CONTENTS

01 Introduction
Page 04

02 Areas of application
Page 06
As-built documentation
Assembly
Ship repair
BWTS-Retrofit
Sister vessels

03 Technical information
Page 16
Five steps of 3D documentation
Product information
SCENE to CAD
Introduction

3D Documentation in the shipbuilding industry

In naval architecture and marine engineering 3D documentation is used to help design, construct and install various on-board systems. It provides designers and planners a helpful tool for collecting accurate documentation to create 3D models of the actual vessel configuration.

The FARO Laser Scanner Focus3D enables fast and reliable scan of vessels and on-board systems. With great ease and flexibility it can be installed in a few minutes on a tripod and set up. It scans surfaces with the laser beam in three dimensions and scans with millimeter precision space and surface geometries. The digital data can be imported in all standard CAD software solutions. Thus they form the basis for 3D plans and views and for different visualizations.

These data are available in the long term and in a freely selectable level of detail.

They allow for a diverse usage in shipbuilding applications, such as:

- Digitising and upgrading complex entities such as shipyards, ship hulls, engine rooms, electrical systems and piping.
- Aiding ship design, construction and assembly.
- Assisting repair and inspection activities.
- Producing volume calculations of engine rooms for retrofit purposes.
- Ensuring quality inspections e.g. clash detection during installations.

Both the FARO Focus3D and the accompanying SCENE software are compatible with all commonly used software applications in the shipbuilding industry such as ShipConstructor, AVEVA, AutoCAD, Inventor, Navisworks, Catia, Bentley Microstation, NX and Pointools.

The powerful FARO Laser Scanner Focus3D captures the as-is status in 360 degrees and provides the necessary data reliably and quickly.

Benefits

- A fast and reliable technology to capture complex as-built status in any type of entity or structure.
- Detailed 3-dimensional information of the actual conditions.
- Risk minimisation in projects where access is difficult and schedules are tight.
- Greater automation and fast visualization increase collaboration anywhere in the world.
- 3D laser scanning is quicker and more accurate than traditional manual measurements. Time can be shortened from days – when done manually – to a few hours.
As-built documentation

Optimising planning and decision-making processes

As-built surveys using 3D laser scanning technology, such as the FARO Laser Scanner Focus3D, provide users with detailed point clouds which enable 3D modelling for diverse tasks including ship reconstruction, hull layout and enhanced data presentation.

For most existing vessels, the drawings or CAD models are often inaccurate, out-of-date or not available at all. Manufacturing of equipment based on inaccurate drawings causes inaccurate fit and costly rework.

3D laser scanning and 3D modelling allow for optimal and applied design which in turn allows for advanced planning. This means more time can be spent on the development of specifications, the pre-fabrication of equipment and the establishment of an installation procedure.

3D models can also be used to optimise the decision-making process. Shipyards and ship-owners are in a better position to assess space, and special requirements.

Benefits

- 3D laser scanning solutions offer naval architects and engineers, realistic modelling data of their vessels and shipyards to ensure correct design updates, saving both time and money.
- The ultraportable design combined with SD card storage of the FARO Focus3D makes it possible to measure on-board while the ship is at sea.
- 3D modelling offers ship-owners as-built documentation when the 3D model owned by the shipbuilder cannot be shared, due to copyright issues.
Assembly

3D data for constructing pre-built sections

Whether for inspection, construction or assembly – the FARO Focus3D measures structures and components of every possible shape and size and produces precise three-dimensional data.

Block construction is a method which involves the assembly of pre-built sections. With 3D laser scan data the size of the various sections can be measured. In the shipyard’s dry-dock these sections are pulled into position and attached.

When applied to existing vessels, a prefabricated hull block is inserted after the hull is split in half. Shipyards can even pre-install pipes, plumbing, and wiring into these pre-built sections.

3D laser scanning can also be used for 3D CAD comparison. By scanning the existing structure the as-built data can be compared with the CAD reference file. Via this method inconsistencies can be efficiently adjusted in all phases of the construction process.

Easy to operate

Thanks to its intuitive control concept with touchscreen display, the FARO Focus3D is as easy to operate as a digital camera. The device also operates fully independently – no additional equipment, cables or laptops are required.

Benefits

- Whole hull sections can be prefabricated using the scanned data.
- 3D laser scanning ensures faster and more efficient assembly of block constructions.
- The as-built data can be compared with the CAD reference file, showing discrepancies before assembly.
Ship repair

3D modeling and inspection

In digitising hulls and other components, the FARO Laser Scanner Focus captures as-built documentation for inspection, repair and restoration purposes.

Identifying the actual state of a vessel is a necessity during large scale ship repairs. Comparing a 3D model of the desired state with an accurate laser scan model of the vessel’s existing structure allows for the accurate design and prefabrication of new parts and sections.

When the vessel reaches the repair dock, the refit design, materials procurement and fabrication work can already be completed, minimizing time out of service.

Owners of older vessels are frequently confronted with repairs. They have an immediate benefit from 3D laser scanning since operational disruption is kept at a minimum. In case of new-builds 3D scans are used to track and inspect the state of the vessel from day one.

Laser scanning also emerges as an efficient alternative to control surface degradation. As corrosion is one of the most critical and recurrent types of vessel deprivation, the inspection and determination of the severity of corrosion allows for the appropriate action to be taken.

3D laser scanning can define the precise extent of corrosion by taking point-by-point measurements. Moreover, it produces photo-realistic images that offers an accurate visual record.

Benefits

- Early availability of accurate 3D scan data enables shipyards to start the fabrication process before the vessel’s arrival in the repair yard, increasing productivity.
- Planners and designers use scan data to visualise possible pipe and cable routes regarding new equipment.
- 3D laser scanning reduces commercial risk, delivering timely repairs, and increased profitability.
BWTS-Retrofit

An efficient solution for space constraints

Legislation requires the installation of Ballast Water Treatment Systems (BWTS) on-board all ocean-going vessels. This Convention requires compliance by all ships and offshore structures designed to carry ballast water, regardless of their age or size.

BWTS retrofitting comes with a number of challenges regarding space and time. No engine room is the same making installation for each ship unique. 3D laser scanning can overcome these challenges by scanning the congested space in engine rooms.

Once the FARO Focus has captured the data points of the target area, a 3D model can be created using accompanying software. The point cloud generated by the scan is put directly into a 3D CAD program to start modeling the BWTS into the existing space.

A preliminary design conveys the existing outfits that may be impacted by the new equipment installations and piping runs. The new ballast water treatment system and its piping route can then be planned and integrated into existing structures.

The detailed design phase includes system and isometric drawings in order to select the right treatment system and to have it pre-built. The data set shows exactly where the new system should be installed.

Benefits

- More accurate, complete as-built data for retrofit design projects translates into better designs.
- Complex piping routing in an engine room can be easily identified using photo-realistic 3D scans.
- After installation ship-owners are left with an accurate as-built of their ships.
Accurate recording

The high-level precision of laser measurement is key to the high-quality 3D documentation achieved with the FARO Laser Scanner Focus 3D.

Benefits

- Overall design needs only to be done once.
- Scanning of each vessel can be done at sea.
- Out of service time is minimised as there is no need for redesign during fit-out phase.

Sister vessels

Installation engineering

Sister-vessels share a near-identical hull and superstructure layout, similar displacement, and roughly comparable features and equipment. Often, sister vessels become more differentiated over-time as their equipment is separately upgraded or restored.

3D laser scanning can be cost effective during the work on sister-vessels. During this process the design is done once while every vessel is scanned. The design can then be checked against the scan of each sister vessel.

The goal of this type of installation process is to reduce the need for costly on-site redesign. Comparing scan data to the actual as-built state of each vessel allows for redesign to be done before the on-site work begins and even before fabrication of parts.
FARO Laser Scanner Focus 3D

Five steps of 3D documentation

1. Setup

After only two minutes setup time, the FARO Focus 3D is ready to scan: It can be easily and quickly mounted on a tripod – just like a normal camera. No external devices such as laptops or batteries are required. Before the first scan is started, the coordinates have to be defined. Registration markers are easily positioned, so that the individual scans can subsequently be combined.

2. Recording data

The project can be created in advance on the PC in the office and the individual settings pre-defined. Alternatively both can be carried out directly on the FARO Focus3D with its easy-to-use touchscreen. The FARO Focus3D is well-known for its short measuring times: it takes between two and fifteen minutes for a scan, depending on the required resolution, depth of detail, colour or black-and-white scan.

3. Data analysis in SCENE

The individual scans of a project can be combined almost automatically with the help of the registration markers and the SCENE software. In SCENE it is also possible to remove any irrelevant scan information and reduce the data volume. The GPS and compass integrated in the FARO Focus 3D, the altitude sensor and the dual-axis compensator greatly reduce manual post-processing.

4. Wide-ranging applications

The SCENE software enables the scan data to be transferred to all commonly available CAD software solutions for architecture, construction engineering, shipbuilding, marine engineering, and surveying. The scan data is thus available for 2D applications and 3D visualisations of all kinds.

5. Global collaboration

With SCENE WebShare Cloud, laser scans and additional information such as CAD drawings, photographs or floor plans can quickly be shared via the internet with the push of a button. That makes collaboration with others involved in the project much easier. WebShare access is carried out via a standard internet browser. Direct measurements can also be done there. In this way all the project partners can work on data simultaneously, which significantly speeds up the processes.

Measuring method

Distance

The laser scanner transmits a laser beam, which is reflected by an object back to the scanner. The distance is measured with millimetre precision by means of the phase difference between the transmitted and received beams.

Vertical angle

The mirror directs the laser beam through the space in a vertical direction. The angle is recorded at the same time as the distance measurement.

Horizontal angle

The laser scanner turns horizontally through 360° while scanning. The horizontal angle is recorded at the same time as the distance measurement.

Defining the 3D coordinates

Distance, vertical angle and horizontal angle result in polar coordinate $(d, \alpha, \beta)$, which are converted into cartesian coordinates $(x, y, z)$. 
Product information

FARO Laser Scanner Focus3D X 330 and Focus3D X 130

- Range: Focus3D X 330: 0.6m – 330m; Focus3D X 130: 0.6 – 130m
- Size: 24 x 20 x 10cm;
- Weight: 5.2kg
- Scan duration, standard scan: b/w: approx. 2min, colour: approx. 5min
- Systematic distance error: ± 2mm
- Can be operated without any external devices
- Intuitive touchscreen
- Integrated colour camera with automatic, parallax-free colour overlay for photo-realistic 3D colour scans
- High-performance lithium-ion battery for recordings up to 4.5 hours; charging while in operation possible
- SD-card for easy and secure data transfer to the PC
- GPS, integrated compass, altitude sensor and dual-axis compensator simplify the combination of scans
- Seamless integration into ShipConstructor, AVEVA, AutoCAD, Inventor, Navisworks, Catia, NX, Bentley Microstation, Pointools and many others.

SCENE to CAD

From the production of a point cloud to a CAD model

The individual scans of a project can be automatically combined in the SCENE software. The recorded scenery can be viewed in three dimensions in SCENE and measurements can be taken with simple tools directly in the scan data. All the scans are also available in colour and as high-contrast intensity images. In SCENE it is also possible to remove any irrelevant scan information and reduce the data volume.

After the scan data has been prepared in SCENE, it can be transferred with no difficulty to a large number of commonly available CAD systems (such as ShipConstructor, AVEVA, AutoCAD, Inventor, Navisworks, Catia, NX, Pointools).
Shipbuilding & Marine Engineering