will need measurements for all 'external' aspects of the boat (including parts of the hull). A bimini will require measurement of steel tubes, and perhaps some deck attachment points. A spray hood or dodger will have deck attachment points as well as a couple of steel tubes. In addition, there may be existing snap locations and other tie downs.

There are three categories of objects to be measured:

1. points that are distinct on the boat when photographed (e.g., snaps, tie downs, bolt holes, etc.)
2. points that are on the deck or hull that are not distinct (cannot be identified as the same in different photos by visual methods alone)
3. canvas steel support tubes

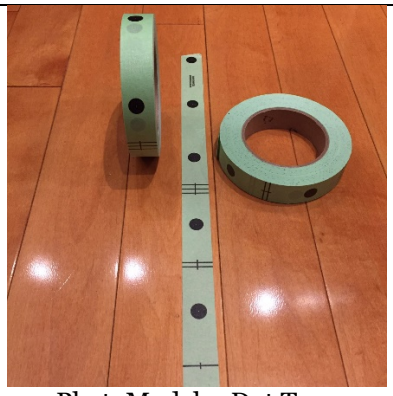
The first category of points is often picked up from the photographs using manual marking and referencing techniques. Occasionally, paired coded targets can be used to 'point' to the distinct item:



Example of paired Coded Targets used to identify and pick-up corners, etc.

The second category of points is often picked up from the photographs using targets (coded targets or uncoded dots). Coded Targets are available in the program to print yourself or are available for sale with a rubber base. Uncoded dots can be dots available from your local stationary/office supply store, or we have a tape with printed dots available for sale as well. In addition, sometimes a plane can be fit to coded target points and Surface Draw is used to pick out points on that plane from just one photo.

PhotoModeler Letter Sheet Targets



PhotoModeler Dot Tape

Example of using dots on an object of interest that has no distinct points of its own.

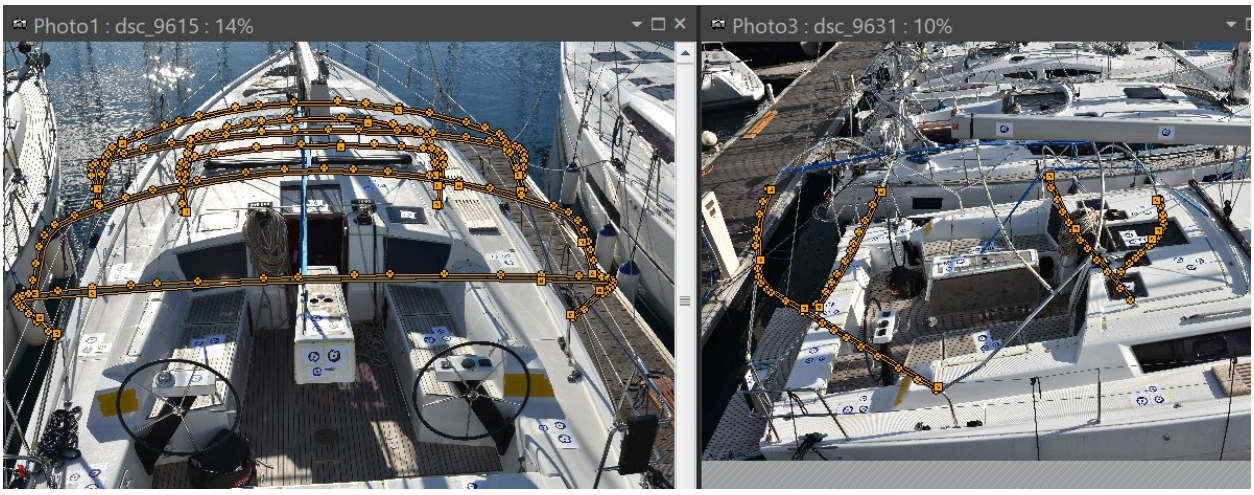
The steel tubes can be picked up with dots or dot tape along their upper surface (then using a combination of manual and semi-automated methods in PhotoModeler to mark and reference them), or with the new Bent Tube facility available in PhotoModeler 2021.0 and later.

PHOTOMODELER BENT TUBE OBJECT

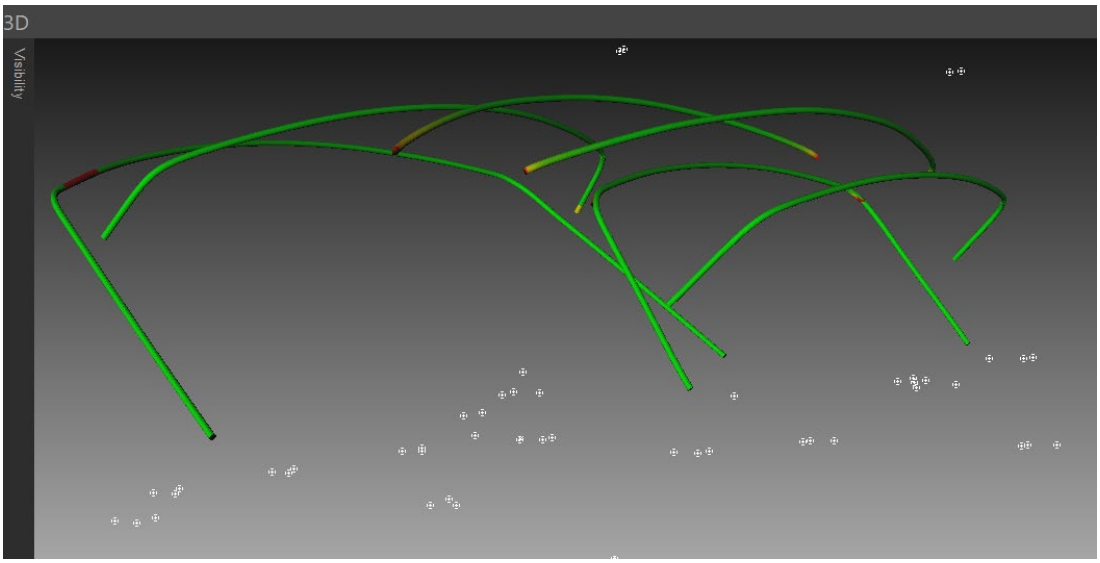
Bent Tube modeling is a unique capability to PhotoModeler. It can greatly reduce the setup time at the boat because no dots or tape are needed on the tubes. Tubes can be difficult to pick up with laser pointers and scanners.

PhotoModeler's unique combination of abilities with Coded Targets, Curves, Cylinders, Surfaces, Surface Draw, wide camera support, and high accuracy, provides a very powerful tool for those doing marine fabrication work.

With this new Bent Tube method there is a bit more work back in the office, but the potential savings of time while on a client's boat more than make up for that. It also removes the need to train the field crew the correct placement of the dots on the tubes.



Example of Bent Tube Marks on two photos. Bimini and sprayhood/dodger tubes. *



Example 3D View of 3D Bent Tubes of four bimini tubes and two sprayhood/dodger tubes. *

* Project data courtesy of *Dustom d.o.o. (Dustom Covers).*

With PhotoModeler's ability to handle coded targets in a robust manner, its subpixel dot marking, manual marking, and its new Bent Tube method, we have a powerful tool for marine canvas measurement using photographs.

More detail will be available in an external document and videos (tbd).

CHOOSING HOW TO SCALE

An important aspect of generating an accurate result, and canvas that fits well, is to obtain accurate scale on the boat. Photogrammetry is essentially scale-less – that is PhotoModeler does not know your photos are of a real sailboat or a toy sailboat that fits in your hand. You provide one or more measurements to PhotoModeler so the correct size can be determined.

There are a few ways to scale a PhotoModeler project. One can use a tape measure on-site to get the distances between one or more pairs of distinct points. You then model these points in PhotoModeler (appearing each on two or more photos) and tell PhotoModeler the distance between them. This is done with the Scale and Rotate Wizard or the Imports and Coordinates features.

It is a good idea to get more than one scale measurement. With more than one scale you have some redundancy and can check them against each other.

Another good way to get scale is with a scale bar. A scale bar is a rigid rod or flat piece of plastic/metal with two dot targets of a known distance apart (if they are Coded Targets then the scale can be automatically set up).

Example scale bar with 2 fixed coded targets of known distance

Scales can also be set up automatically with the PhotoModeler Letter Sheet system (with one caveat). Scales should be long. The longer the better but remaining practical – a long scale bar is hard to carry around (unless it comes in pieces).

THE STEPS

The following outlines the steps for a typical canvas measurement project. These steps would apply to most canvas projects from full covers, to sprayhoods and dodgers, and to biminis.

SET UP THE BOAT

Now that you have chosen your methods above, let us start with the steps of a typical project.

Each project will require some planning. You should first determine your measurement goals (are there existing tubes to be measured, what points are needed on the deck, are there existing snaps, etc.)?

When you visit the boat (or pre-study some client photos), determine where you will place your targets, how you will measure items that are distinct (like snaps), and how you will get less distinct features such as windshield top, tubes, deck surface where the canvas might touch, and possible locations of halyards and stays if they will interact with the canvas. These topics are covered above.

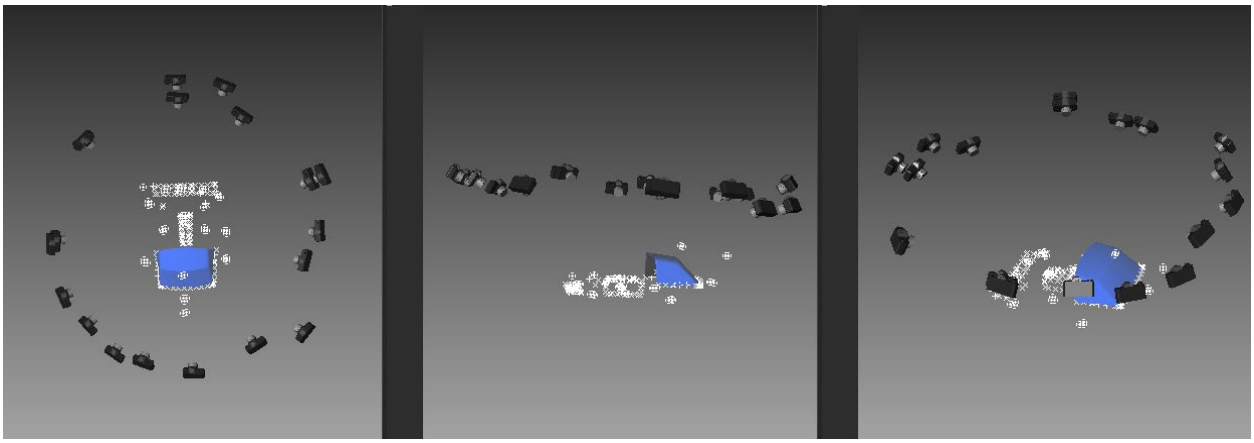
1. Place your targets and your scales on the boat. Ensure good coverage.
2. Take scale measurements (if needed).
3. Plan out the photography.

Example of dot tape on deck and dot targets on the track for bottom of sprayhood/dodger canvas. Project data courtesy of *Dustom d.o.o. (Dustom Covers).*

TAKE PHOTOS

It is important to plan your photography. Map it out in your head or draw it out so you do not miss key photos. Take a lot of photos but ensure to move between each shot - photos from one location do not help. We will come up with some prescriptions for how to take photos based on the type of project but for now experimentation will be needed. Consider angles needed of points and tubes, and the overlap needed for targets and points. Ensure all your targets and points appear in two or more photos from different angles. Ensure that tubes are captured with rotations about the tube for each required part (more of this in the Bent Tube document and videos).

Often a good approach is the orbit. There will be restrictions due to locations of docks, other boats, shed walls, etc. but aim for the best possible. Orbit around the boat at one height taking photos looking towards the center (center of cockpit for most canvas replacement projects, or center of boat for a full cover). Then lower the camera and orbit again. Note if using coded targets there will be a limit how low the second orbit can be unless there are a mix of horizontal (on deck surface), and vertical (sticking to walls, booms, tubes, decks, etc.) coded targets. Sometimes a single orbit will suffice as example below shows.



Top, side, and perspective views of camera positions in an orbit around cockpit of a sailboat. Project data courtesy of *Dustom d.o.o. (Dustom Covers)*.

If you can take a notebook computer to the site, it is a good idea to load your photos and review them on-site before leaving or removing any targets. Check photo quality (exposure, blurring), and overlaps. If you have PhotoModeler on the computer and are using Coded Targets, or SmartMatch (with Premium), you can do a preliminary run of the photos to ensure all or important photos orient, and that scales can be seen etc.

Only once photos are verified, and scale(s) proven out, can you then remove targets and any dot tape from the boat and pack up for the office.

ORIENT AND CHECK PHOTOS

The first stages of running a PhotoModeler project are:

1. Load the photos (start with a smaller set first)
2. Load the camera calibration (if there is one)
3. Perform the camera orientation (if Coded Targets in the photos, or this is a SmartMatch project this can be done automatically. If not, manual point marking, and referencing is needed first.)
4. Check through the oriented photos to see that they have the overlap and coverage needed for key items (for scales and for modeling). If not, determine why some photos did not orient, and/or add additional photos and perform the orientation again.

MARK POINTS, SURFACES, TUBES, ETC.

Once the important photos are oriented (it is a good idea to save your work regularly and perhaps with different file names as you progress), you will start to build your model.

You will need to identify the points and objects you will need in your canvas design. Common elements would be locations of snaps and rails, tubes, deck locations, and possibly halyards, stays, etc. These will be done with the various point, line, edge, curve, cylinder, and bent tube modeling tools in PhotoModeler. Refer to the tutorials and help files.

How to use Bent Tubes to extract the surfaces of canvas support steel tubes will be presented in another document and videos to come.

You might also consider the use of Layers in PhotoModeler. It can help when you have your data in your CAD package to be able to hide certain aspects. For example, put all the Bent Tubes for the bimini in one layer, all the deck points in another layer, and the coded targets used for orientation in another.

It is important review your project as you build it using the 3D Viewer and 3D photo projections. You should also keep track of the maximum point residual to ensure errors have not crept in. And ensure your scales are done on your most accurate points and use the Check Distance table to verify scale results.

TBD links to tutorials etc. for guidance.

EXPORT DATA TO CAD

Once the project has been modeled to your satisfaction and you think you will have enough 3D data to build your canvas panels in your CAD program, you will do an export. The export will be in a full 3D format (unlike decking which is often done in a 2D format). A common file format, that may CAD packages read, is DXF. If you are using Rhino 3D you can also use the native 3DM file format.

You will export the object types and layers you need for your canvas design such as Points, Lines, Curves, Surfaces, Cylinders, and Bent Tubes.

CAD/CAM

We assume that the reader has experience with doing 3D canvas design and layout work in CAD. See Resources below for guidance on training in these areas.

The typical process would be:

- Import file (DXF or 3DM) from PhotoModeler
- Align and mirror data as needed (mirror if only half the boat was captured in PhotoModeler)
- Add lines, panel edges/curves, and panel surfaces for the fabric to the 3D data points and objects

- Consider PhotoModeler visualization (see below)
- Flatten the 3D design
- Add seam allowances, darts, holes, panel labels, etc.
- Export data to cutting software or plotting software

A common CAD package used in the industry is Rhino 3D. As well, several customers in this area use one or both of MPanel Production and/or ExactFlat plug-ins. These Rhino plug-ins can assist with flattening 3D designs to flat fabric panels for cutting, while dealing with fabric stresses, and production features such as seam allowances, labeling, and nesting. Some customers with a lot of 3D CAD experience might not need the plug-ins, but they can fill an important role and many customers swear by them. For customers newer to 3D canvas and CAD design, these plug-ins can be a big efficiency boost! Please contact the respective vendors for additional detail.

This aspect of the canvas design phase is not our expertise, so we suggest you review the Resources below for more information.

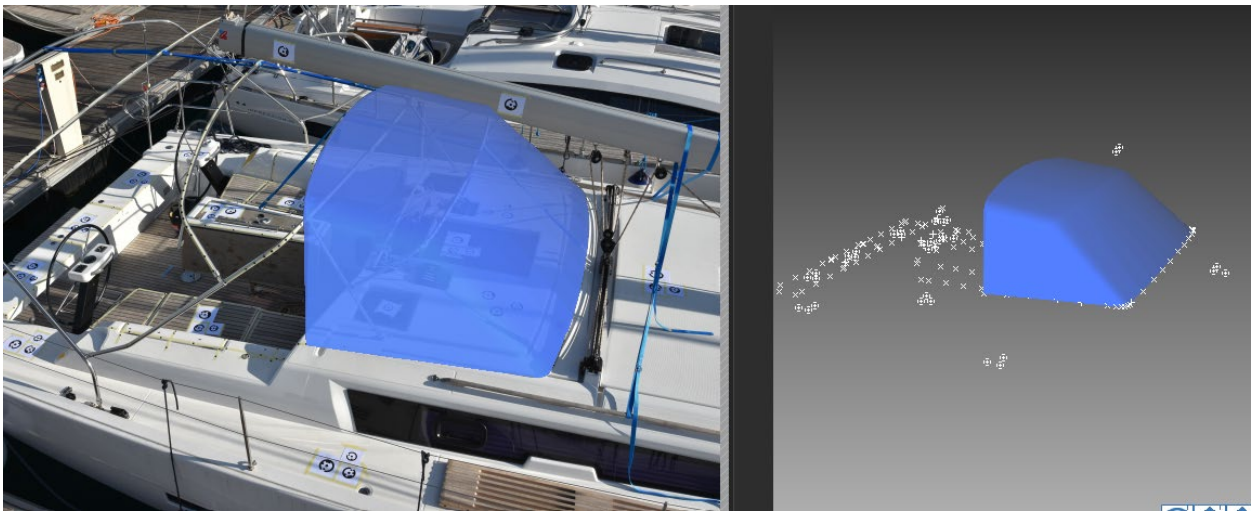
Lastly, in addition to PhotoModeler and your CAD software, you may interact with CAM software that comes with your CNC fabric cutter.

VISUALIZATION

One thing that can help with business and client confidence is to show clients a visualization of some type of what the completed canvas product will look like. When doing 3D CAD design, you can get a nice rendering and send that image to the client.

In addition, PhotoModeler can re-import 3D CAD data and re-project it on one or more photos. You can then send a picture to the client of their boat with a 3D rendering of the canvas on it. A real confidence boost for you and the client.

This YouTube video shows this capability in PhotoModeler. It is a building example, and not a boat, but demonstrates the concept. The following shows the ability to use Bent Tubes to create a surface and project back onto the photos for your and client feedback. In this case the surface was created in PhotoModeler, but more interestingly you could create the surfaces and panels in your CAD package and reimport them to display in PhotoModeler like this.



Example photo projection of a surface created from two sprayhood/dodger tubes and measured dots on the deck surface at a canvas attachment rail. Project data courtesy *Dustom d.o.o. (Dustom Covers)*.

You can also create pdf documents for the client with embedded renderings, with videos, and 3D models. You can create 3d surface models in PhotoModeler and convert them to the U3D format (in an external program or website) and import into the PDF document. This gives the customer a 3D model they can look at from all sides.

3D CANVAS RESOURCES

Below are some resources that can assist with how to use PhotoModeler and how to work in 3D CAD with canvas, or how to learn and study further.

PHOTOMODELER TUTORIAL VIDEOS

While we expect there to be more resources in the future with specific steps and recommendations for marine canvas measurement, here are a collection of current (non-marine) PhotoModeler tutorials videos that touch on useful aspects of the program that would be used in a canvas measurement project. The video title is a link to play the associated video.

MODELING AND MODELING OBJECTS

- Manual Points Project. An important aspect of many PhotoModeler marine canvas projects is the process of manual point marking and referencing. This may be needed in canvas projects for picking up non-coded points - such as on snaps, stay and halyard attachments, etc.
- Referencing. Building on the previous video more on manual referencing between photos.

- Automated Coded Targets. Shows non-marine examples of using Coded Targets to perform camera orientation and basic modeling. One of the two automated systems in PhotoModeler (compared to the manual methods described above).
- Create Coded Targets. While we have the Letter Sheet systems for Coded Targets there will be cases where you want a different style, range, or size.
- SmartMatch and DSM. For those interested in exploring the use of dense point cloud modeling (see caveats in this document) this video shows a non-boat example of how it works. (Premium only)
- SmartMatch and Manual Marking. This video describes how one combines SmartMatch photo orientation with manual marking. A task that might be useful in marine canvas modeling. (Premium only)
- Cylinders – This video shows the marking and referencing to solve 3D cylinders. There are often cylindrical objects on a boat that interact with the canvas in various ways (wires, railings, etc.). This tutorial describes the Cylinder modeling tool. Do note that for very thin objects like stays and halyards you might consider using the Edge modeling object instead. And for tubes that are not straight edges (such as the tubes that support canvas), Bent Tube modeling is appropriate.
- Bent Tubes. Video TBD.

SETTING UP CANVAS PROJECTS

- Scale / Rotate/ Translate. To obtain measurements that are true to the real-world, the project must have one or more scale measurements. A rotation is useful too to correctly orient your exported data in CAD.
- Camera Calibration. To obtain accurate results PhotoModeler needs to know the exact specifications of the camera(s) used. This step, called camera calibration, can be done in several ways. This first video shows the in-office calibration technique which is often useful as a first step with marine projects.
- Field Calibration. Another way to obtain a camera calibration, or fine-tune an existing one, is to calibrate it at the size of the final subject and is done with the final project. This is called field calibration.
- Layers and Materials. In a more complex canvas measurement project, it can be useful to organize the data into layers - for example, a layer each for a) all orientation coded targets, b) deck points, c) bimini tubes, and d) dodger tubes. Layers help to hide detail in PhotoModeler and help with the work when exported to CAD.
- Image Enhance. It can be useful to change the intensity and contrast of a photo to better see features hiding in shadows or bright areas.

CHECKING CANVAS PROJECTS

- Measure. Once accurate scale is set up (see above), one can get various measurements of length, angle, and area within PhotoModeler.
- Dimensions. Like Measure, you can apply dimension annotations of length directly to your photos.
- Check Distances. If you have multiple distance measurements on the boat (recommended), you can check them against each other to see if there is agreement. An excellent QA tool.
- Open photos showing selected. In PhotoModeler you will often want to see what photographs image a particular object. This capability will open all photos that show an object so you can verify its correctness.
- Point Review Mode. The Point Review Mode lets you see the photographs where points appear so you can ensure references are correct.

EXPORTING AND CAD

- Seven Useful Tips for Using PhotoModeler with Rhino 3D. Rhino 3D is a commonly used CAD packaged used in the marine fabrication industry. This video outlines some of the interesting ways PhotoModeler interacts with Rhino.

FACEBOOK MARINE CANVAS GROUP

On Facebook there is a private group of over 1500 people in the marine canvas industry that you can ask to join (and then ask questions):

- Facebook Marine Canvas & Upholstery Discussion Centre

ONLINE VIDEOS AND ARTICLES ON DIGITAL WORKFLOWS

John Bland, of Tecsew in the UK, is well-known in the industry, not only for the leading-edge CAD work his firm does with canvas design, but also his interest in helping the industry. In 2016 John recorded three introductory videos for MFA (Marine Fabricators Association):

- First presentation to the MFA by Tecsew on 3D CAD design, an Introduction
- Second presentation to the MFA by Tecsew on 3D CAD design
- Third presentation to the MFA by Tecsew on 3D CAD design

The Digital Patterning website (*ExactFlat* focused) has some good articles on digital patterning:

- Best Practices in Marine Canvas
- The Simple 5-Step Process to Create Digital Patterns

Timothy Akes of *MPanel* gave a webinar Dec 2020 to IFAI/MFA members on a digital canvas workflow using *MPanel Production* (webinar video access requires a simple name/email registration):

- MPanel Marine Canvas Workflow

TRAINING

Darren Arthur is involved with the MFA (Marine Fabricators Association) in a senior capacity and is well-known for his support of the industry. He often does courses at MFA conferences on digital techniques and CAD, but also hosts people at his facilities in New Jersey for training. He can also be contracted to assist remotely.

- Darren Arthur email: darren@nautiluxcanvas.com
- Darren Arthur phone: 732 888 3220

CAD VIDEOS

The two popular plugins for CAD in the industry are *ExactFlat* and *MPanel Production*. They are used for the important step of 3D flattening plus dealing with other aspects of creating fabric panels for CNC cutting. Their YouTube channels have videos on use of their tools in marine canvas work.

- ExactFlat YouTube marine playlist
- MPanel Production YouTube video
- Rhino3D Flattening Commands & YouTube Videos