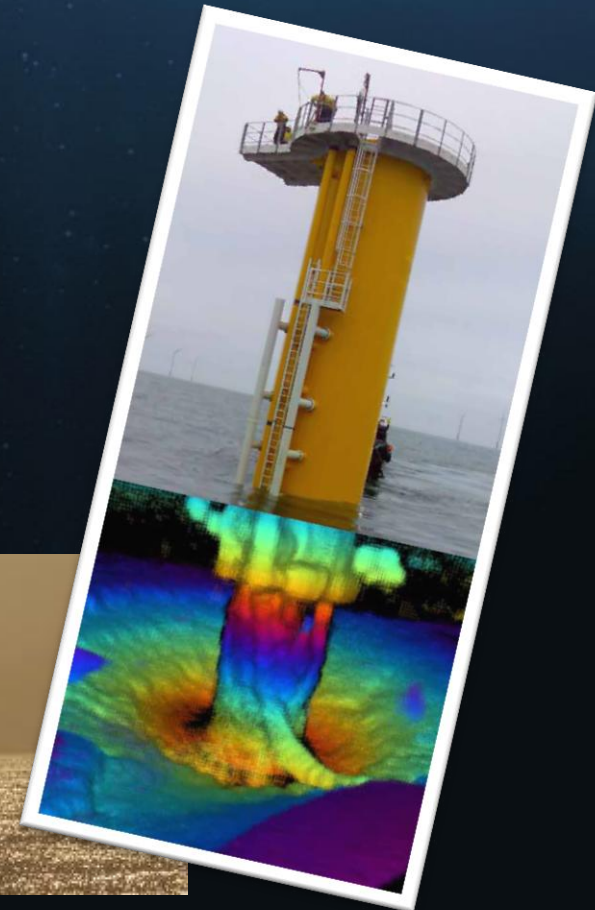


Increased Safety and Efficiency using 3D Real-Time Sonar for Subsea Construction

Blair Cunningham
Chief Technology Officer
CodaOctopus Products, Ltd.



Booth A33a



2D
Imaging

3D
Multibeam

Real-Time 3D
Multibeam Imaging

What's the
difference?

2D, 3D and Real-Time 3D (4D) Sonars?

2D Imaging

Images an intensity volume in front of the sonar as a time series

Typically limited to 20° vertically and provides no depth data = vertical ambiguity

Simple video stream output with no mapping capability

3D Multibeam

Single across-track slice of data prone to acoustic shadow in complex Subsea environments

Mapping requires the platform to move, high quality nav & attitude data and post processing

Cannot visualize or monitor a live or moving scene

Real-Time 3D Multibeam Imaging

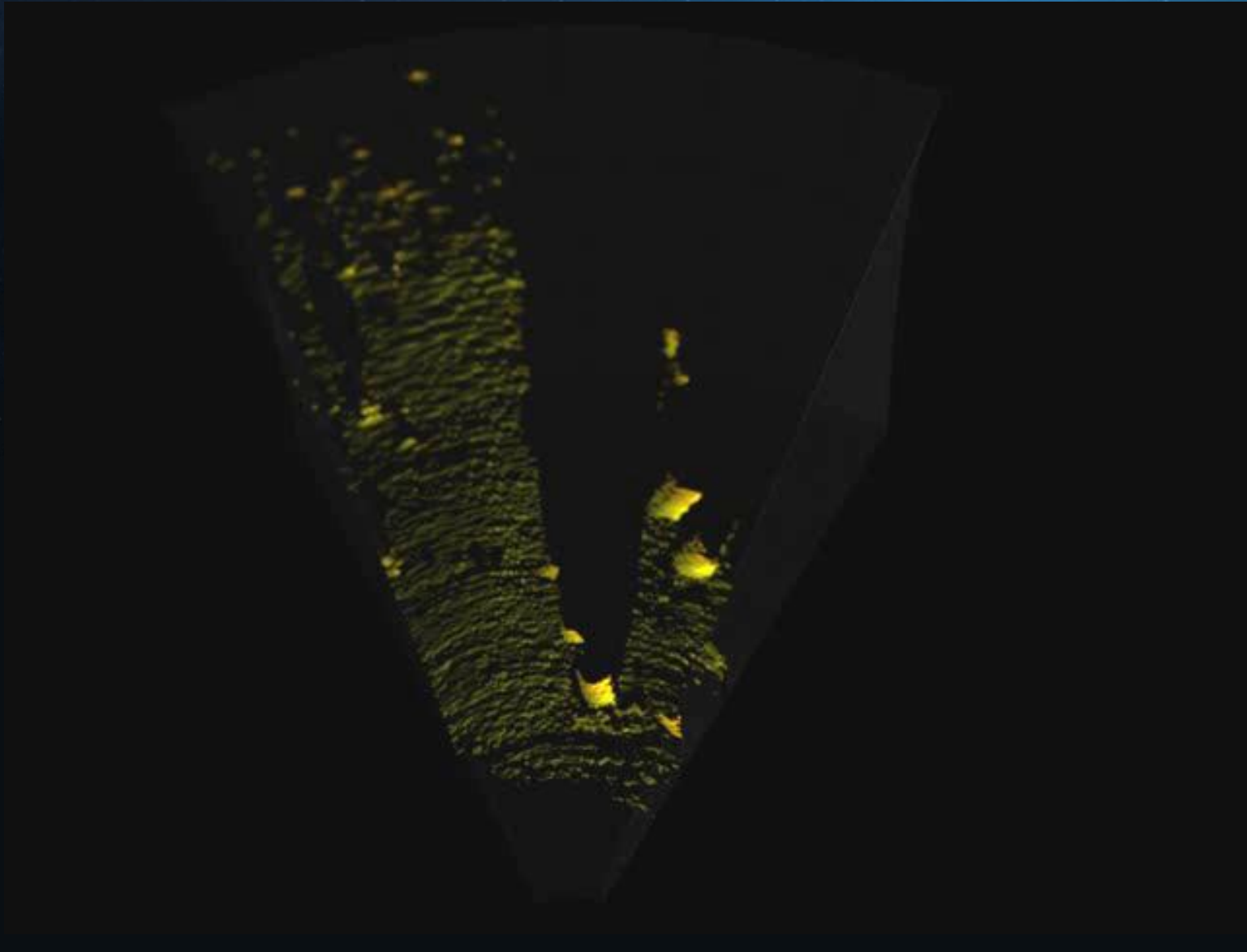
Visualize a complete volume with virtually no acoustic shadow on complex structures

Massive data density typically 40x traditional multibeam for statistical processing

Works equally in moving and static applications

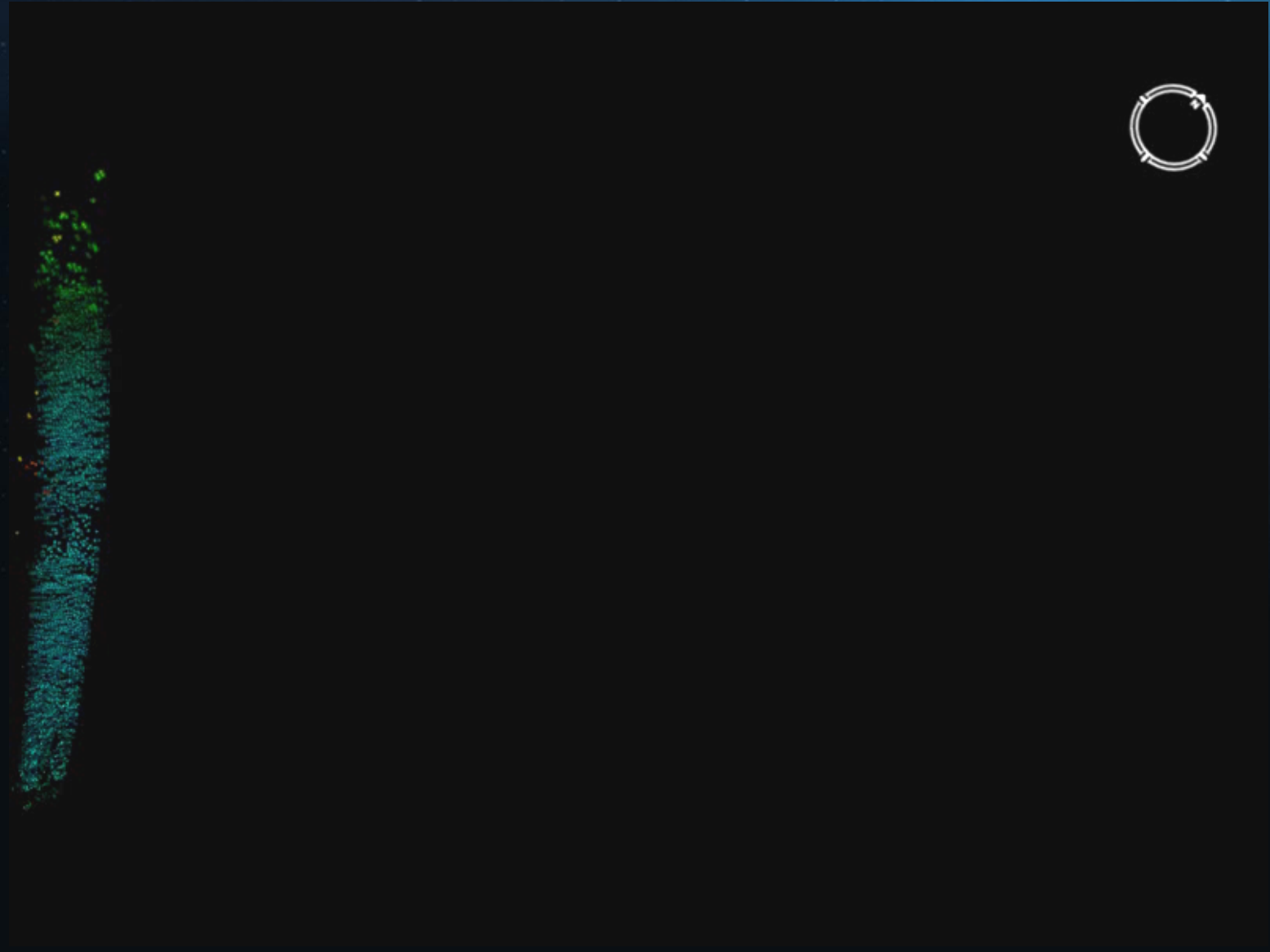
2D, 3D and Real-Time 3D (4D) Sonars?

2D
Imaging



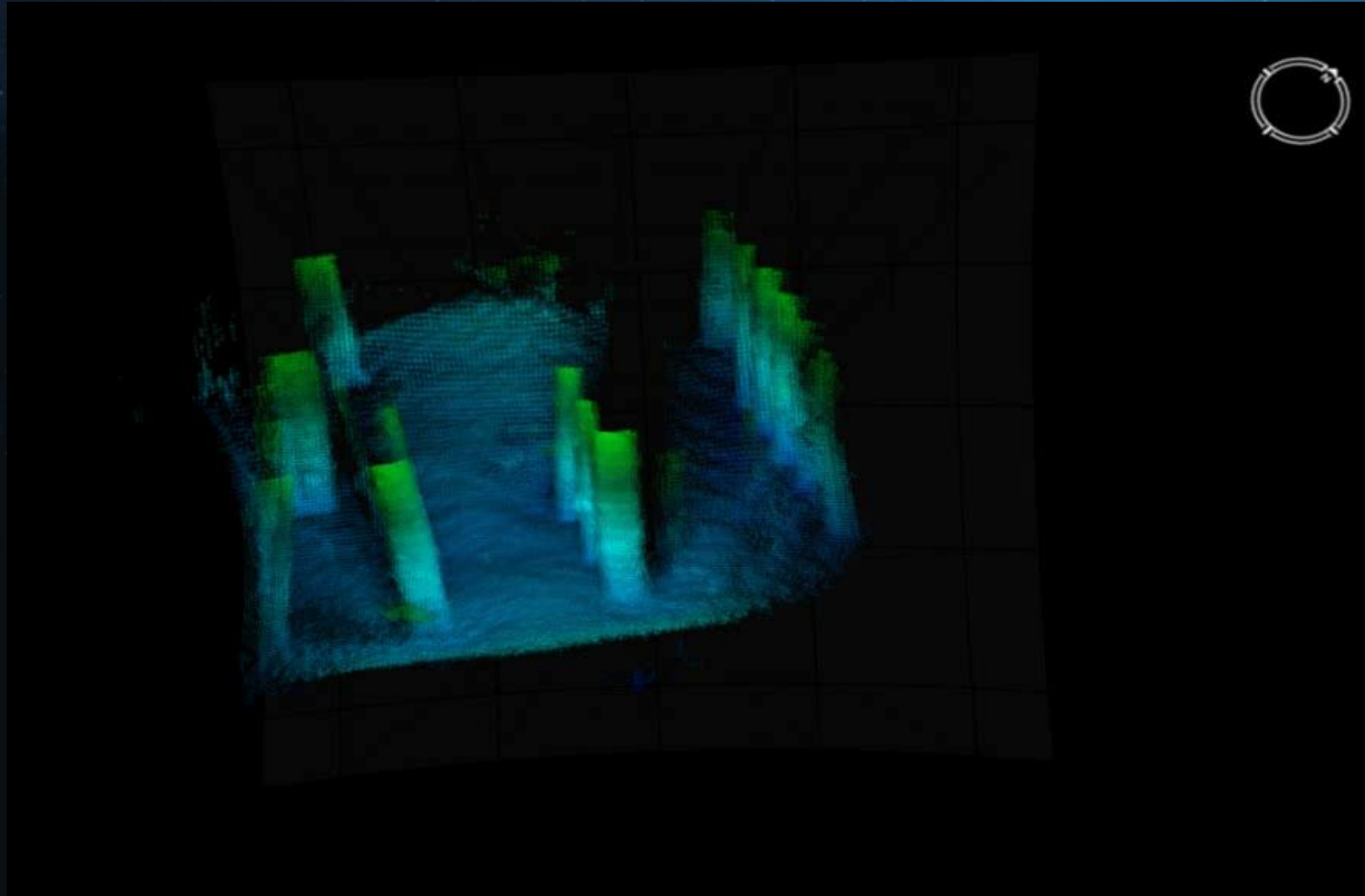
2D, 3D and Real-Time 3D (4D) Sonars?

3D
Multibeam



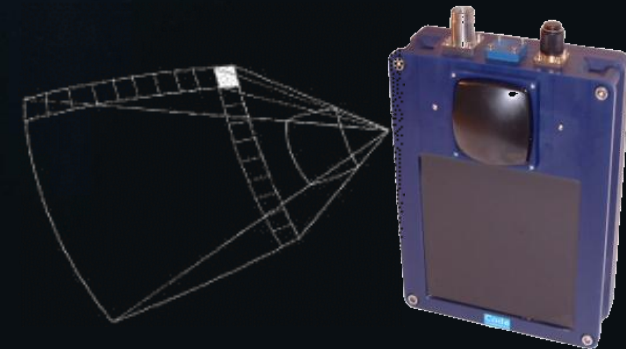
2D, 3D and Real-Time 3D (4D) Sonars?

3D Real-time
M/Beam Imaging



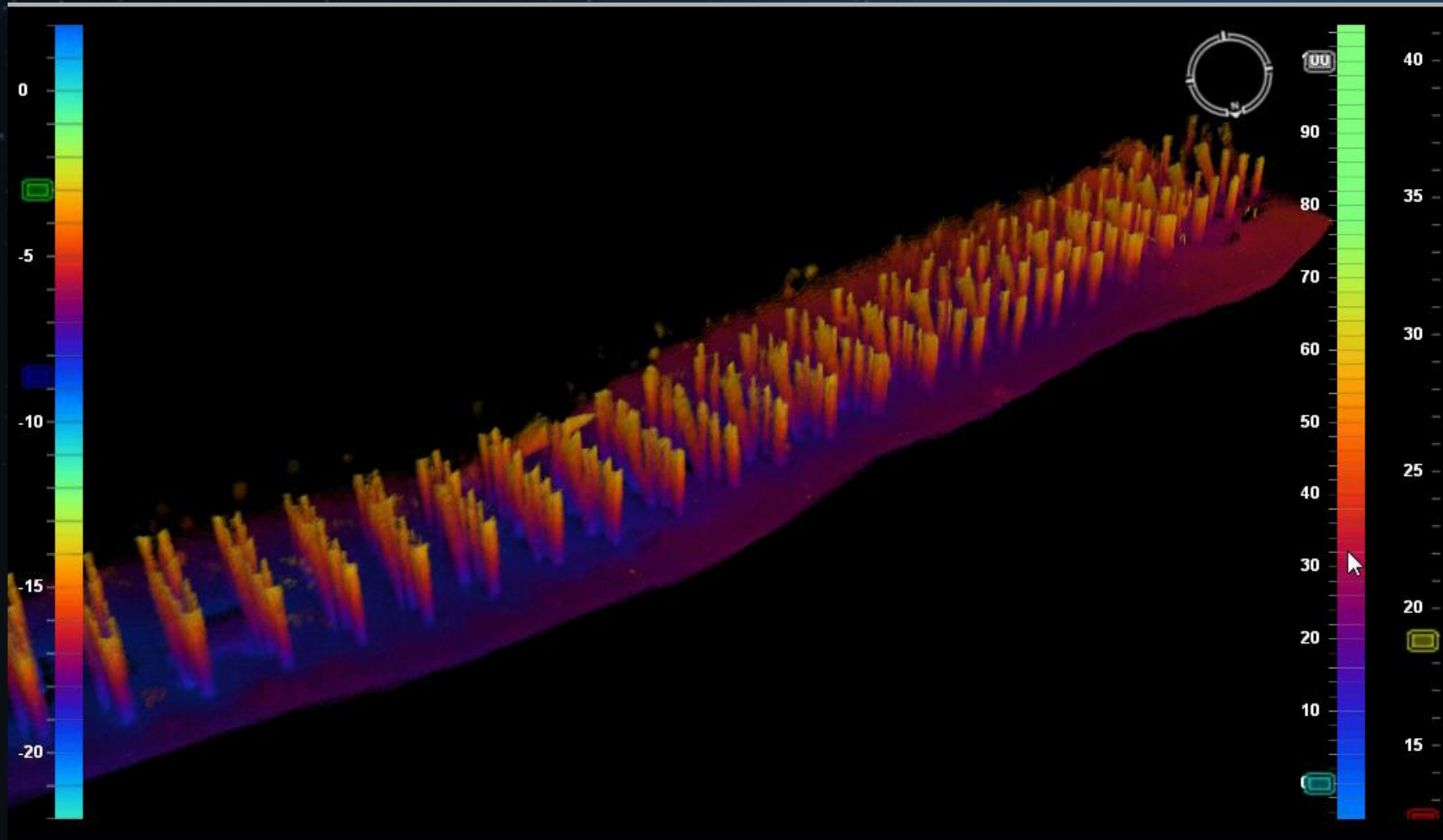
Echoscope® Real-Time 3D Imaging Sonar Technology

- Two-Dimensional Phased Array active sonar that generates 3D volumetric data
- **16,384** beams per ping (up to 12pps)
 - ✓ Range Slice every $\geq 3\text{cm}$
 - ✓ Process over 260 million beamformed (range and intensity) results every second at typical 40m range to target at 12 pps
 - ✓ Complete **x,y,z** and **intensity** (backscatter) – measurable – dataset
- Saturates an area with discrete beams from multiple different angles, many time a second minimizing data shadow or interpolation between distant points
- Patented real-time GPU based rendering engine means complete 3D geo-referenced visual data



Echoscope® Real-Time 3D Imaging Sonar Technology

- Not just what you see – it's what you don't see!



Subsea environment is Cluttered and Complex

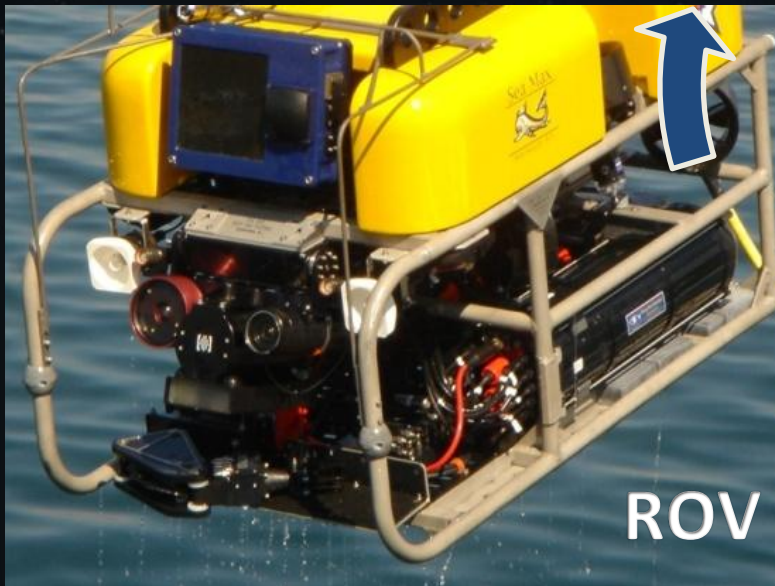
- Without additional multi-sampling visual sensors – how can we be sure of complete coverage in the environment?
- Angle of incidence is critical for sonar returns!
- Echoscope™ has 128 angular multibeam slices in every ping
- Ability to ensonify the same target from multiple different angles many times a second
- Complete statistical analysis capability for improved probability of target & object verification and identification (sub-beam object detection)
- Ability to instantly switch from MAPPING to MONITORING in a single deployment – providing real-time support for divers and ROV

Real-Time **Data** = Real-Time **Decision Making**

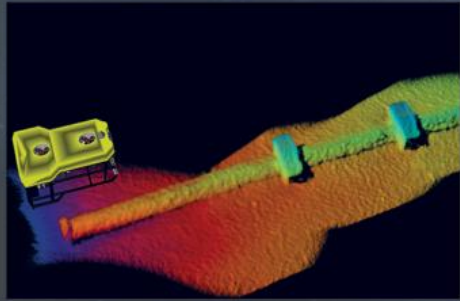
Why is Real-Time 3D important for Subsea Visualization?

- Subsea operations are often in **zero visibility**
- Operator on surface needs to **see, place or remove asset**
- Speed and accuracy of operation is critical to remain efficient and cost effective
- Real-Time data for accurate decision making is vital to avoid re-work
- Safety concerns mainly for personnel, but also subsea asset
- Meets the priority and focus of Industry Key Players (example Chevron)
 - ✓ **Improve Sensor Capability?**
 - ✓ **More Efficient Collection of Data?**
 - ✓ **Better Representation of Data?**

Non-Vessel Platforms

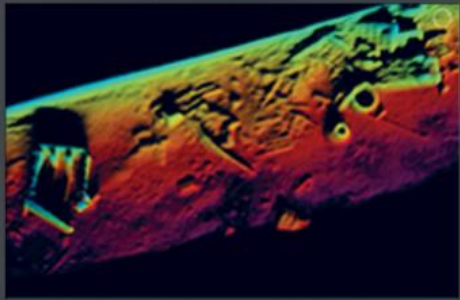


Monitor



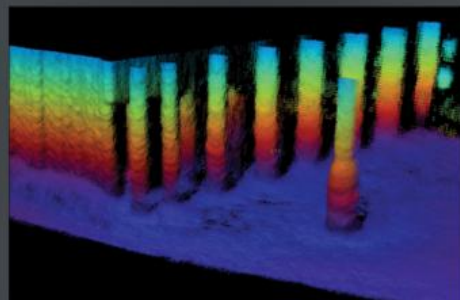
Static or moving applications for LIVE camera replacement and 3D real-time visualization

Map



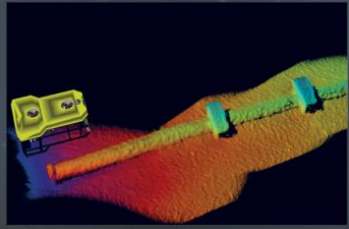
Hydrographic survey, seabed and infrastructure mapping of complex targets

Measure

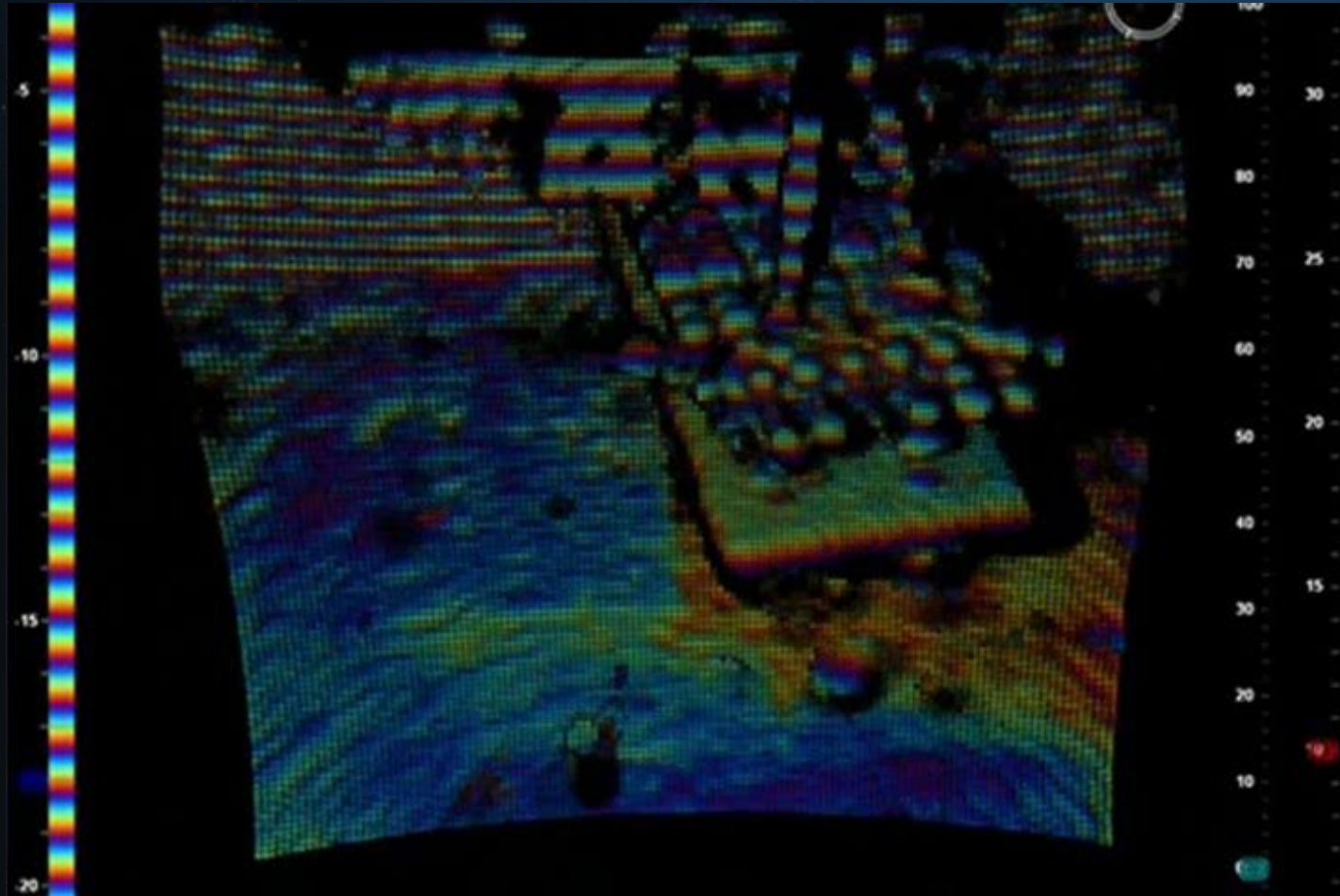


Complex structure TRUE 3D measurement with model augmentation

Monitor

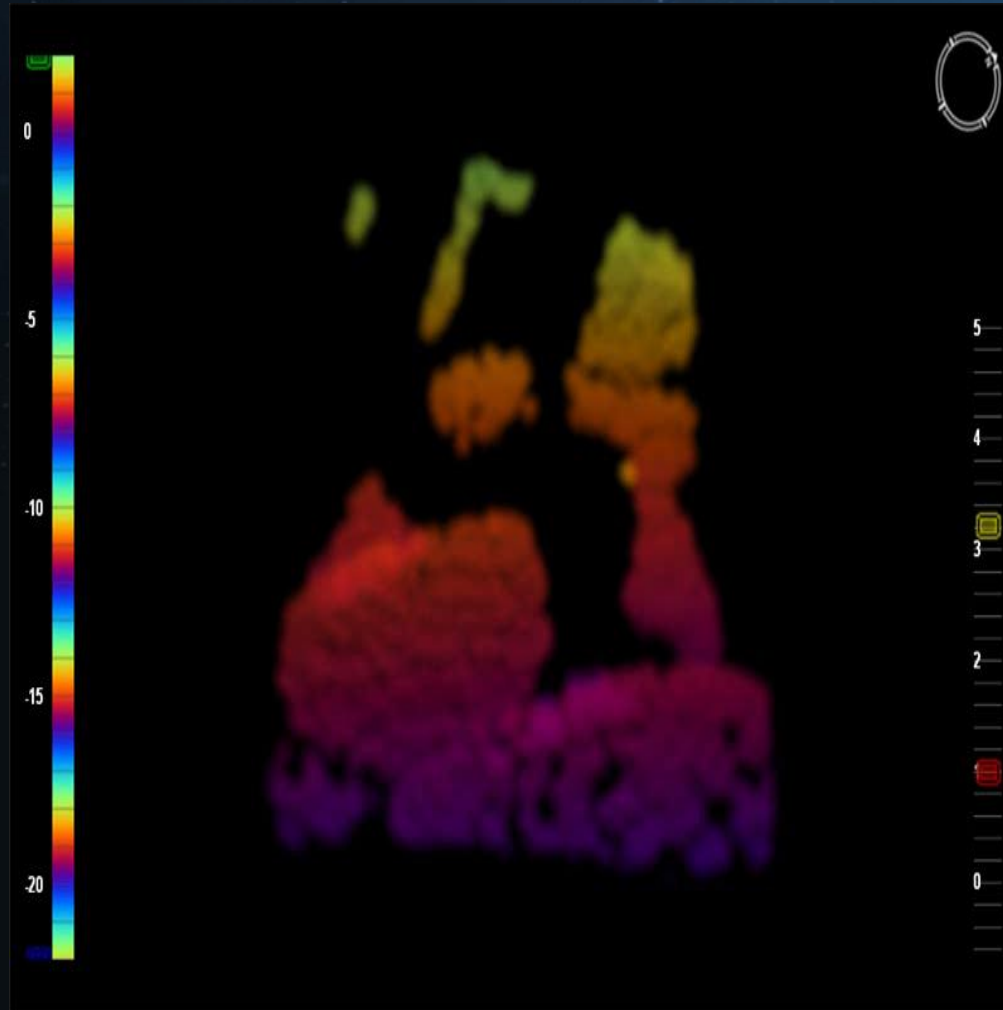


Construction & Decommissioning, Diver Support,
ROV / AUV Support, Gas and Leak Detection....



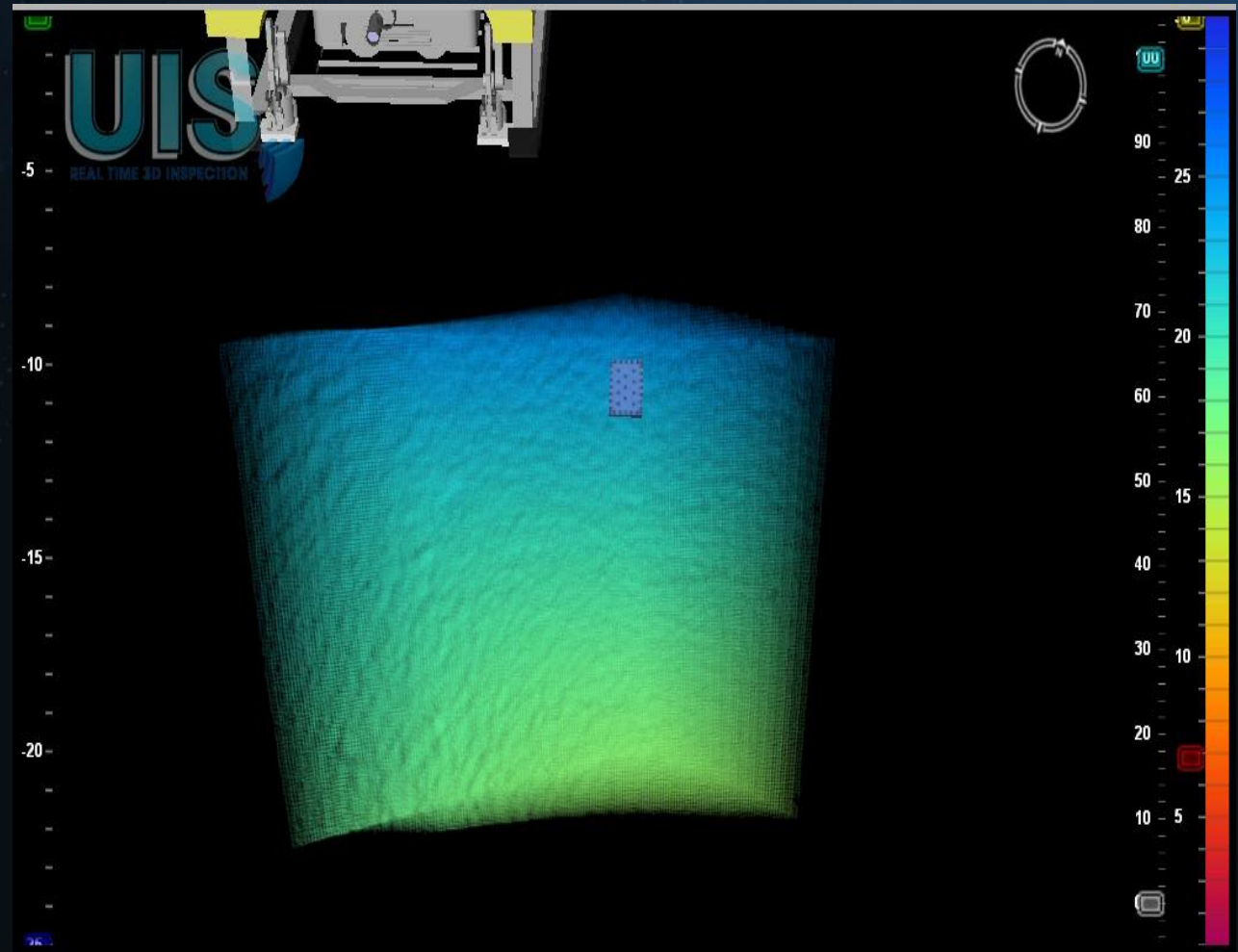


Construction & Decommissioning, **Diver Support**,
ROV / AUV Support, Gas and Leak Detection....

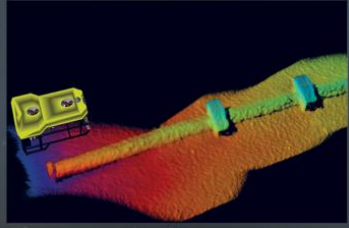




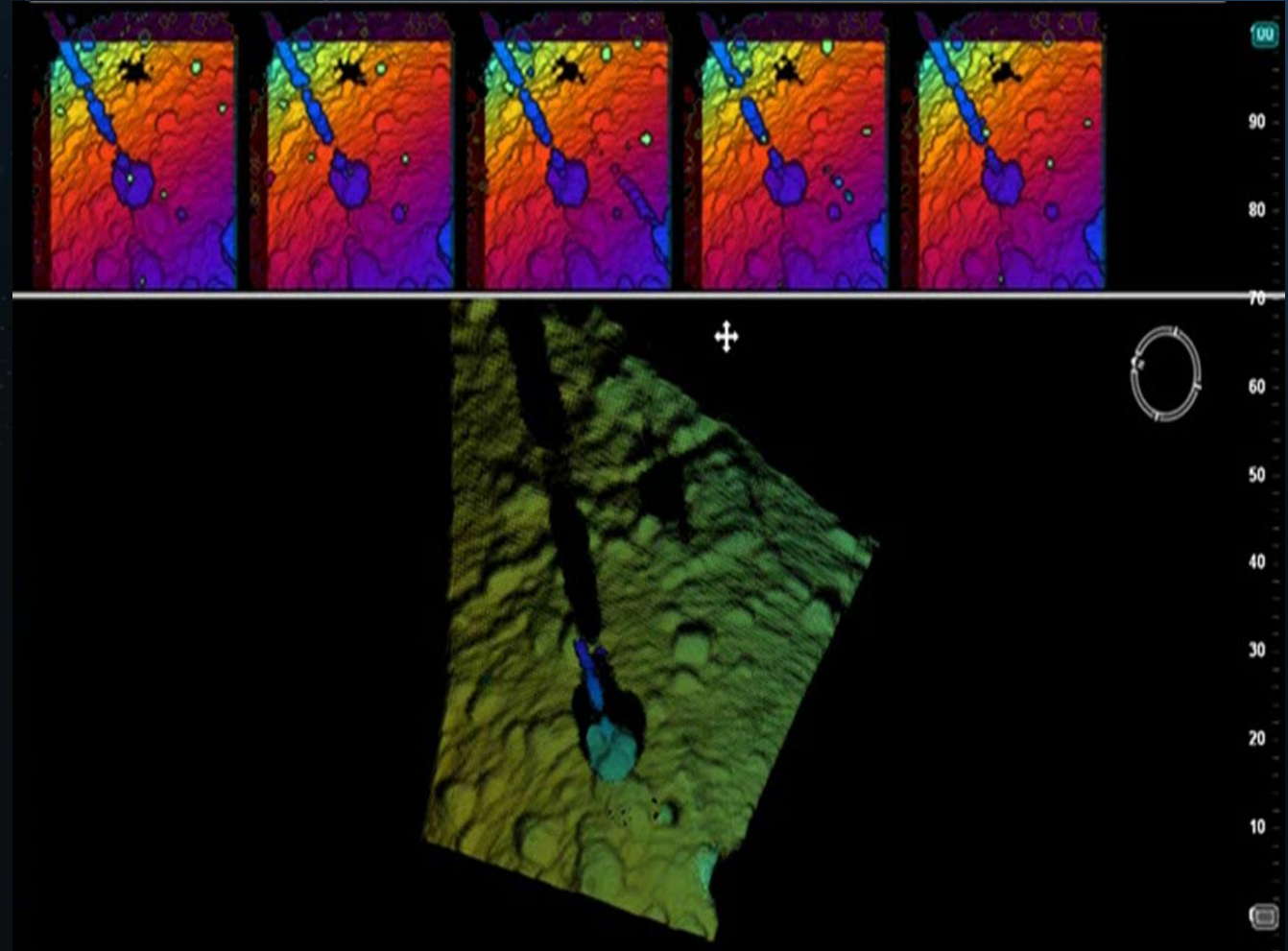
Construction & Decommissioning, Diver Support,
ROV / AUV Support, Gas and Leak Detection....



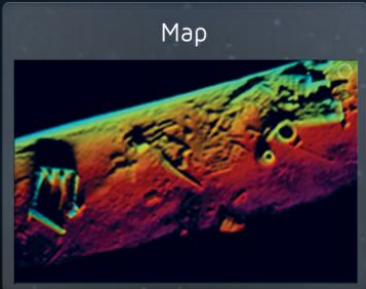
Monitor



Construction & Decommissioning, Diver Support,
ROV / AUV Support, Gas and Leak Detection....



Survey, Pipeline Inspection, Decommissioning, Rig Inspection, Salvage, Construction, Comparison...



Camera View



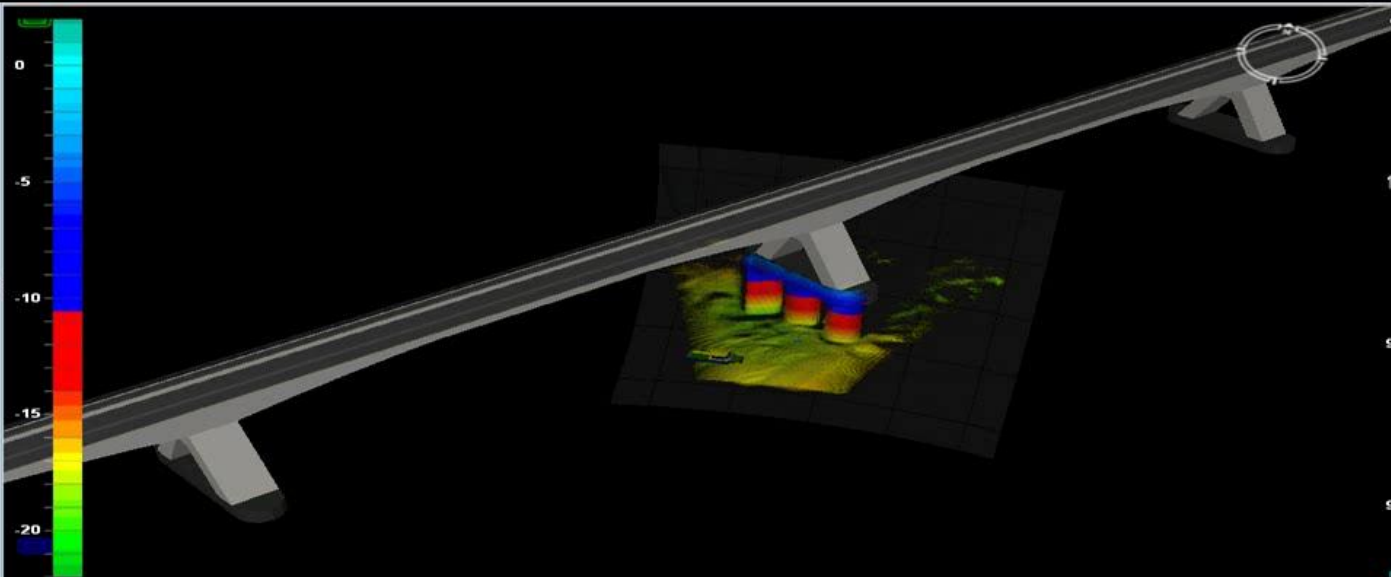
Echoscope 2D View

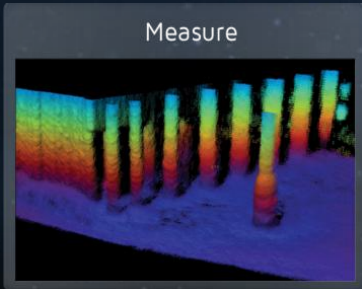


Chart Overview

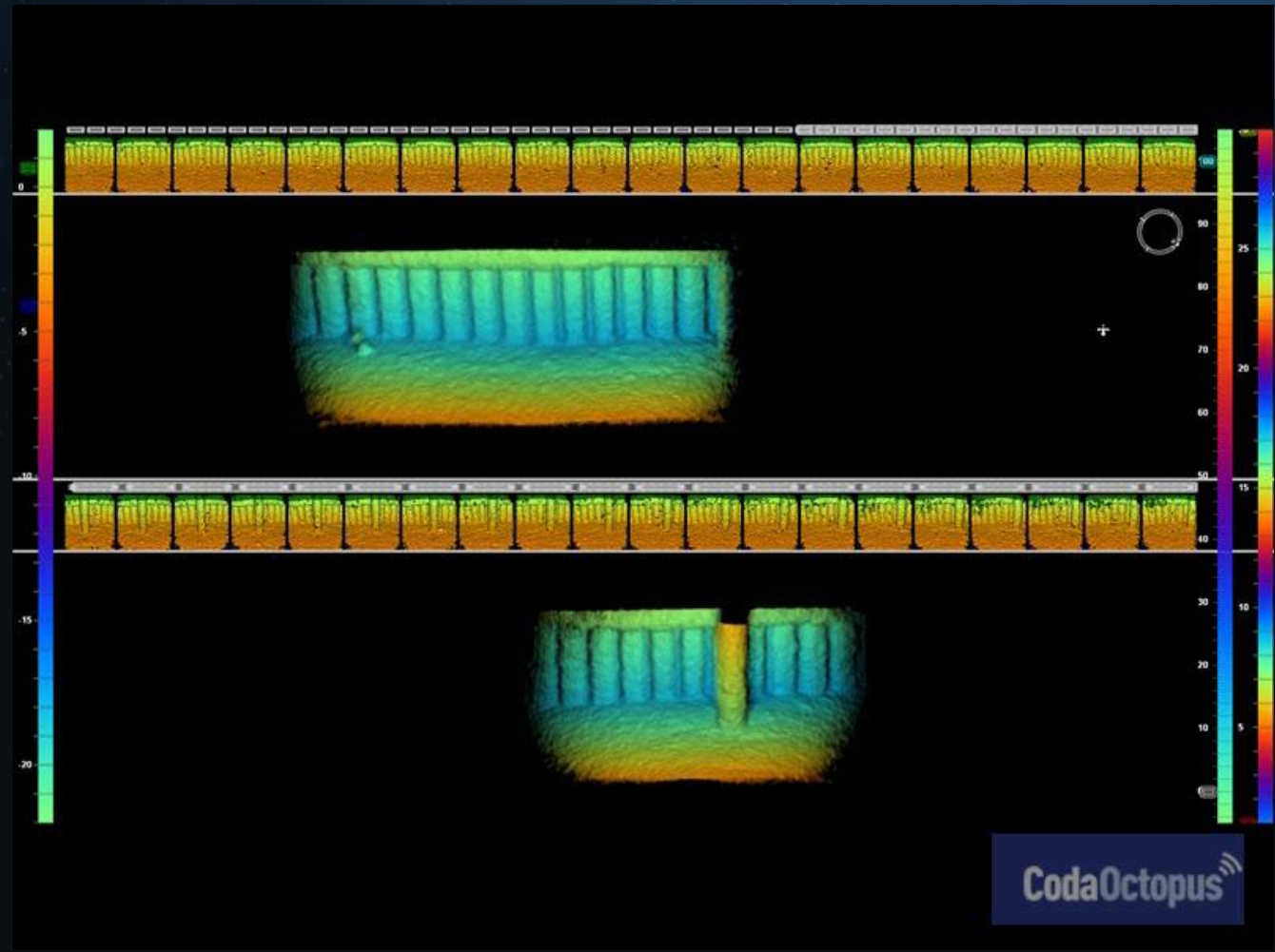


2.5 km



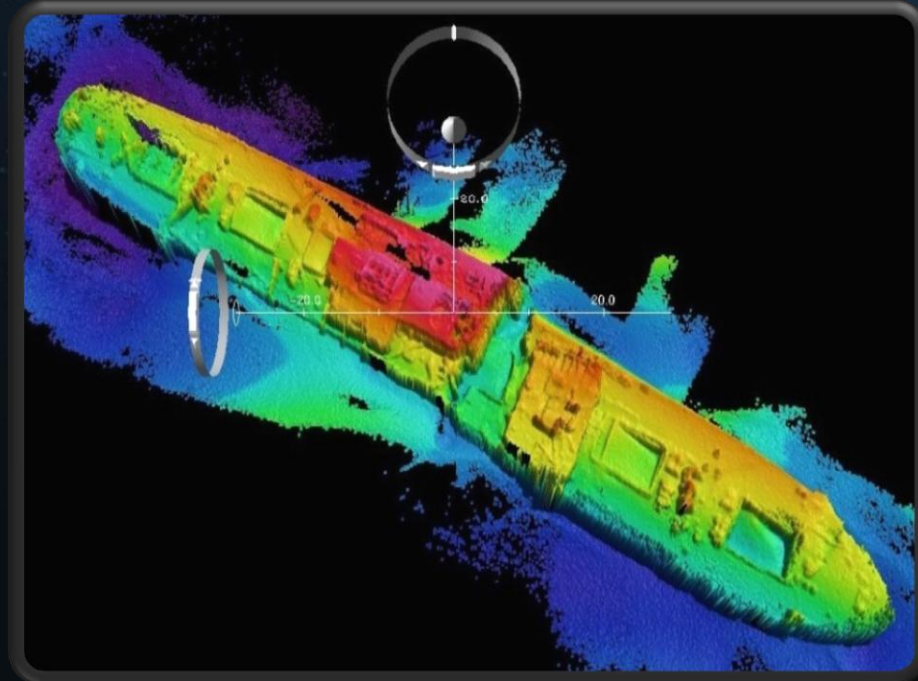
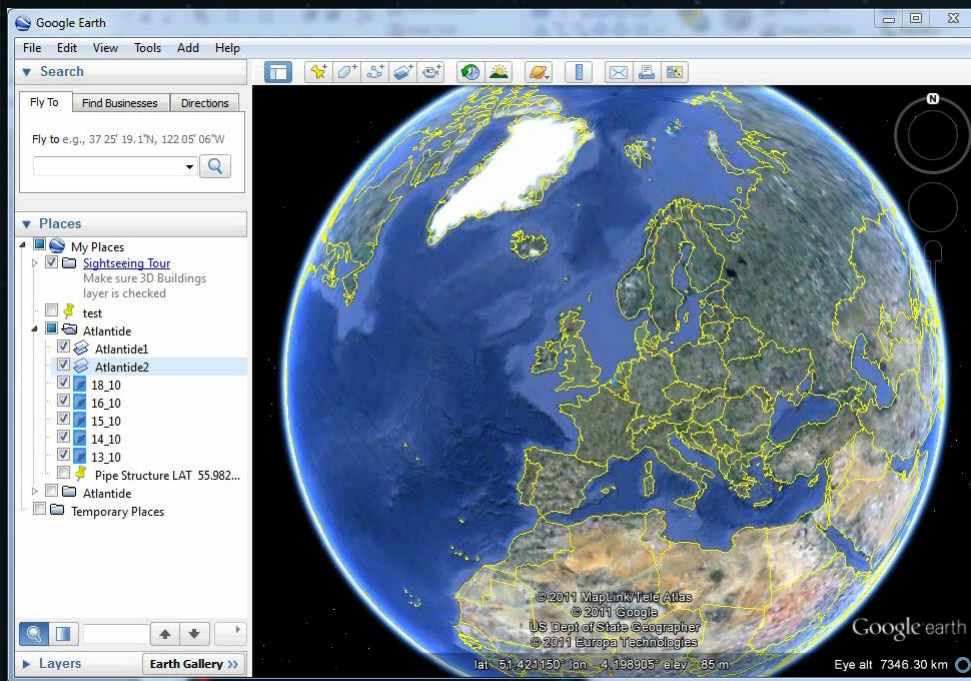


3D Modeling, Change & Baseline-Comparison, Navigation and OA, Scene Awareness...



Data Sharing and 3rd Party Integration

- Data can be easily exported and integrated with standard 3rd Party Systems
- Full XYZi Export Binned or RAW (any point cloud application)
- Direct interfaces with QPS QINSy and Hypack



Real-Time Data = Real-Time Decision Making

What are the key benefits from Real-Time 3D?

TIME & COST SAVING

- Reduced survey time = significant cost reduction
- No or Minimal Post-Processing Required
- Immediate data visualization to avoid re-work
- Single sensor for both Moving and Static Applications



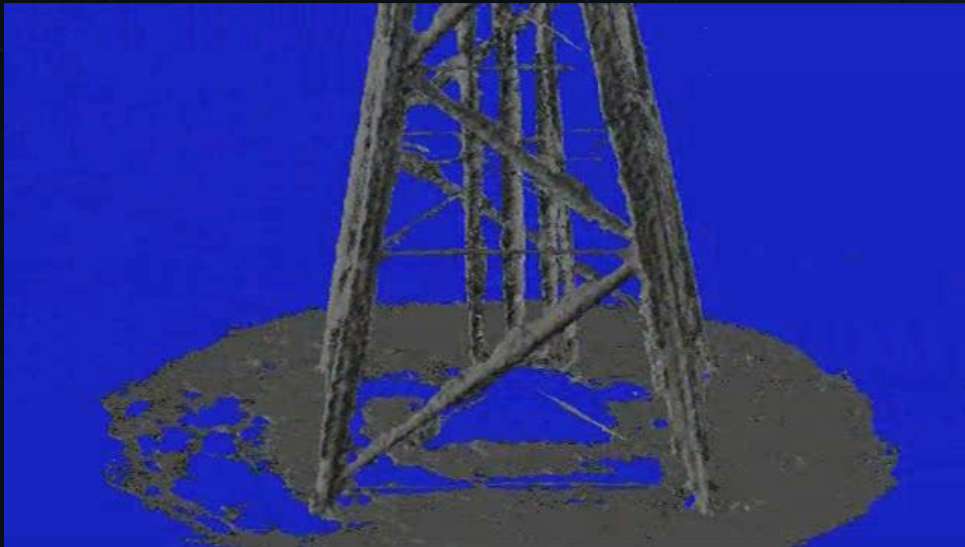
QUALITY

- HUGE data redundancy for improved accuracy
- High definition imagery and bathymetry from a single sensor
- Image fidelity = Intuitive = High user confidence
- We SEE more than any other sensor – minimal shadows!



Subsea environment is Cluttered and Complex

- Lockheed Martin MARLIN™ – Intelligent Autonomous Vehicle
 - Primary Sensor is Echoscope™ Real-Time 3D Sonar
 - Mission profile reduced from days to minutes
 - Echoscope™ Data Density and Coverage enables Real-Time Change Detection and adaptive mission planning
 - Survey to processing and model < 1hour in the clients hands!!



Real-Time **Data** = Real-Time **Decision Making**

Thank You!.....Questions?

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