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Underwater Surveillance Systems

DASA - Digital Acoustic Surveillance Array

DASA-2515 System Shown (battery powered, 64 sensors, 540 m length)

Overview

DASA is a low-frequency acoustic sea-bed array platform designed for long-term area monitoring and surveillance applications.

The array construction and digital sampling format have been designed to support a wide range of array lengths, and sensor positions, and sampling rates. DASA is a proven system with multiple deployed configurations ranging from 100 m to 1600 m long using as many as 94 hydrophones in multiple nested apertures.

DASA can be configured for long-term deployments with shore-connected cable or as a battery-powered autonomous recording system. The lower power electronics allow for longer, smaller, shore cables and reduces the power requirements at remote operating sites. Battery configurations can operate and record continuously for more than six weeks.

Each configuration can be customer-defined or can be selected to match from a list of predefined systems. Customers can select array length, sampling rate, and sensor count with a near linear trade-off between these parameters.

- *up to 94 Digital Hydrophones (at 3 kSps, 1600 m)*
- *adjustable sampling rate up to 25 kSps*
- *Input referenced noise well below Sea State 0*
- *Simultaneous sampling*
- *Modular design in up to 5 sections*
- *2500 m depth rating*
- *Titanium pressure cases for long term deployments*
- *Shore cabled and battery options*
- *< 1 m spooling radius for deployment and recovery*

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Area Surveillance and Tracking

DASA can be used for large area monitoring and target tracking by deploying two orthogonal arrays in the area of interest. Bearings from each array provide cross fixes that build target tracks for surveillance and area awareness.

Time Synchronization

The array controller synchronizes hydrophone samples across all sensors and can synchronize data timestamps to a GPS/GNSS source or chip-scale atomic clock. Timestamps and system identification are embedded with acoustic samples simplifying data management and integrity checking in post-processing applications.

Hydrophones

The Low-Frequency hydrophones for DASA are a low-noise, low-power design. The hydrophones attach to molded connectors on the array cable and are held in place by a protective plastic shroud. The hydrophone pressure vessel is constructed from Grade 2 Titanium and is designed for long-duration and/or deep-water deployments. The hydrophone electronics are gain matched and simultaneously sampled. Sensor specifications are provided in the tables below.

Side Channel Data

In addition to the acoustic samples, sensors within hydrophones and DCU measure and record diagnostic and auxiliary information including voltage, power usage, battery level (when applicable), hydrophone orientation, internal case temperature, pressure and humidity.

Additional Sensors and Controls

The DASA sensor bus format supports many different sensor types that can be included with the acoustic array. These sensors can include one or more high-frequency hydrophones (up to 192 kSps). Three-axis magnetometers can be installed in place of acoustic array channels. The acoustic channels can be configured over one or more sub-arrays in any geometry. Systems have been configured with horizontal, vertical, circular and orthogonal 3-axis arrays.

Data Processing

The DASA Array Receiver Controller (ARC) runs a custom Linux operating system on a dual-core ARM Cortex-A9 processor with an FPGA coprocessor. The ARC software includes functions for array operation, logging, scheduling, health monitoring, and energy/event detectors. Omnitech Electronics provides user support and comprehensive interface definitions and data APIs that users can use to integrate additional functionality and data processing. Users can use spare processing on the ARC or add a separate coprocessor

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Array System Specifications

PARAMETER	SPECIFICATION	COMMENTS
Sensors		
LF Hydrophones	up to 94	at 1600 m, 3 kSps
HF Hydrophones	1 (optional)	located on Array Receiver
Apertures	customer defined	
Optional Mixed Sensors		
Magnetic	triaxial, fluxgate	
Health Monitoring		
Voltage measurement	per sensor	
Current measurement	per sensor bus	measured at ARC and each repeater
Signal Integrity	Signal levels	min, max, % clipping,
Data Integrity	Parity Errors, Data Drops	
Logs - Data statistics - Diagnostic sensor readings - Non-acoustic sensors	to file	configurable record interval.
Communications	over modem	
Mechanical		
Segments	1 to 5	
Total Length	100 m to 1600 m	
Minimum Bend Radius	0.75 m	limited by segment linkages and cable tension during recovery
Cable Strength Member	Central Aramid Yarn	
Breaking Strength	4500 kg	
Safe Working Load	1350 kg	
Maximum Operation Depth	2000 m	
Electrical		
Power Consumption		example system power based on a 64 hydrophone, 3 segment array.
5 kSps	12.7 W	
10 kSps	14.5 W	
12.5 kSps	15.0 W	
Data Interface	Ethernet	to shore

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LF Digital Hydrophone Specifications

PARAMETER	SPECIFICATION	COMMENTS
Acoustic		
Bandwidth	6 - 5000 Hz	-3 dB range, at 10 kSps
Sample Rate	3k, 5k, 10k, 12.5k	selectable during operation
Sample Resolution	24 bits, >19 bits noise-free resolution	
Dynamic Range	115.5 dB	of ADC (not including gain)
Sensitivity @ 100 Hz	-193.5 dB ± 1 dB	re 1V/µPa, variance can be calibrated and corrected in hydrophone hardware
Gain	0 - 90 dB	in 10 dB steps
Self-Noise		
@ 10 Hz	< 37 dB re 1µPa/√Hz	at 40 dB, 0°C
@ 100 Hz	< 29 dB re 1µPa/√Hz	
@ 1 kHz	< 26 dB re 1µPa/√Hz	
Phase Matching	± 5° @ 1 kHz	
Max. Unclipped Tonal	195 dB	at 0 dB gain
Electrical Cross-talk	< -110 dB	between acoustic sensor channels
Simultaneous Samples	< 1 µs	*excluding electrical signal propagation
Mechanical		
Weight in Air	< 1.0 kg	
Dimensions	212 mm x 44 mm	cylinder
Operational Depth	> 2000 m	
Material	Titanium	

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