Coda Octopus
Sound Underwater Intelligence

/Echoscope PIPE®
Parallel Intelligent Processing Engine

The World's Most Advanced Real Time Sonars

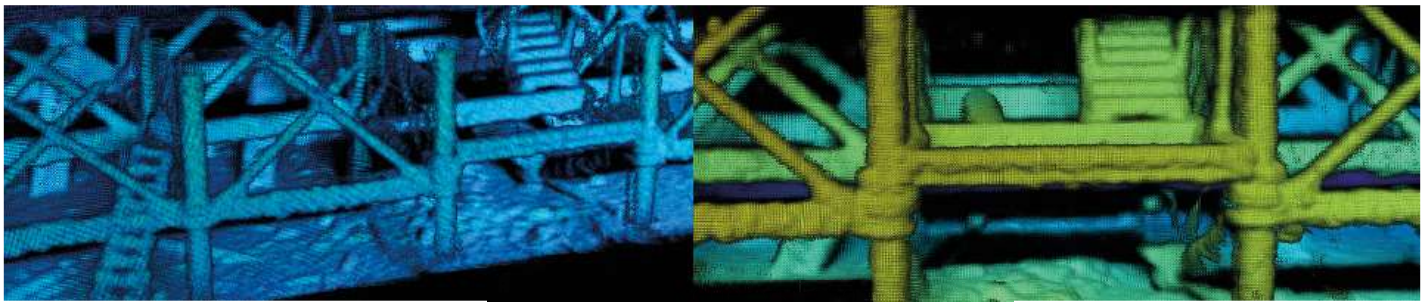
First Real Time 5-Dimensional ("5D") and 6-Dimensional ("6D") Imaging Sonars.



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

Coda Octopus' 5D and 6D Echoscope PIPE® sonar series ("PIPE" sonars) significantly advances its existing real time 3D sonar series with several new and revolutionary innovations. At the heart of the 5D and 6D sonars capability is our new Parallel Intelligent Processing Engine ("PIPE") which significantly increases the amount of data that can be processed and displayed in real time. It is designed to allow independent users, within the same underwater operations, access in real time to multiple parallel and sequential 4D Imaging Outputs. The 4D imaging Outputs can be matched to individual users' requirements by using different acoustic parameters (such as different frequency, range, filters and processing), thus providing a true multi-sensor platform from a single sonar deployment.

The PIPE Processing engine which sits at the heart of this new generation of imaging sonars can capture, process and display in real time significantly higher data density with multiple parallel outputs and much higher ping rates. In addition, increased processing capability allows more advanced beamforming algorithms including phase-based processing resulting in more accurate bottom detection. An innovation of the PIPE series includes 3D full time-series data offering the capability to process up to 81 million points per ping (180x180x2500), to generate 4D images with typically several 100Ks 4D points per ping (depending on the insonified scene).



Coda Octopus' PIPE 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 Features

Some of the new and innovative PIPE Features (which are user selectable in real-time) are:

Improved Beam Detection through phase-based processing (split-aperture), greater dynamic range and 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
Increased Beam Density up to 180x180 compared to 128x128 (in our previous generation of sonars)
Advanced Beamforming Mode allowing users to change beamforming method. Field of View (FoV) Focusing and Beam Density (number of beams applied to an underwater target to maximize the resolution and image definition)
Live Real Time XYZ data point output using Coda Octopus top end software. Live Real-Time XYZ data point output also available direct from sonar with new OEM Option.
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
Parallel Processing and Display of Real Time Images
Availability of Full Time Series 3D Backscatter Range and Intensity Data comprising millions of data points per acoustic ping

New Features: Additional Module Required

Core

PIPE: Core Module

This module is common to all Echoscope PIPE® sonar systems and provides the core functionality including enhanced dynamic range, improved image processing and advanced beamforming with dynamic frequency and beam density adjustment in real-time.

Sequencer

PIPE: SEQUENCER Module

This module allows users to create a sequence of up to 10 different parameter sets for acoustic capture and processing including different frequencies allowing hands free multi-application data collection from a single deployed sonar system.
** Only available in 4G USE® Software Package

Full Time Series

PIPE: FULL TIME SERIES Module (5D Capability)

This module provides the ability to capture and record raw 3D Full Time Series Data up to 81 million data points per acoustic ping. This FTS capability is highly beneficial for seabed coverage surveying and volumetric analysis of water column data.
** Only available in 4G USE® Software Package

Raw

Multiple 4D and 5D Images and RAW Data (6D Capability)

This module offers the ability to log RAW acoustic data and process multiple 4D images and 5D images with different imaging and acoustic parameters offline. With RAW data processing the user is in control of reprocessing any recorded data to extract required results and is highly beneficial on autonomous platforms with no human in the loop for QC and data visualization in real-time.
** Only available in 4G USE® Software Package

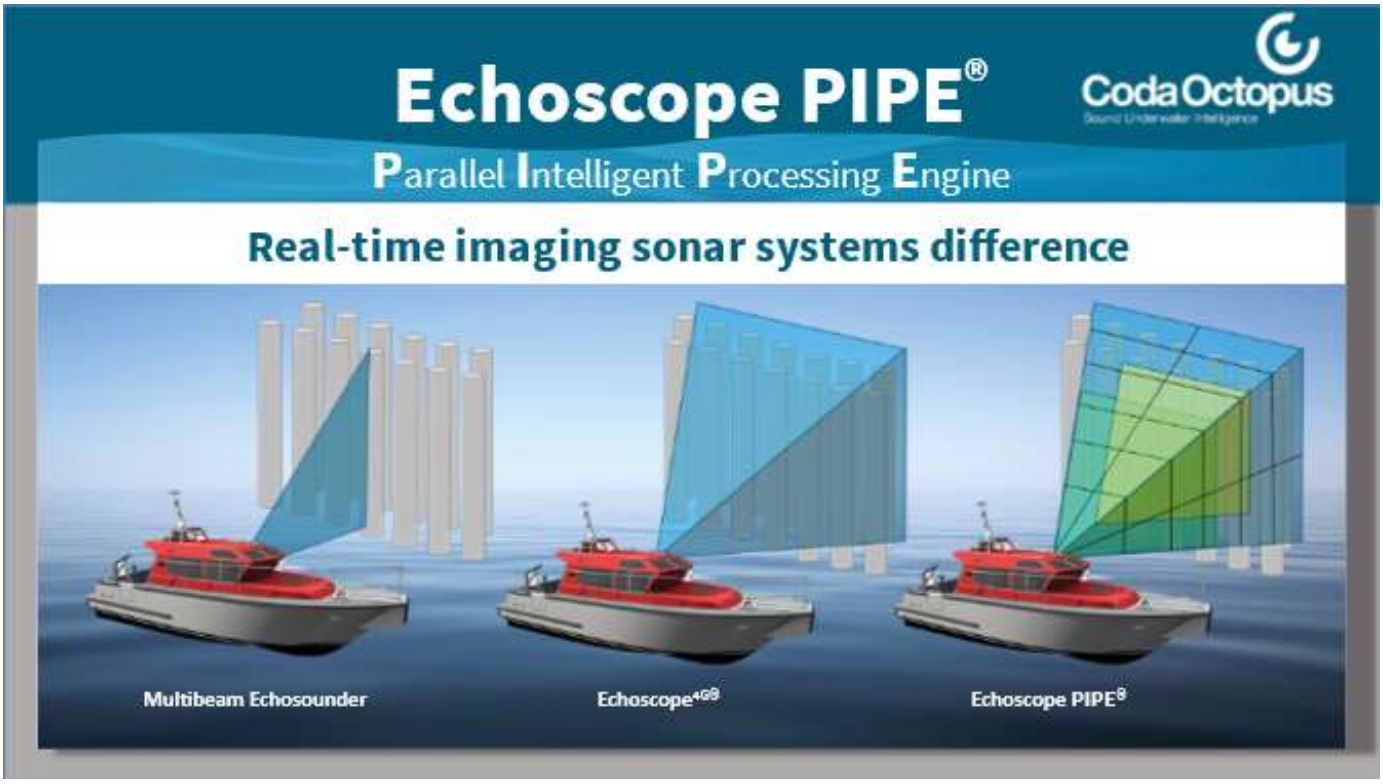
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Evolution of 5D and 6D Sonar

	Echoscope® 3rd Generation of Sonars	Echoscope PIPE® Sonars	
3D Shape 3D XYZ Data	**Real-Time 3D 4D** Time Moving Objects	**5D** Depth Time Series	**6D** PIPE Parallel Intelligent Processing Engine
3D Imaging typically is the scanning of an object of a sequence of images to construct a 3D Shape. The limitation of this approach is the inability to see any moving objects and having high dependancy of a stable platform to perform the imaging.	4D Volumetric Images represent a true volume of spatial data collected and processed at the same instant. Sequential 4D Volumetric Images represent a time sequence of the scene showing moving objects within the volumetric image.	5D Images are 4D Images represented with multiple slices of depth data - similar to a medical CT Scan. The 5D Images contain more depth information, detail and resolution of each target and sequential 5D Images over time show higher resolution moving targets	6D PIPE allows multiple parallel 5D images to be generated with different imaging and sonar parameters. This allows different processing to be performed on the RAW sonar data in parallel and extract more specific results without compromise.

Technology Competitive Advantages

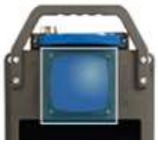
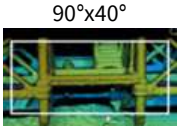
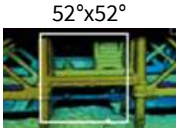
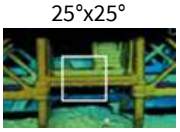
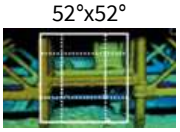


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Differences between our Echoscope4G Imaging Sonars and our Echoscope PIPE® Imaging Sonars (Dual Frequency)

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° - 46°x46° and 33°x33° - 25°x25°
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 Beams and Values per Beam	128x128x1 Value	180x180xUp to 2,500 (depending on viewing range)
Multiple Sequential Configuration Files to capture and display 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
Advanced Beamforming Mode	No Capability	Capable (allowing dynamic change of FoV and number of beams on target (Beam Density), increasing resolution and definition of underwater target.

Acoustic Projector Types

Description	XD Low-Frequency	Mid-Frequency	High-Frequency	XL Wideband
				
Centre Frequency	240kHz	375kHz	630kHz	450kHz
Frequency Range	220kHz – 280kHz	315kHz - 425kHz	550kHz - 700kHz	315kHz - 700kHz
Maximum range	150 m (492ft)	120 m (394ft)	80m (262ft)	120 m (394ft)
*The actual working range will depend on the target's size, reflectivity, and the level of detail required for the application				
Transmit (Tx) Field of View	90°x40° 	52°x52° 	25°x25° 	52°x52° 
Switchable Coverage (Shapes)	Horizontal – Fixed Vertical – Adaptive	Fixed	Fixed	52°x52°, 52°x25°, 25°x52°, 25°x25°

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Technical Specifications for the Echoscope PIPE®

Performance (by Model)	Dual Frequency	Triple Frequency
Acoustic Projectors	Mid-Frequency (375 kHz) and High-Frequency (630kHz)	XD Low-Frequency (240kHz), Mid-Frequency (375 kHz) and High-Frequency (630kHz)
Adaptive Frequency Band	375kHz: 315kHz – 425kHz 630kHz: 550kHz – 700kHz	240kHz: 220kHz – 280kHz 375kHz: 315kHz – 425kHz 630kHz: 550kHz – 700kHz
Number of beams (Density)	Up to 180 x 180	Up to 180 x 180
Number of Values Per Beam	2,500 (Dependent on Features Purchased)	2,500 (Dependent on Features Purchased)
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
Imaging Field of View (User Selectable)	315kHz – 425kHz: 54°x54° – 46°x46° 550kHz – 700kHz: 33°x33° – 25°x25°	220kHz – 280kHz: 100°x44° – 76°x33° 315kHz – 425kHz: 54°x54° – 46°x46° 550kHz – 700kHz: 33°x33° – 25°x25°
Beam Density (Spacing)	315kHz – 425kHz: 0.3°x0.3° – 0.26°x0.26° 550kHz – 700kHz: 0.18°x0.18° - 0.14°x0.14°	220kHz – 280kHz: 0.56°x0.24° – 0.42°x0.18° 315kHz – 425kHz: 0.3°x0.3° – 0.26°x0.26° 550kHz – 700kHz: 0.18°x0.18° – 0.14°x0.14°
*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)	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	21.7 kg (47.8lbs)	22.3kg (49.2lbs)
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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