Coda Octopus
Sound Underwater Intelligence

/Echoscope PIPE® Real-Time XYZ

Parallel Intelligent Processing Engine

The World's Most Advanced Real Time Sonars -

First Real Time 5-Dimensional ("5D") and 6-Dimensional ("6D") Sonars.

Multiple Parallel 4D Data Sets Simultaneously for Different Requirements of Underwater Operations in Real Time

Fully embedded Real-Time 4D Sonar with industry standard XYZ data output for Different Requirements of Underwater Operations in Real Time.

The Echoscope PIPE® Real Time XYZ sonar series (available in our C500 form factor and our standard Echoscope form factor) forms part of our OEM and System Integrator offering. The Real-Time XYZ sonars have the full PIPE processing engine embedded but are configured to output PIPE CORE 4D Ping data in an industry standard format for ease of integration and development. The sonar can be converted to a full featured PIPE sonar at any point allowing access to the additional modules including PIPE Sequencer, PIPE FTS, PIPE Multi and PIPE Raw.

PIPE Real-Time XYZ sonars remove the need to use Coda Octopus top end software packages such as CodaOctopus® Underwater Survey Explorer or 4G USE®, instead providing industry standard computed XYZ and Intensity data, direct from the sonar over the network. The sonar outputs speed of sound corrected, local coordinates, (that is relative to the Echoscope® position), for each of the 16,384 beams in every ping. Where required, these can be readily transformed by third-party applications into global coordinates using the platform's navigation system data. The sonar also allows a direct network connection for simple control and status information and so can be readily integrated into autonomous control or user-driven software applications. Since all communications are direct to the network, any Operating System with network support is supported (Windows or Linux). The control interface uses WebSockets while the data interfaces use UDP.

The PIPE Real Time XYZ sonars are delivered with a (Windows Only) Control Application softwre tool that allows full control of the Echoscope PIPE® sonar and allows a simple real-time XYZ preview of the data. The Control Application with the XYZ preview functionality is intended to help Third party integrators check that their own XYZ rendering is correct and help confirm their control software is performing as expected. The previewer also allows some basic controls for the rendering of the XYZ point cloud data. The Echoscope PIPE® XYZ Control software package excludes any Data Acquisition record and replay capability, only allowing real-time visualization and control.

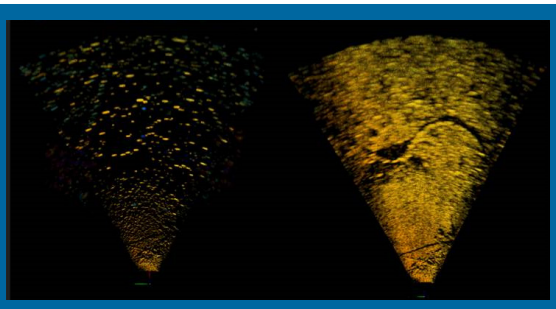

Figure 1: Echoscope® vs Echoscope PIPE®

Figure 1 which is a single ping from our Echoscope® shows the increased density of data from PIPE compared to our previous generation of sonars.

Coda Octopus' PIPE Real Time XYZ Sonars are 5D and 6D sonars because:

- PIPE sonars can capture and process the full time series backscatter 4D acoustic data (128x128x2,500 data points) thus providing 5D data
- PIPE sonars can capture and process multiple 5D images in parallel with different processing parameters thus providing 6D data

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PIPE Real-Time XYZ Features

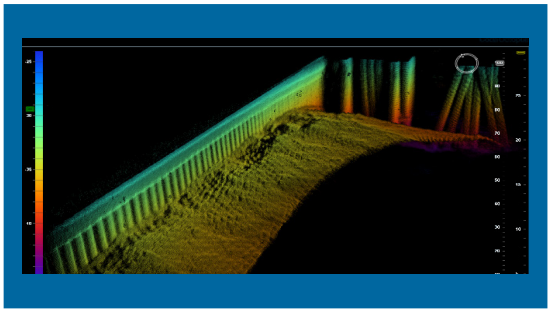
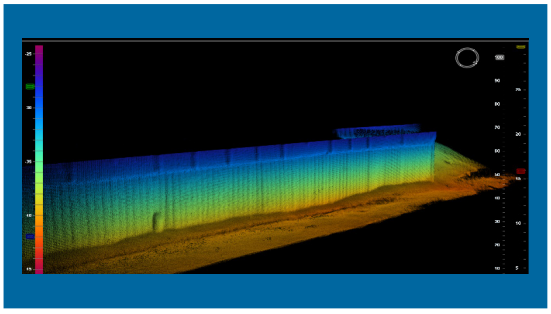
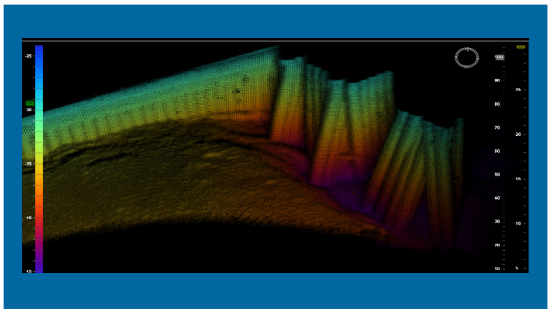
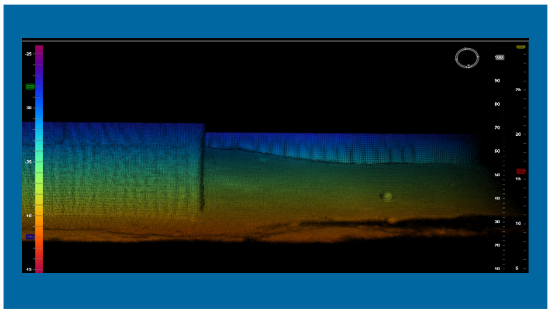
The features of PIPE Real-Time XYZ sonars are designed to increase productivity for underwater operations. Some of the new and innovative PIPE Features are:

Improved and greater dynamic range incorporating full floating-point processing resolution.
Improved Image Processing with greater control and capability over image processing, greater selection of noise suppression, user selected sidelobe rejection filter and extensive array shading
Improved Beam Detection processing utilising full floating-point precision and filtering
Ability to process up to 40 million points to generate 4D images with typically several 100Ks 4D points per ping (depending on the insonified scene) and providing more than 25 times 4D data than our previous generations of real time 3D sonars.
Ability to swap configuration sets instantly ping-to-ping to achieve dynamic frequency, field of view and other capture and processing functions
Multiple real time 4D images with different capture and process parameters which can be accessed and displayed in independent views of the survey operations in real time
Ability to create a sequence of up to 10 different parameter sets for acoustic capture and processing including different frequencies allowing hands free operation for different processing requirements in a single sonar system
Parallel Processing and Display of Real Time Images
Sequential Processing and Display of Real Time Images
Availability of Full Time Series 3D Backscatter Range and Intensity Data comprising up to 40 million data points per acoustic ping (128x128x2,500)
Ability to capture and record raw 3D Full Time Series Data- 40m data points per acoustic ping (128x128x 2,500)
Ability to process offline raw 3D Full Time Series Data
Live Real Time XYZ data point output without using Coda Octopus top end software
Includes Smart Ping Manager that allows a wide range of Frequency, Field of View or Filtering Parameters adaptable in real time

PIPE Real-Time XYZ sonars are available in a number of different models including:

Type	Frequency	Angular Coverage
Dual Frequency Options	375kHz - 425kHz 600kHz - 700kHz	54°x54° – 47°x47° 32°x32° – 28°x28°
Triple Frequency Options	240kHz - 280kHz 375kHz - 425kHz 600kHz - 700kHz	88°x41° – 73°x35° 54°x54° – 47°x47° 32°x32° – 28°x28°

Echoscope PIPE® Data Gallery

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PIPE Real-Time XYZ Applications

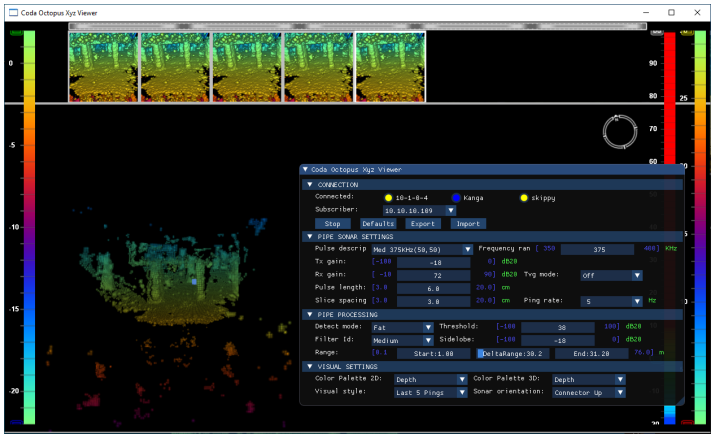

Figure 2: Coda Octopus XYZ Viewer

Echoscope PIPE® Real-Time XYZ Applications

The PIPE Real-Time XYZ sonars are designed for OEM and System Integrators to embed our technology in their own solution platforms. The data format of the Real Time XYZ sonars allows ease of integration with minimal development effort but with the flexibility to use and integrate the real-time data in a variety of industry standard point cloud toolsets. Ideal applications and platform include:

- Embedded ROV Sonar package with control for Obstacle Avoidance and perception mapping in real-time
- AUV Survey Platform for autonomous survey data collection and dynamic target detection
- Robotic 3D machine control for object identification, navigation control and manipulator and sensor guidance
- Closed loop autonomous platforms

Differences between our Standard Echoscope and our new PIPE Real-Time XYZ Sonars

Description	Current Echoscope	PIPE® Sonars
Real Time Capability	Yes, 4D Images	Yes, 4D, 5D and 6D
Angular Cover Dual Frequency	50°x50° and 24°x24°	54°x54° - 47°x47° and 32°x32° - 28°x28°
Adaptive Frequency Capability	No	Yes
Ping Rate	Up to 20Hz	Up to 40Hz
Multiple Real Time 4D Images	No, one single Real Time Image	Capable of Multiple Real Time Images
Number of Data Points per Single Ping	Up to 16,386	Up to 40 million
Number of Beams and Values per Beam	128x128x1 Value	128x128xUp to 2,500 (depending on viewing range)
Multiple Sequential Configuration Files to capture data using different parameters	No Capability	Up to 10 Configuration sets for real time capture and display
Full Time Series Raw Data Capture	No Capability	Capture of Raw Data Capture
Full Time Series Raw Data Offline Processing	No Capability	Capable of Raw Data Offline Processing
Multiple Parallel Beamformed Data Output	No Capability	Capable of Multiple Parallel Beamformed Data Outputs
Smart Ping Manager using Frequency, Field of View, Filtering in Real-Time	No Capability	Capable

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Technical Specifications for the Echoscope PIPE Real-Time XYZ

Performance (by Model)	Dual Frequency	Triple Frequency
Frequency	375kHz, 630 kHz	240kHz, 375kHz, 630 kHz
Adaptive Frequency Band	375kHz: 375kHz – 425kHz 630kHz: 600kHz – 700kHz	240kHz: 240kHz – 280kHz 375kHz: 375kHz – 425kHz 630kHz: 600kHz – 700kHz
Number of beams	128 x 128 x 2,500	128 x 128 x 2,500
Number of Values Per Beam	2,500 (Except PIPE CORE – Please check your sonar variant)	2,500 (Except PIPE CORE – Please check your sonar variant)
Maximum range*	120m (394ft) at 375 kHz 80m (262ft) at 630 kHz *The actual working range will depend on the target's size, reflectivity, and the level of detail required for the application.	150m (492ft) at 240 kHz 120m (394ft) at 375 kHz 80m (262ft) at 630 kHz *The actual working range will depend on the target's size, reflectivity, and the level of detail required for the application.
Minimum range*	0.5m (1.64ft)	0.5m (1.64ft)
Range resolution	3cm (1.2")	3cm (1.2")
Update rate (ping rate)	Up to 40Hz	Up to 40Hz
Angular coverage	375kHz – 425kHz: 54°x54° – 47°x47° 600kHz – 700kHz: 32°x32° – 28°x28°	240kHz – 280kHz: 88°x41° – 73°x35° 375kHz – 425kHz: 54°x54° – 47°x47° 600kHz – 700kHz: 32°x32° – 28°x28°
Beam spacing	375kHz – 425kHz: 0.42°x0.42° – 0.37°x0.37° 600kHz – 700kHz: 0.25°x0.25° - 0.22°x0.22°	240kHz – 280kHz: 0.68°x0.32° – 0.57°x0.27° 375kHz – 425kHz: 0.42°x0.42° – 0.37°x0.37° 600kHz – 700kHz: 0.25°x0.25° – 0.22°x0.22°
*The actual working range will depend on the target's size, reflectivity, and the level of detail required for the application		
Physical		
Dimensions (h x w x d) (excluding connectors and handles)	328mm x 301mm x 151mm (12.9in x 11.83in x 5.94in)	361mm x 301mm x 162mm (14.21in x 11.83in x 6.36in)
Dimensions (h x w x d) (including Echoscope® Protective Cover)	338mm x 311mm x 154mm (13.29in x 12.22in x 6.07in)	366mm x 311mm x 165mm (14.39in x 12.22in x 6.49in)
Weight in Air	20.6 kg (45.5lbs)	22.6kg (46.3lbs)
Power Consumption	3 – 6 A at 24 V DC **An, up to, 10 A inrush for less than 20 µs may occur on start-up.	3 – 6 A at 24 V DC **An, up to, 10 A inrush for less than 20 µs may occur on start-up.
Depth Rating	We supply Sonars rated from 20m (65ft) up to 4000m (13,123ft) – check your packing list containing your Product Certificate which provides details such as depth rating and weight of the actual system purchased. Failure to keep within this depth rating can irretrievably damage the unit.	We supply Sonars rated from 20m (65ft) up to 4000m (13,123ft) – check your packing list containing your Product Certificate which provides details such as depth rating and weight of the actual system purchased. Failure to keep within this depth rating can irretrievably damage the unit.

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