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

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

What’s the difference?
## 2D, 3D and Real-Time 3D (4D) Sonars?

<table>
<thead>
<tr>
<th>2D Imaging</th>
<th>3D Multibeam</th>
<th>Real-Time 3D Multibeam Imaging</th>
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</thead>
<tbody>
<tr>
<td>Images an intensity volume in front of the sonar as a time series.</td>
<td>Single across-track slice of data prone to acoustic shadow in complex Subsea environments.</td>
<td>Visualize a complete volume with virtually no acoustic shadow on complex structures.</td>
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<tr>
<td>Typically limited to 20° vertically and provides no depth data = vertical ambiguity.</td>
<td>Mapping requires the platform to move, high quality nav &amp; attitude data and post processing.</td>
<td>Massive data density typically 40x traditional multibeam for statistical processing.</td>
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<td>Simple video stream output with no mapping capability.</td>
<td>Cannot visualize or monitor a live or moving scene.</td>
<td>Works equally in moving and static applications.</td>
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</table>
2D, 3D and Real-Time 3D (4D) Sonars?
2D, 3D and Real-Time 3D (4D) Sonars?
Real-Time 3D Sonar Technology

**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 times 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

- AUV
- ROV
- Construction Assets
- Survey Vessel & Barge
Application Segments

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

Hydrographic survey, seabed and infrastructure mapping of complex targets

Complex structure TRUE 3D measurement with model augmentation
Monitor Applications

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

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MONITOR Applications

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

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

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

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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