Coda Octopus
Sound Underwater Intelligence

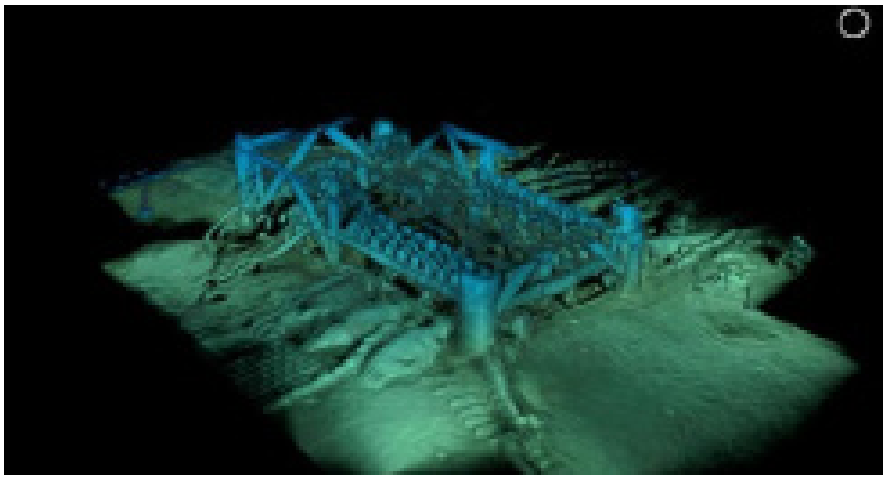
CodaOctopus® Underwater Survey Explorer ("USE") Overview

Version 1.9.11.20

Product Summary

CodaOctopus® Underwater Survey Explorer (USE)

Benefits
Real-time visualization software for Echoscope 3D sonars and Echoscope® Air topside cameras
Patented rendering techniques for clear, noise-free enhanced 3D imagery
Modern, customizable user interface for ease of operation and work-flow
Feature-rich tools for real-time outputs, reporting and data deliverables
Additional software modules to enhance capabilities for specific applications
Over 90% of feature set can be used in real-time LIVE mode as well as Replay and Post-Processing
Expert 24x7 Technical Support



Real-Time 3D Visualization Software

USE is a state-of- the-art software package used for:

- Controlling and capturing data from our real-time 3D range of sonars and Echoscope® Air topside cameras
- Controlling and capturing positioning data from our range of 3D Rotators (IPT and ISAR)
- Controlling and capturing motion data from our range of F180 and F280 GNSS Aided INS systems
- Capturing real time navigation, attitude and environmental data from industry standard motion and positioning sensors
- Displaying real time Live 3D data
- Displaying 3D Models, 3D Maps and mosaics
- Processing and filtering real time 3D data; and
- Reporting on real time 3D data which is collected.

USE which embeds many innovative techniques, some protected by patents, is an industry standard package which is widely used for many applications including:

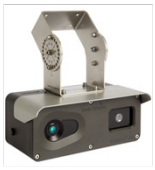
- Cable touch down monitoring
- Complex structural survey
- Critical asset inspection
- Change detection assessment
- Bridge Inspection
- Dredge monitoring
- Oil and gas leak detection
- Port and harbour security
- Trenching and rock dumping
- Diver inspection, safety and support
- Accurate asset placement
- Pipeline survey

Product Summary

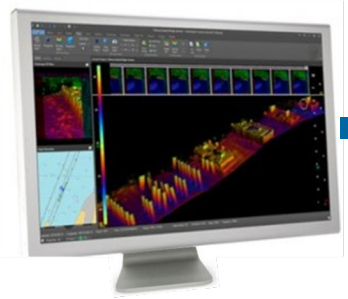
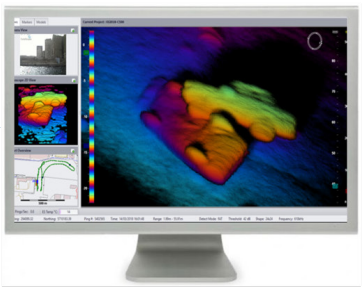
Equipment to Live Deliverables

CodaOctopus®: **Sensor Family**





CodaOctopus®: **LIVE Application Software**


Underwater Survey Explorer (USE) and DIU

System control, acquisition, and processing software

3D Survey Monitor

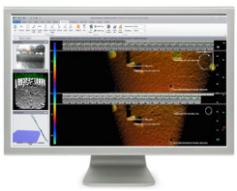
Real-Time 3D viewer to monitor live operations on one or more independent computers

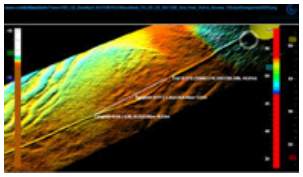
Vantage

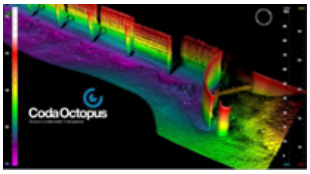
Multi-Aspect Real-Time 3D viewer to monitor live ROV and Vehicle operations on one or more independent computers

CodaOctopus®: **Deliverables**

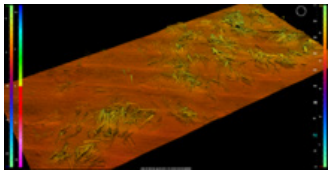

3D Survey Viewer


Baseline Comparison


3D Markers & Images



3D Volumetric Models


3D XYZ Exporting

USE Features

USE Software has many powerful features which are designed to enhance the efficiency of capturing good quality data and precise engineering tools for preparing and reporting on project deliverables. Some of these options include:

- Live tagging
- Making, editing and output of 3D markers
- Multiple real time perspective viewing
- Live 3D measurements and multi-point feature tagging with exporting
- Beam-to-beam editing and data filtering
- 3D data and real time measurements exchange with third party navigation systems
- Saved mosaics of areas of interest or entire survey with data cleaning and filtering tools
- Inclusion of numerous XYZ point cloud output methods compatible with 3rd party tools
- Volumetric rendering engine allowing for data to be rendered as a textured model with much higher resolution

Did You Know...

How USE Improves Subsea Applications

Live Mode

Live mode enables users to view and record real-time 3D Echoscope sonar and Echoscope® Air topside camera data. All sonar and camera parameters can also be modified on-the-fly, with real-time preview showing the impact of your changes. Coda Octopus strongly advocates the use of feature-rich tools and capabilities in Live mode to assist with operations and to collect the cleanest data in real-time, significantly reducing the need for post-processing and data cleaning! This efficiency driven approach means that over 90% of the feature set in USE is available in LIVE mode including deliverables production during or in between survey lines!

Live data is not restricted to just the Echoscope family of sonars, our UIS (Underwater Inspection System) solutions allow capture and recording from our above water camera system which can be invaluable for marine construction and inspection applications. To assist with enhanced spatial awareness, we can also take position and motion data from multiple other sensors or platforms to visualize these in real-time with 3D moving models. This for example would allow an Echoscope mounted to an ROV to also visualize where the surface vessel is or the location of divers and other tracked assets in real-time.

Replay Mode

Replay mode is used for offline review of previously acquired Echoscope sonar data and to produce additional deliverables not performed in Live mode. Replay not only allows spatial query of all the data collected, to make simply maps and mosaics of specific areas in the survey, but allows real-time playback of the Echoscope® data for video output and analysis to show and analyse live events such as a mattress placement over a pipeline. Projects and datasets can be merged allowing the user to combine fragmented projects into a single, encompassing project, or split to allow efficient export of a single event or survey line for engineering review.

Though we strive to minimize the workflow and effort from data collection to deliverable, for those occasions where Navigation dropped, incorrect offsets or settings were applied, or a tighter reprocessed navigation solution from an ROV or AUV survey is available, USE provides a powerful NAV corrections suite to correct and immediately visualise and re-output all deliverables. Some corrections, such as Patch Values and Sound Velocity adjustment are available with Live Instant Preview – allowing the user to watch their mosaic data instantly become sharper and more accurate!

Live Reporting

Communication in Live operations is vital for efficiency, safety, and accuracy. USE allows the user to instantly report on findings in real time through the use of our 3D Markers features These Markers are bookmarks or snapshots of either moving events or specific features seen in the data. The Markers can then be visually adjusted to show the 3D data in the most intuitive way and measurements and annotation can also be added to further reflect the engineering data that is required to be conveyed. The Marker is automatically saved in the project but can be saved as an industry standard PDF at any point and emailed to remote workers whilst still at the scene.

When working in mor complex operational situations with additional sensors, systems or machinery it is very important to be able to quickly exchange measurement, waypoint and feature data with these other systems. In real-time USE can output LIVE measurement data, waypoint or target measures such as Touch Down Points on a Cable Lay project or live navigational data such as the location of the Sonar and the vessel platform allowing other charting systems to precisely know the location of the Echoscope systems and see live measurement points. Data is exchanged over serial or Ethernet in a simple documented telegram which can be easily read by most 3rd party systems.

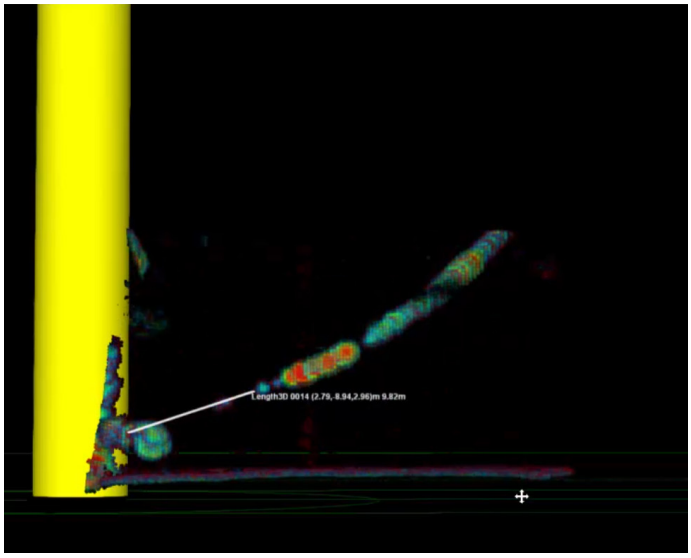


Figure 1: Cable pull in during a Windfarm installation. Cable distance from the entry location on the monopile, bend radius and height off seabed can be reported.

Did You Know...

How USE Improves Subsea Applications

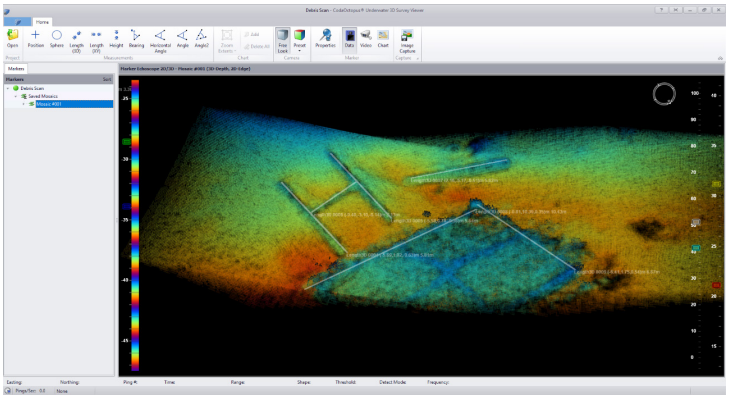


Figure 2: Example of a Debris Scan being viewed in 3DSV. The Simplified Interface with measure Tools is Shown.

3D Survey Viewer

3D Survey Viewer is an end-customer viewer that utilises the same powerful 3D rendering engine but with a very simple set of controls to look, measure and review final deliverables from a project. This is the final step in most projects with the survey or processing team exporting their Markers, Mosaics and Volume Models in final form to a 3DSV (3D Survey Viewer) single project file that can be emailed or uploaded to the review team.

3D Survey Viewer is a separate program to USE. It can be installed on a client or customer's PC without any need for a USE dongle or license. As standard our Coda Octopus Rental Program provides a 3D Survey Viewer License at the end of the rental to allow customers to continue to review their final deliverables.

Vantage Visualization Module (VVM)

Similar in concept to 3D Survey Monitor, Vantage Visualization Module is specifically aimed at ROV and vehicle control applications where the vehicle operator requires a multi-aspect view of the Live data without the need to touch the display or adjust visual controls – a simple hands-free visualization system. The user can configure up to 4 different views of the same real-time data – essential for ROV and vehicle manipulation and control. The views include a top-down "birds eye" perspective similar to traditional sector scan system and is useful ranging, a Side Profile view useful for obstacle avoidance and altitude planning, a Front View which puts the viewers "eyes" directly on the front of the vehicle for a 1st person perspective view and finally our patented 3D view which can be oriented, zoomed and panned at will by the user.

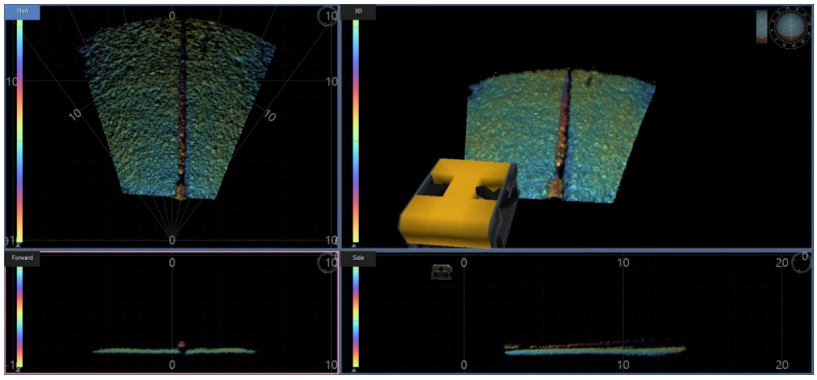


Figure 3: The Quad View of Vantage

The Vantage Visualization Module is an additional module to Underwater Survey Explorer. Using the Combined USE and Vantage Visualization Module – the ROV Pilot can use this to fly the ROV while the Survey Team can also simultaneously utilize Underwater Survey Explorer for survey tasks (e.g. markers, measurement etc). You will need a second processor to run Vantage. This Software Package can be used in two independent Display Screens.

Did You Know...

How USE Improves Subsea Applications

View

Simultaneously, the user may view the interactive 2D and 3D displays, chart view and optional camera view. Inside the 3D view, an online mosaic (≤20 pings) can be seen and an overview mosaic (≤500 pings) can be created to give greater situational awareness.

USE includes several different view styles to tailor the view to the user. Changes in the render styles, point sizes and data coloring allows the view of USE to be altered to suit the user. Users can color their data by range or depth and create custom color palettes to emphasise particular points of interest in their 3D data.

Noise and bad data can be hidden quickly and effectively by varying the number of visible beams in the data as well as using data clips to hide data by depth, range and intensity of the returns.

Corrections

Time stamped Echoscope® data can be adjusted to bring in:

- modified positioning and attitude
- new offsets
- varying speed of sound values
- tidal corrections

Corrected data will ensure Echoscope projects are always as accurate as possible. It is possible to modify projects so that all data is shown to a different vertical datum e.g. MSL, LAT.

Live Targets

Creation of navigation aids using Targets is also possible. These targets are created as simply as the standard measurements in Live mode and assist with vessel manoeuvres.

Target Positions can instantly provide distances and bearings to the selected target.

Target Lines can instantly provide a distance and bearing to the line created as well as a value for how far off the line the vessel is.

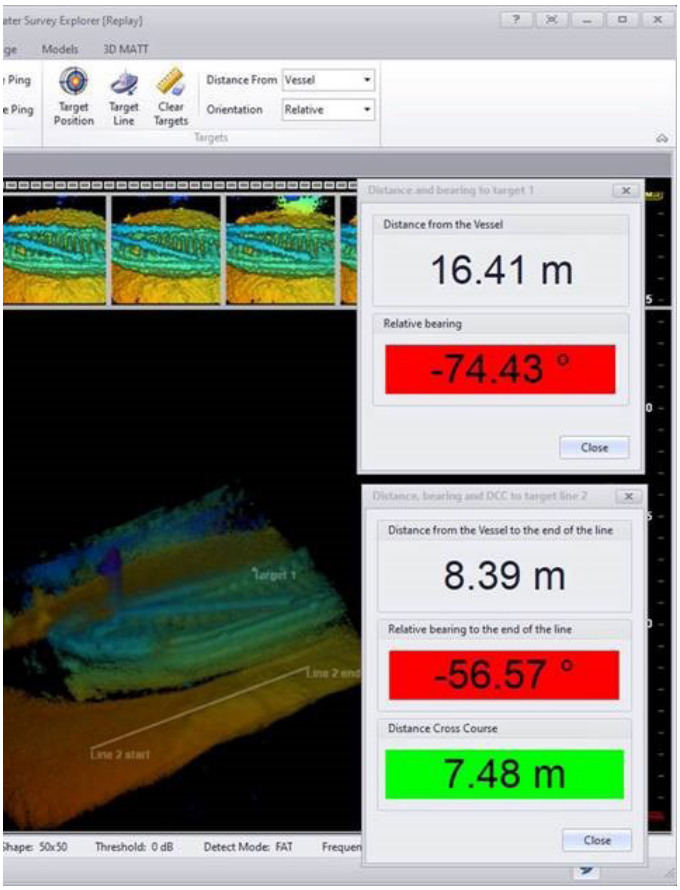


Figure 5: Examples of Target Position and Target Line placed on a shipwreck

Did You Know...

How USE Improves Subsea Applications

Markers

Markers are an eventing tool which can be used to simply create an instant bookmark in the data or compose a detailed, yet concise, output PDF in a few seconds. USE Markers enable the user to save any points of interest discovered during an inspection at the press of a button. These can be reviewed upon completion of the survey or during the survey (without having to pause the inspection). Markers can be quickly output in the form of a PDF file with detailed positional information, annotated images of the 3D view, images of the Chart view along with any descriptive information the user requires to add to the Marker.

3D Survey Monitor

This companion product to USE, 3D Survey Monitor can be licensed and installed on multiple additional computers to allow completely independent view and visualization control of the real-time 3D data in LIVE mode. The USE software and operator remain as the MASTER control for all sonar parameter changes but 3D Survey Monitor is highly beneficial for real-time monitoring from the ship bridge for piloting and navigation, crane and winch operators during real-time construction operations and often we find end-clients and 3rd party auditors wishing to monitor live situational awareness without having interrupt the live operations.

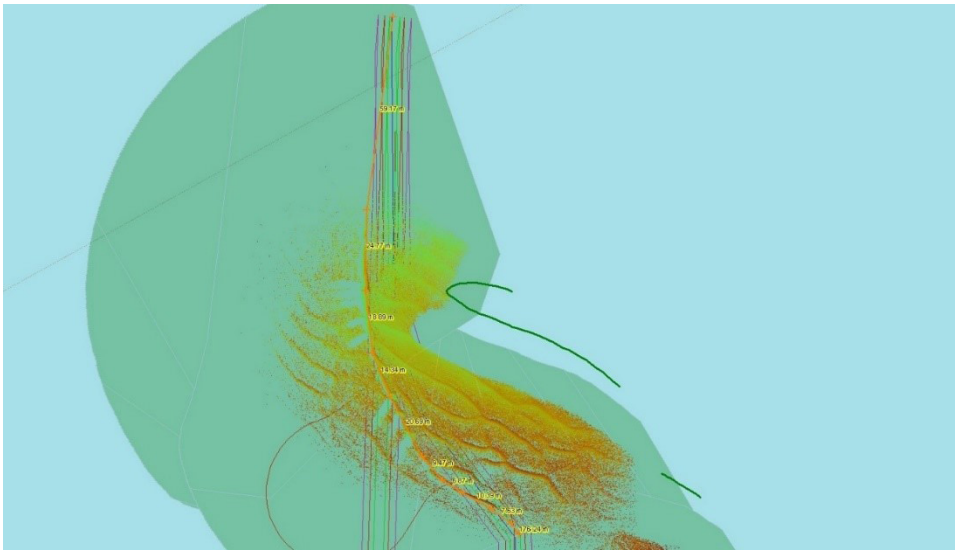


Figure 4: Example of a Chart View with Run Lines, Seabed Image and Sonar Coverage

Chart

The Chart view displays a geographically based chart of the vessel track, Echoscope coverage, marker information and current ping location. The view can be further enhanced by importing marine charts or other geo-referenced data.

Add situational awareness by importing survey lines and visualize these in real-time!

Current ping, Coverage, Track, various Marker information and charts can also be displayed and customized on the Chart View. Display the required information and hide the unnecessary information. Chart view will also show the total area already covered in the survey, allowing a quick estimate of survey coverage.

Did You Know...

How USE Improves Subsea Applications

Rotator

With the use of our Integrated Single-Axis Rotator (ISAR) or Integrated Pan and Tilt (IPT), the project can be optimised. Control the orientation of the rotator to allow for the best view of the chosen target and ideal geometry for the Echoscope® image. Select a point within the project as an area of interest. The rotator can then automatically pan/tilt the sonar to remain focused on this area.

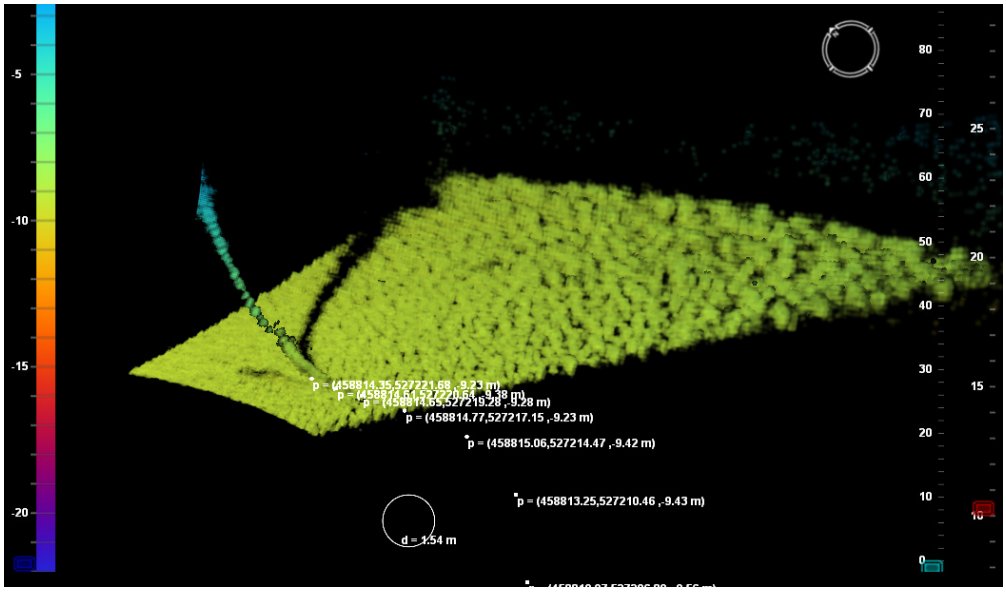


Figure 11: 3D MATT Feature Used to Pick Touch Down Points of a Cable Automatically

3D Multiple Automated Target Tracking (3D MATT)

A real-time multiple target tracker. Users can define a target to be tracked that is visible in the real-time 3D sonar data. Through a set of specifically designed constraints and by allocating the probability extent and the approximate dimensions and speed of the target, 3D MATT can accurately track targets in real-time. 3D MATT is fully aligned with the Echoscope and any object that can be visualized by our sonar can be the subject of tracking by 3D MATT. Some applications include:

Cable Installation & Survey
3D MATT will automatically track and record cable touch down points, an essential aspect of the cable laying operation. 3D MATT removes a monotonous task from the operators' responsibility, and automatically tracks cable touch down points helping maintain a safe and stead tension on the cable as the vessel moves.

Diver Tracking & Support
3D MATT is capable of tracking complex targets such as Divers which change shape dynamically, for example due to changes in the pose of the diver (swimming or walking) or due to the diver exhaling which causes visible bubble streams rising to the surface. Topside personnel can now easily monitor diver progress and safety in real-time with full 3D spatial awareness.

Vehicle Target Tracking
In maritime security and defence applications where the target is not known, or in standard AUV and ROV support operations, 3D MATT, is capable of tracking and recording the full 3D path of these targets simply with additional refinement such as size of the vehicle or speed of movement, even in zero visibility conditions.

Did You Know...

How USE Improves Subsea Applications

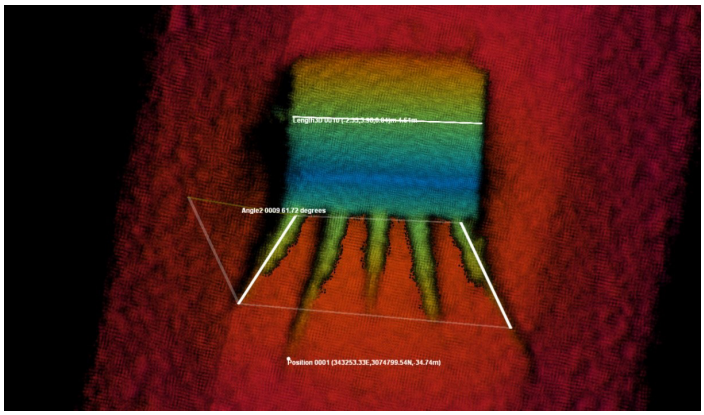


Figure 6: Examples of Measures Taken on Subsea Target

Live and Offline Measurements

USE can measure lengths, angles and take position fixes on 3D data. These can all be completed while acquiring the data in Live mode or when replaying the project in Replay mode. All measurements are completed with simple selections using the mouse.

Patch Test

Linear distances and angular differences measured between the navigation Central Reference Point (CRP) and Echoscope® CRP, entered into the project configuration, are calibrated to align all Echoscope® data recorded.

Different fragments of the project are compared and checked for alignment in multiple planes/datums. The final product is a clear, aligned project with a greater accuracy. An absolute must for any mapping or survey tasks.

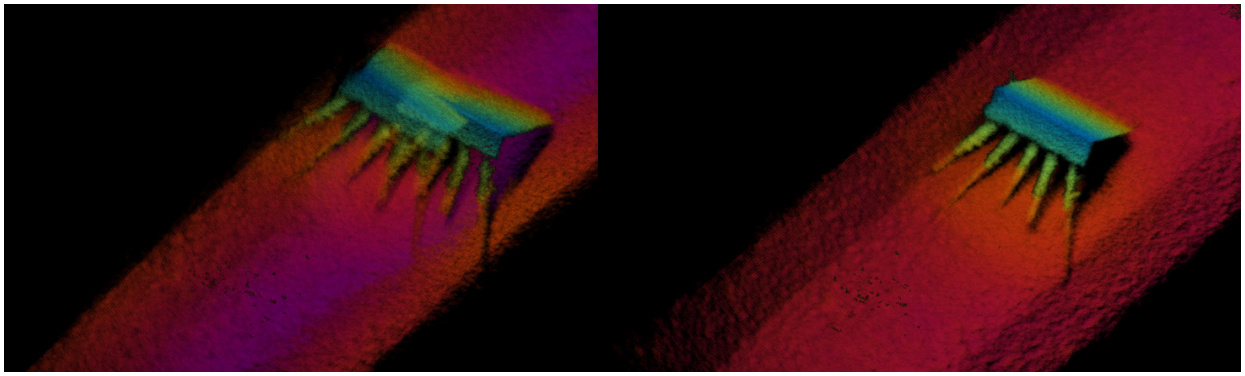


Figure 7: Data Before and After a Patch Test

Baseline Comparison

The Baseline Comparison software module automatically compares data from an area with previously recorded data of that same area to make immediate comparisons. The user can instantly identify underwater features that have either been added or removed from the area of interest.

Data can be compared by opening 2 projects in replay mode or by opening previously recorded data to be compared to the data being acquired in real time.

The Baseline Comparison split viewer gives the user the ability to compare data sets instantly and document any changes in the underwater scene over time.

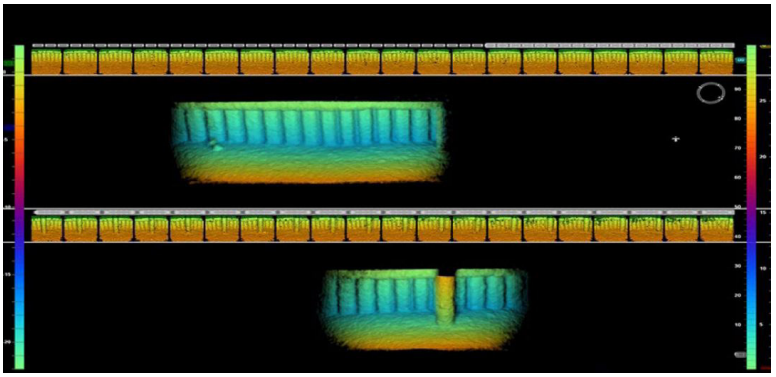


Figure 8: Baseline Comparison Used to Spot a New Feature During a Harbour Scan

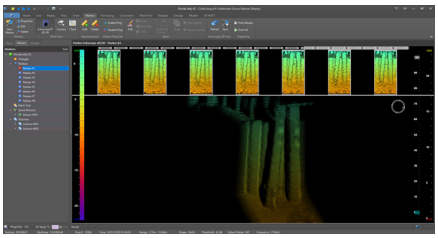
Deliverables

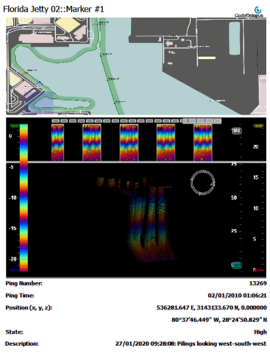
Markers

Create markers during live operations or inspections to revisit for further investigation

Output marker details for client investigation

One Click PDF Generation for Instant Reports

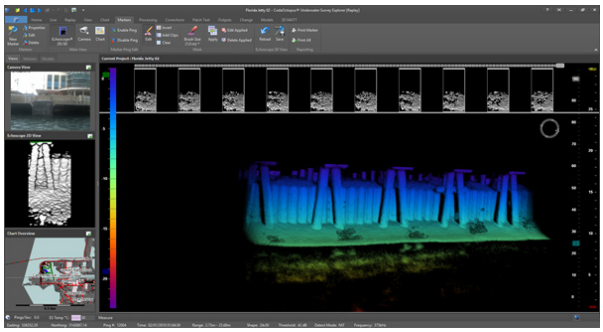




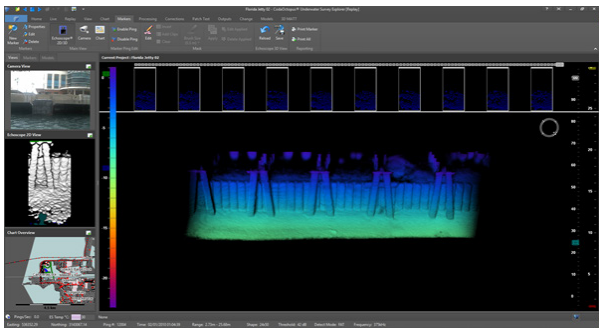
Mosaics

Create 3D images using point cloud data

Manually edit point cloud data to remove noise as desired



BEFORE EDITING



AFTER EDITING

Exporting

XYZ

- Data collected can be output as an XYZ file for use in third party softwares
- These can be raw or binned format

Raw XYZ	This will simply export every ‘dot’ of the mosaic.
Binned XYZ	This will create a point cloud made up of stacked boxes. This is typically the best used for structures with overhanging elements.
Binned XY Raw Z	Grid when viewed on plan but draws every Z value for each of the XY positions. This is best for verticle structures only, e.g. a wall.
Binned XY Binned Z	This simply creates a single Z for every XY position of the grid. Like bathymetric multi-beam data.

2D Images

- Bitmap
- JPEG
- Google Earth KML

Deliverables

Outputs

Image capture outputs are available for quick screenshots of the current view. The image capture can be customised to capture different regions of the screen or to change the image output format.

XYZ point cloud outputs allow 3D Echoscope® data to be exported in a generic point cloud data. This allows data gathered in USE to be viewed in any 3rd party software that uses the XYZ format. Echoscope® data can be combined with other 3D point cloud data to create a more complete 3D environment (e.g. bathymetric scans of a seabed from a multibeam sonar combined with a more complex 3D Echoscope® data set of assets on the seabed or structures).
Various types of binning formats and bin sizes are available.

USE projects can be trimmed down using Export to Project tools. If a small exert of a large project is required, it can be exported to a separate project. Creating a new project with a smaller file size. The exported project then exists inside the original and new projects. A simplified Coda Octopus 3D Survey Viewer project can be created to show static 3D Echoscope® data on PCs that do not have USE installed. Coda Octopus can supply the Underwater Survey Viewer program to customers so that their final customers, clients may view their Echoscope® data without the need of any USE dongles or licensing.

Measurements taken inside the 3D data can be output from USE in real time. Output measurements to a different machine on a UDP or serial string e.g. touchdown points of a cable can be sent to a 3rd party survey software so that the cable touchdown is recorded in USE and by the existing survey spread.

Volumes

The 3D data recorded in USE can be manipulated and edited like point cloud software. A static 3D image can be made into a volume marker. This volume marker can then be edited so that pings inside the marker can removed with a brush tool, creating a final image that can be cleaned of all noise and unnecessary data. Volume markers can also be used to generate models. The data is binned and surfaces are created from the 3D Points. These models can be imported into the 3D environment or exported as a XYZ file.

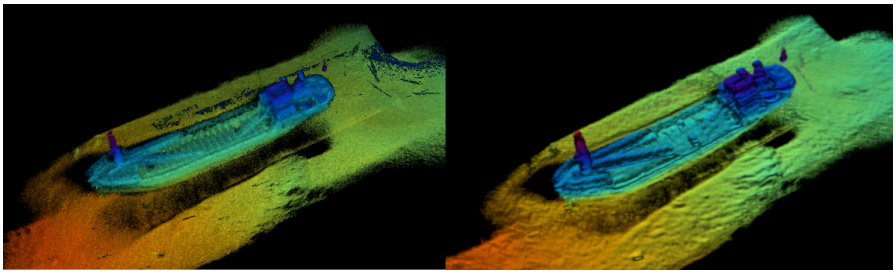


Figure 12: Example of Noisy 3D Data Recorded with Sub-Optimal Sonar Settings. Data is Cleaned and

Models

Models provides the user with the ability to import user-created models into USE's 3D environment. These can be used to enhance the Echoscope sonar data and significantly aid Live and Replay visualization. Add 3D models of pipelines, wind turbine jackets, piles or any other subsea asset at known locations to improve the 3D view for work within offshore construction. Furthermore, the position of multiple models can be controlled and manipulated on-line via a series of incoming navigation and motion matrix strings.

The software can import 3D models in the ".dxf" and ".x" formats. Models can be created in a third party software such as 'AutoCAD'. There are also some pre-set simple shapes available in the software for quick model additions. All models can be controlled via basic transformations (translations, scales, and rotations).

Echoscope® data can be colored based upon vertical distance from the surface of the model. This give a visual guide to depth. For example, a model is inserted into USE to show the target for dredge operations, the dredge operator would then be able to dredge away material until the seabed turns the correct colour. No measurements or readings would be required.

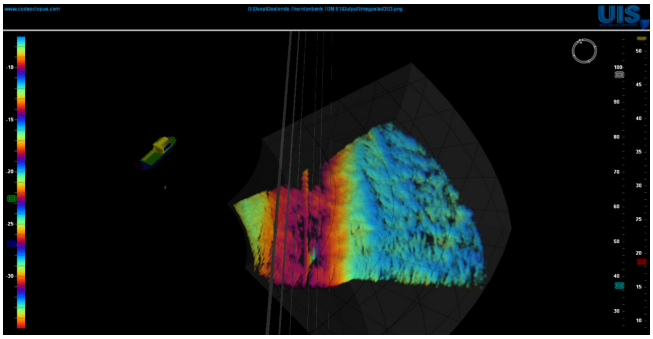


Figure 9: Model Used to Add Cable Lay Corridor to 3D Environment

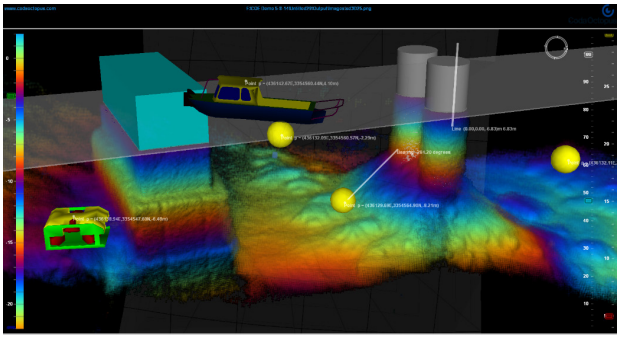


Figure 10: Models Used to Add Context for Bridge Structure, Show a ROV in the Subsea Environment and Highlight Various Targets

How To Access USE Software

USE is available for outright purchase, daily rental, or added to an annual subscription package.

PC Specifications for CodaOctopus® Unerwater Survey Explorer (USE)	
Hardware Requirements revision date	September 9, 2020
Processer	Intel® Core™ i7 Recommended
RAM (Computer Memory)	Minimum 8 GB Recommended
Disk Space (Software)	100MB for installation (approximately 3.0-3.5 GB per hour, dependent on ping rate)
Disk Space (Data Storage)	500 GB Recommended Data storage rate is typically up to 3.5 GB per hour (dependent on ping rate, UIS camera and charts and model data loaded)
Graphics (Laptop/Desktop)	nVidia® Geforce GTX 1060 or higher (Recommended) with 4GB RAM *NOTE: AMD Radeon™ GPUs is not supported.*
Operating System	Microsoft® Windows® 10.
Ethernet (LIVE Operations)	1 x 10/100/1000 Port Minimum 2 x 10/100/1000 Port Recommended
USB 2.0/3.0 ports	3 minimum 6 recommended *USE Dongle requires at least 1 spare USB 2.0 Port for operation in LIVE or REPLAY*