BioSonics

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Marine Life Observer

A Long-Range Target Detection and Classification System for Biological Monitoring at Marine Renewable Energy Sites

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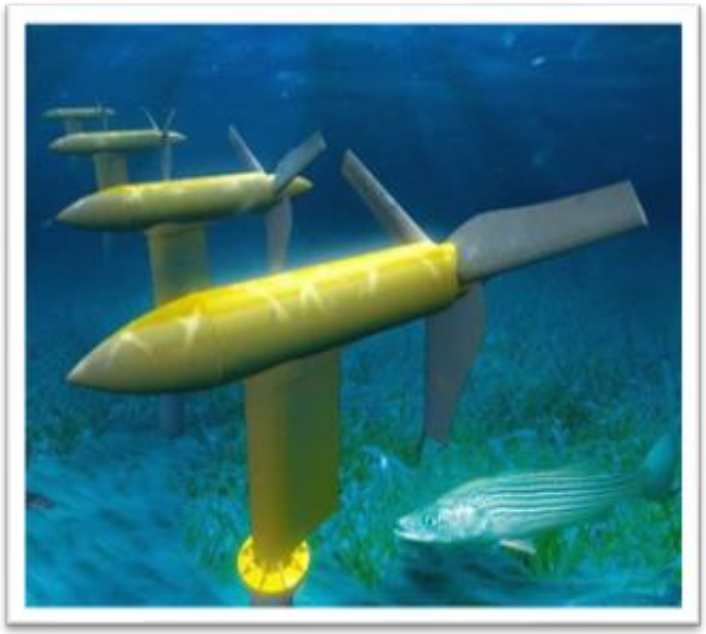
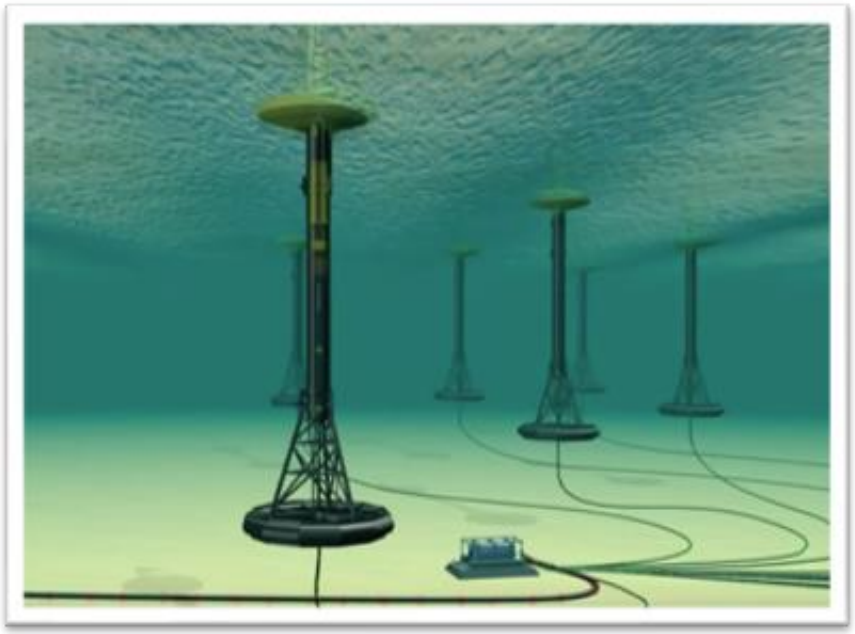
Marine Renewable Energy

The Technology is Here
Robust, Efficient and Scalable



Tidal Energy



Wave Energy

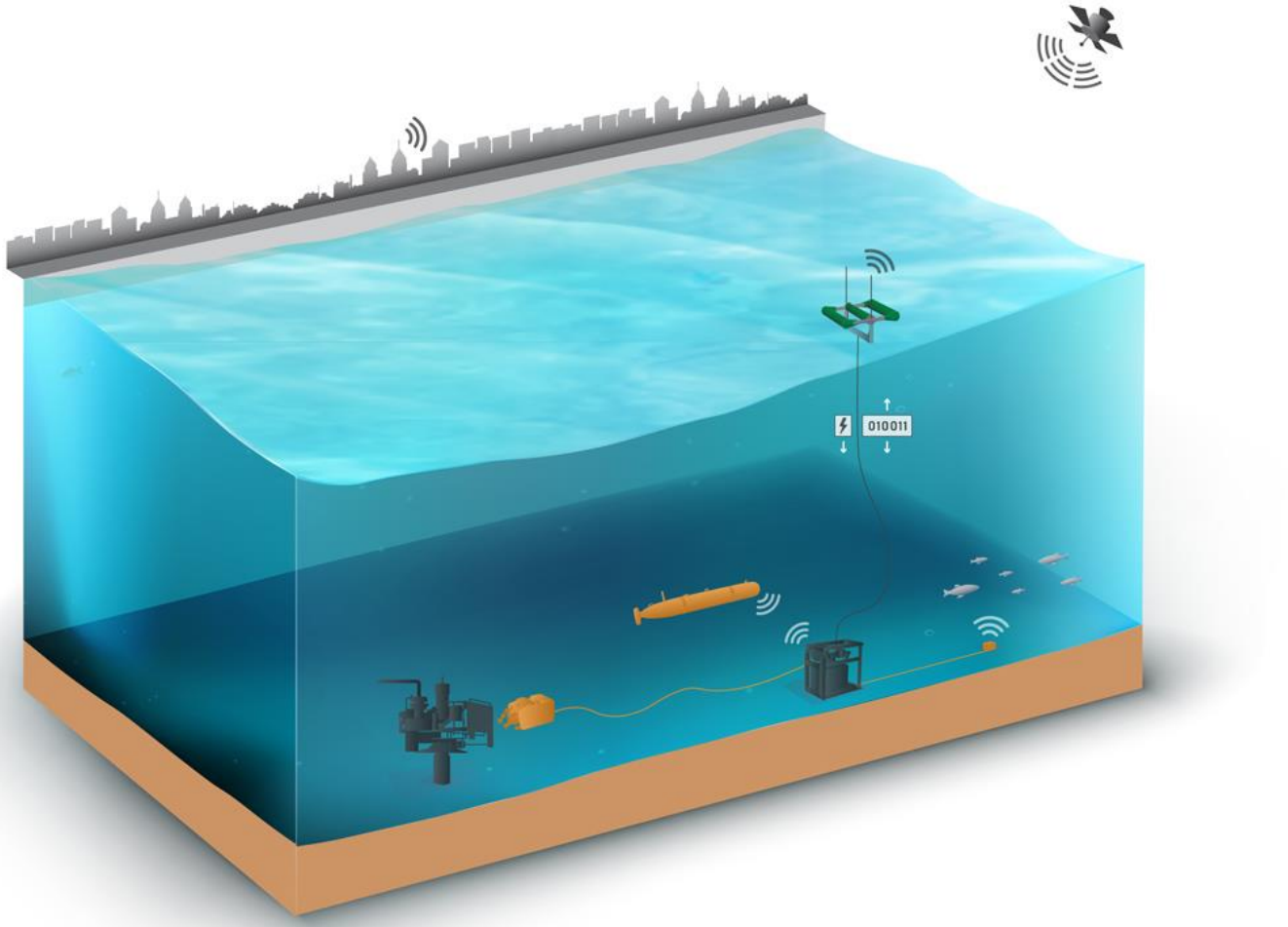
Wind Energy

Marine Renewable Energy

Opportunity: Renewable Energy / Low Carbon Footprint / Many Applications

Fact: Will result in more and more technology in the water for longer periods of time / Permeant residence

Challenge: Wide acceptance will require a better understanding of the long-term environmental effects



Biological Monitoring

Developers, regulators and the public need to understand how candidate Marine Energy devices effect the behavior of marine life for project permitting.

U.S. DEPARTMENT OF ENERGY

Triton Initiative

Develop a suite of tools to effectively monitor marine life around Marine Energy devices to help move the industry forward in an environmentally responsible way.

Acoustics:

University of Washington - DAISY
Integral Consulting - NoiseSpotter

Electromagnetic Fields:

Woods Hole Oceanographic Institute

Biological interaction monitoring:

BioSonics - Long range detector and classifier
Florida Atlantic University - LiDAR

Integrated systems:

University of Washington - 3G AMP

Habitat Mapping:

Integral Consulting - SPI/PV

Marine Life Observer for Long Term Animal Interaction Monitoring

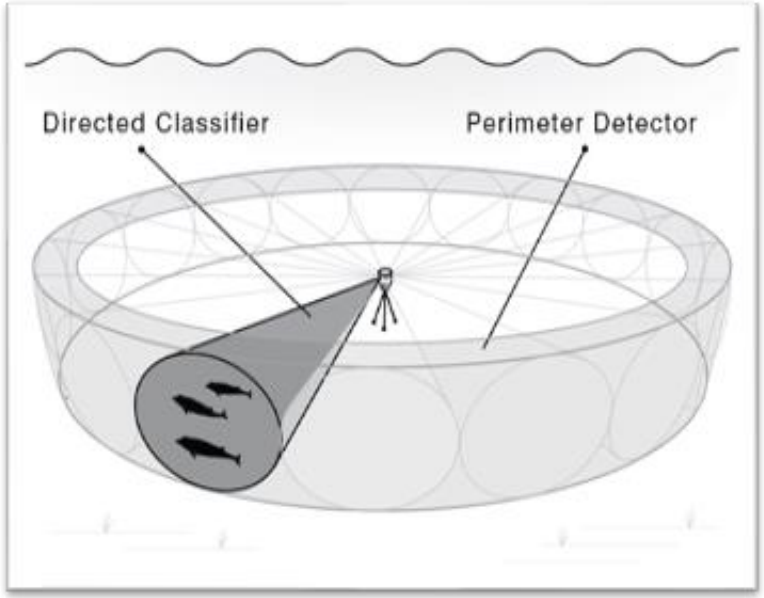
A Long-Range Biological Detection, Tracking and Classification System Using Integrated Active Acoustic Technology

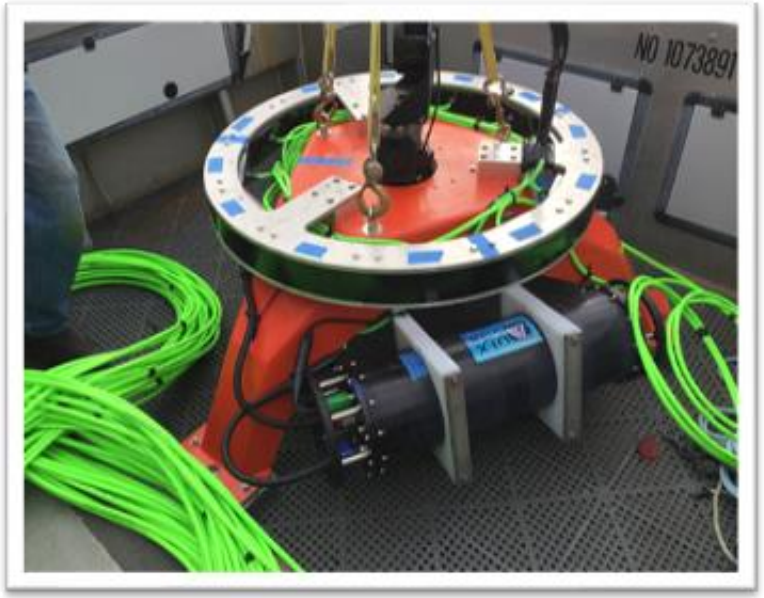
Omni Directional Perimeter Detector: Automatically detect and geolocate targets of interest at ranges of 200-300 meters

Split Beam Directed Classifier: Automatically aim at a detected target to track the target's position in three dimensions and assess acoustic signatures to provide a classification capability

Cloud Processing and Web-Based Reporting: Real-time reporting / Adaptive management

Primary Design Challenges: Fully Automated system / Scientific quality data / Minimal biological impact from active acoustics





Primary Design Challenge

Minimize biological impact from using continuously transmitted omni-directional active acoustics

<u>Programable sector coverage</u>
To provide exclusion zone capability in omni direction array. Only monitor where you need to.

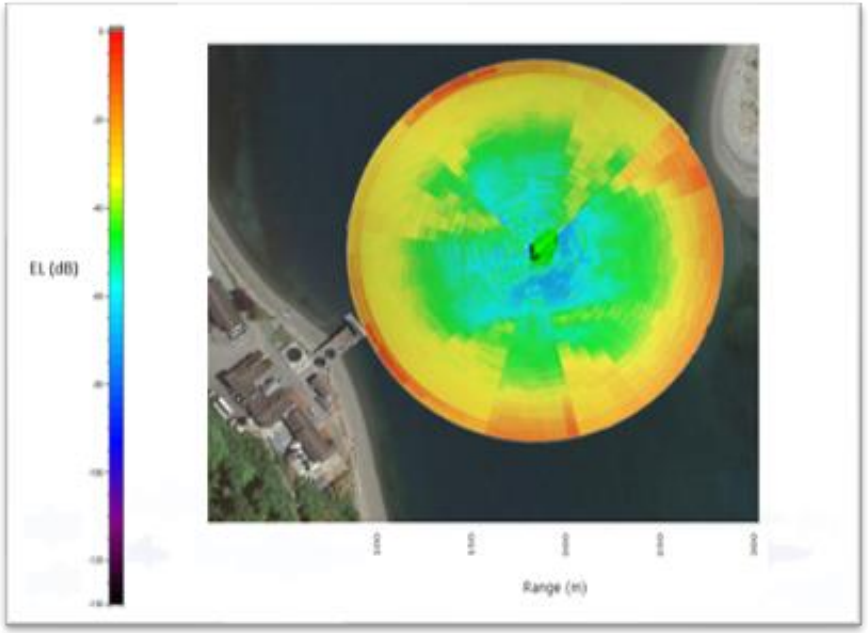
<u>Programable duty cycle</u>
Configurable; transmit power (SL), pulse duration, ping rate and multiplexing to minimize total system energy output, but still be effective at large biological target detection at range (200 – 300m)

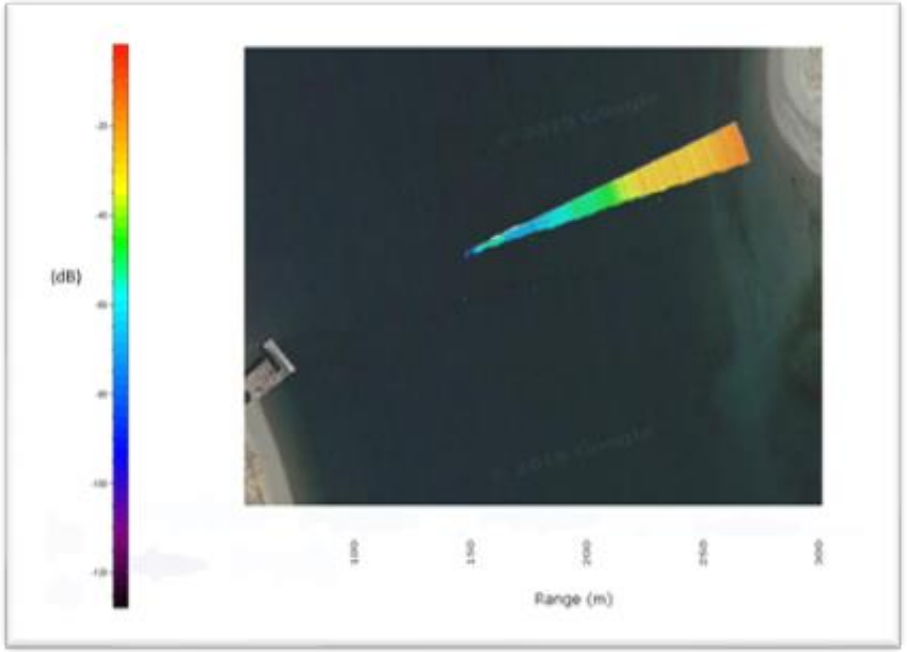
<u>Eliminate completely or minimize all acoustic frequency transmissions less than 200 kHz</u>
Try to stay above the hearing range of marine mammals

Minimize Biological Impact From Using Continuously Transmitted Omni-Directional Active Acoustics

Programable sector coverage / Programable duty cycle

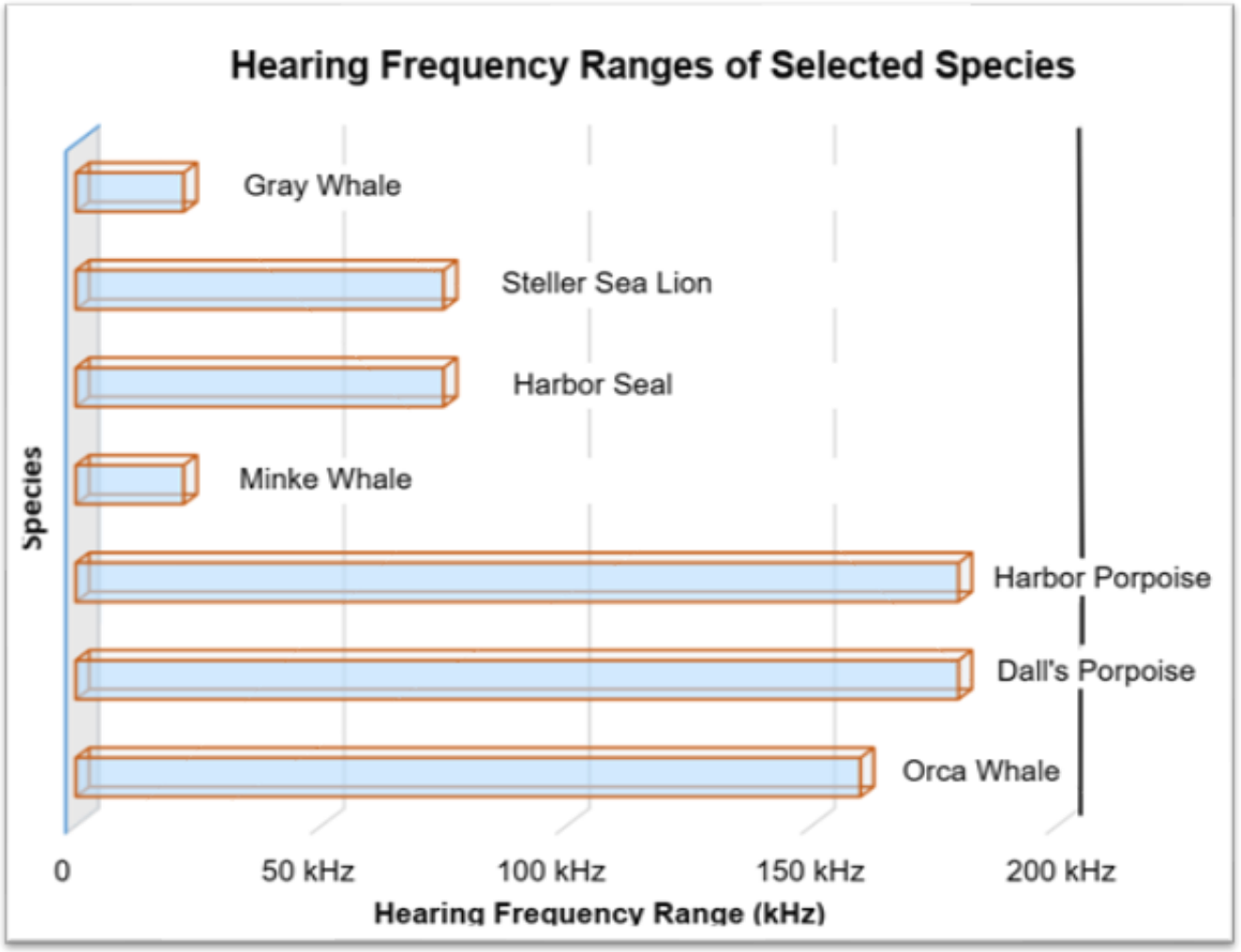
- 48 individually operational overlapping 9° conical 200kHz broadband transducers (7.5° spacing) 205 -230 kHz CHIRP
- Optimized balance between ping rate and cross talk: 8 channel (8x6) multiplexing, i.e. (1,8,16,24,32,40), (2,9,17,25,33,41)……..
- Example: At 200 meters with full omni directional operation using (8x6) multiplexing = 3.75 / 8 = 2 second system wide update = .5 pps per transducer. 3ms pulse duration @ .5 pps **= <u>0.15 % duty cycle per beam coverage location</u>**





Minimize Biological Impact From Using Continuously Transmitted Omni-Directional Active Acoustics

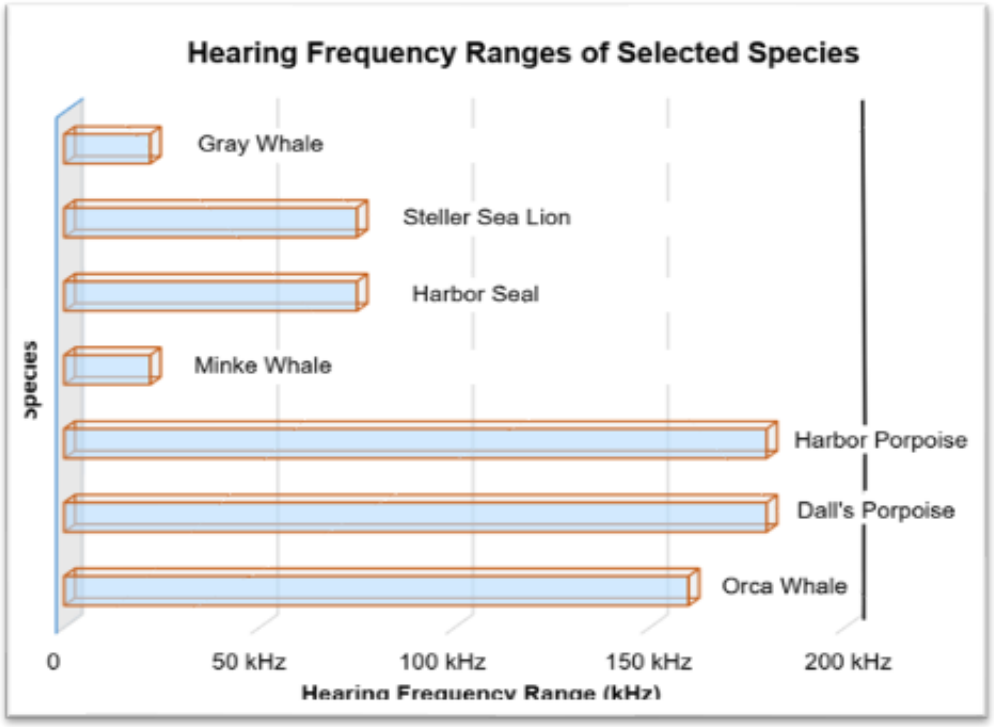
Suppression of Sound Energy Within the Hearing Range of Marine Mammals

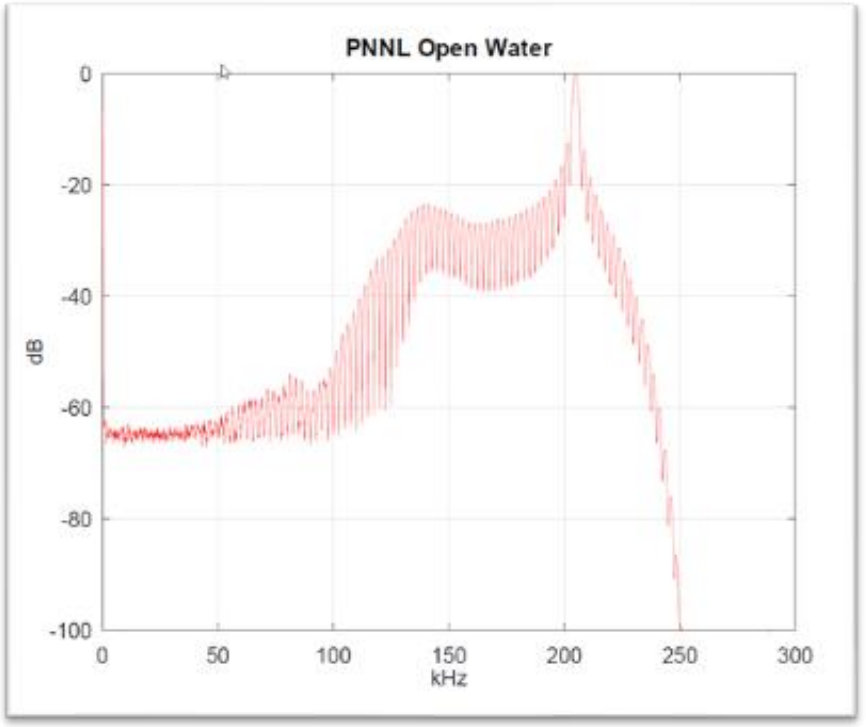


Minimize Biological Impact From Using Continuously Transmitted Omni-Directional Active Acoustics

Suppression of Sound Energy Within the Hearing Range of Marine Mammals

Existing active acoustic technology has shown limitations in usefulness in biological monitoring applications as there may be potential behavioral changes of detected animals (specifically marine mammals) due to their ability to "hear" the monitoring system.



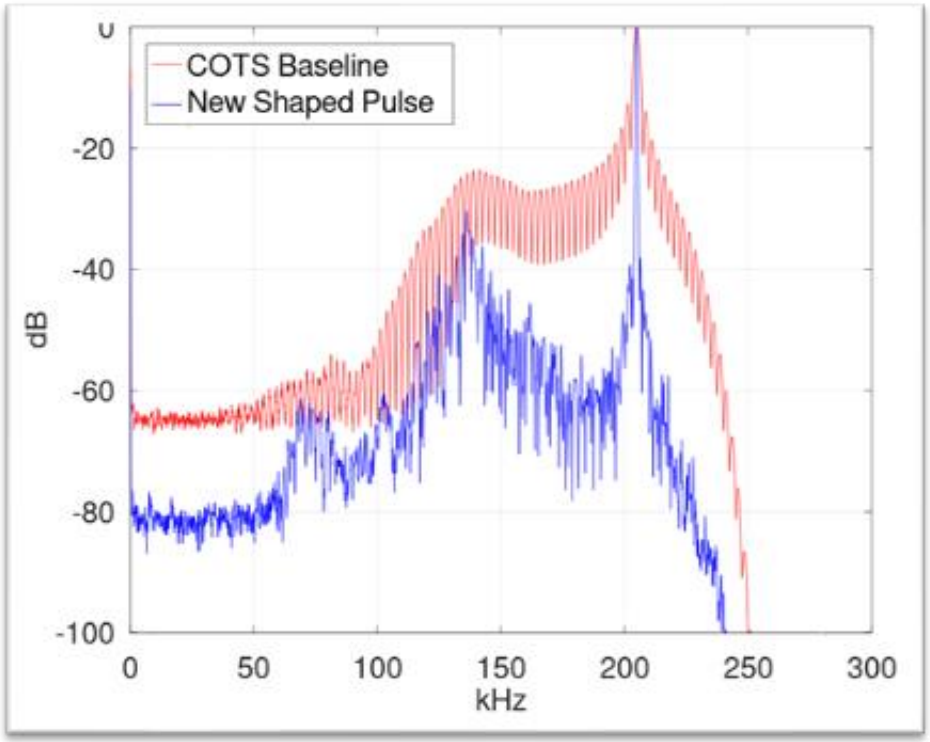


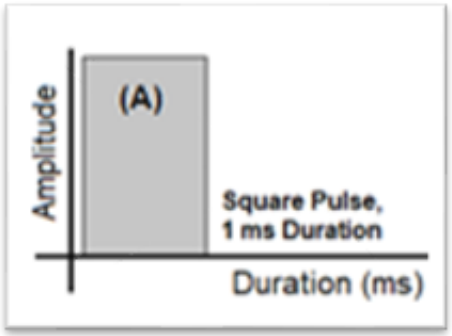
Minimize Biological Impact From Using Continuously Transmitted Omni-Directional Active Acoustics

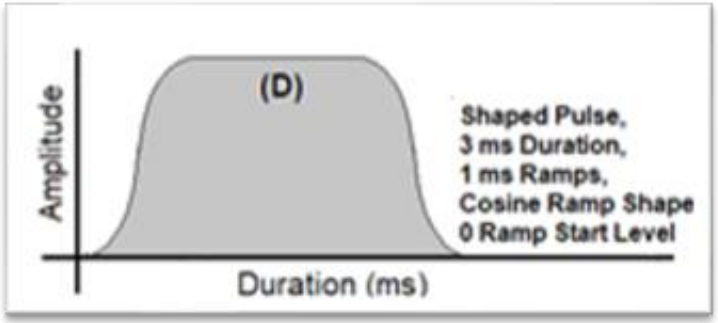
Suppression of Sound Energy Within the Hearing Range of Marine Mammals

Pulse shaping techniques decreased sound in the hearing range of marine mammals with out affecting the main 200kHz transmission by 10 - 30 dB depending on frequency and pulse shaping technique

Sound Pressure Levels can be manipulated over different frequency domains by using different pulse shaping techniques







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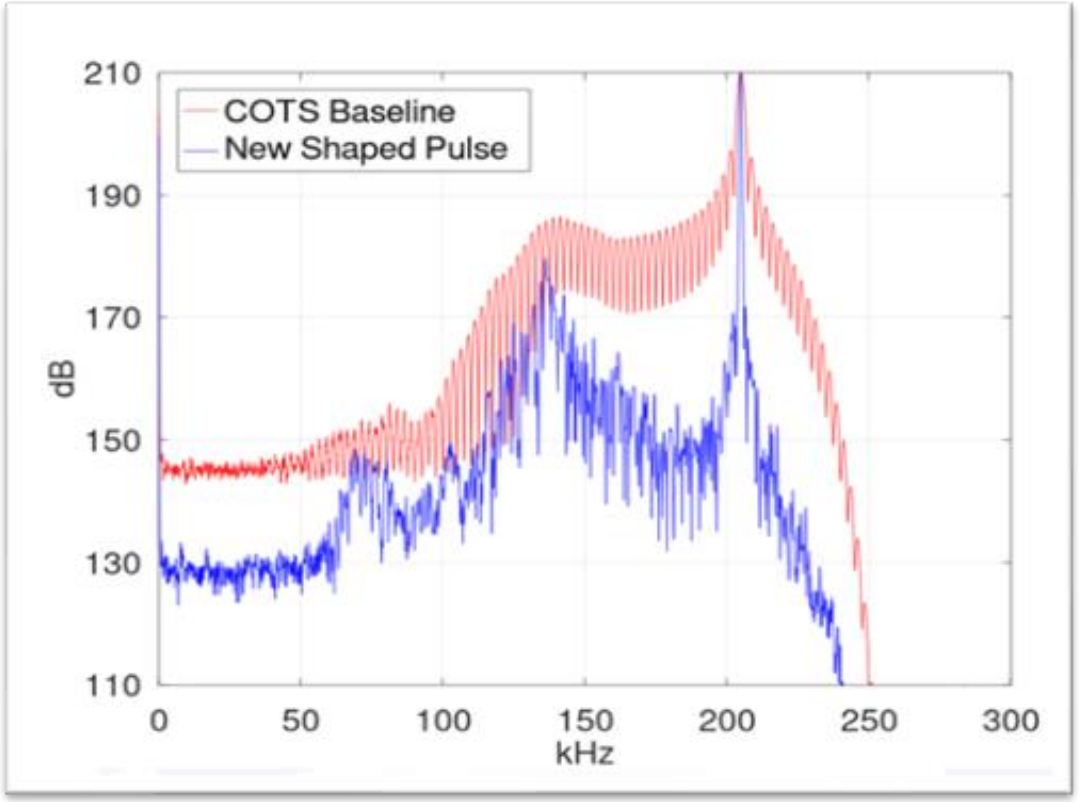
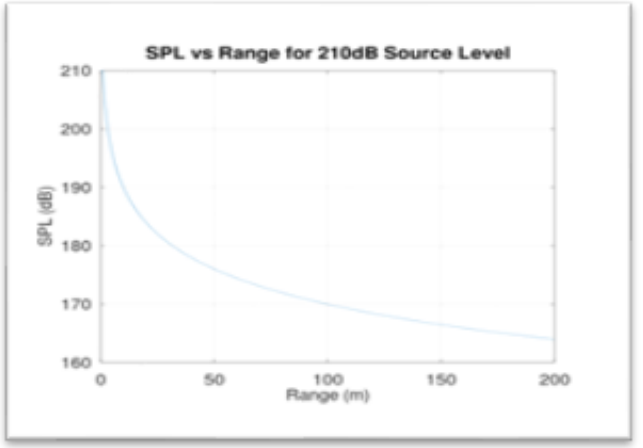
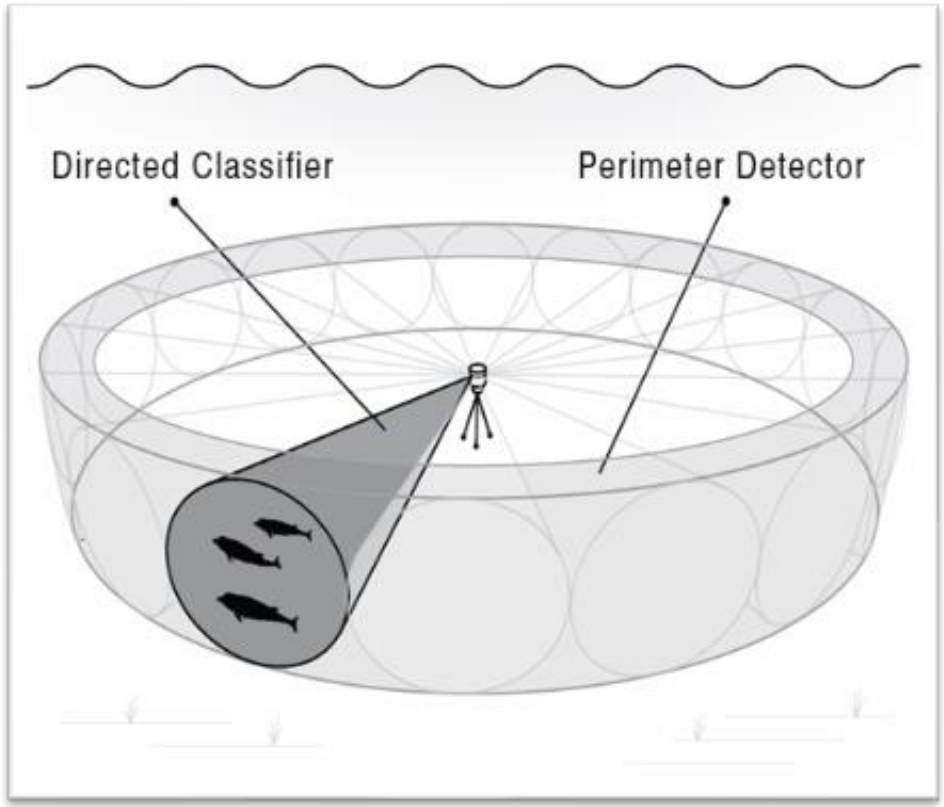


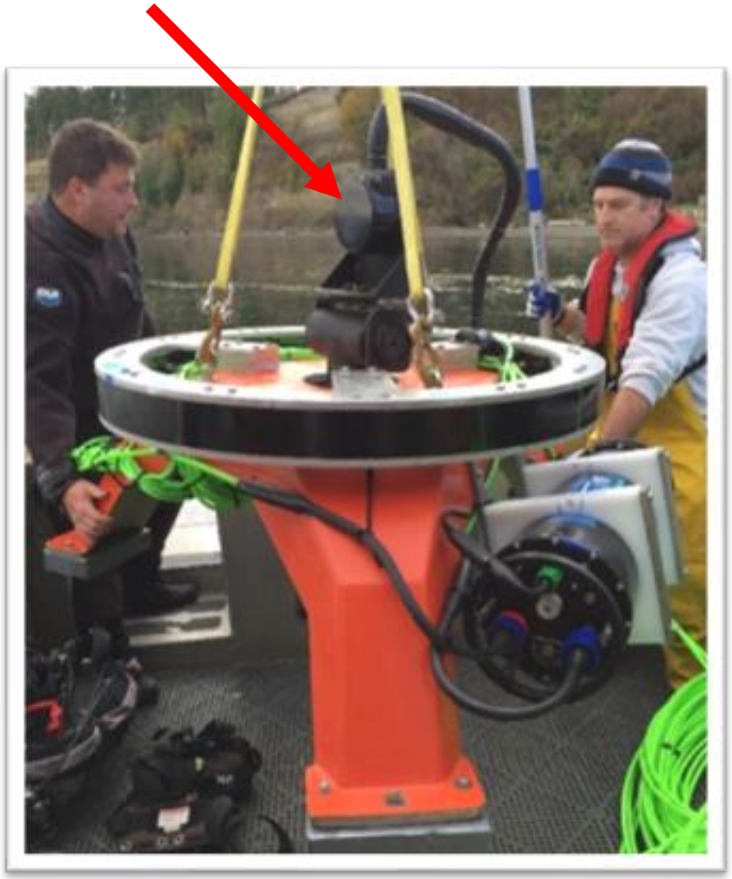


SPL @ 150 kHz @ 200m = 115dB
SPL @ 125 kHz @ 200m = 135dB
SPL @ 50 kHz @ 200m = 85dB
One 3ms ping every 2 seconds
Sound exposure @ .15% duty cycle

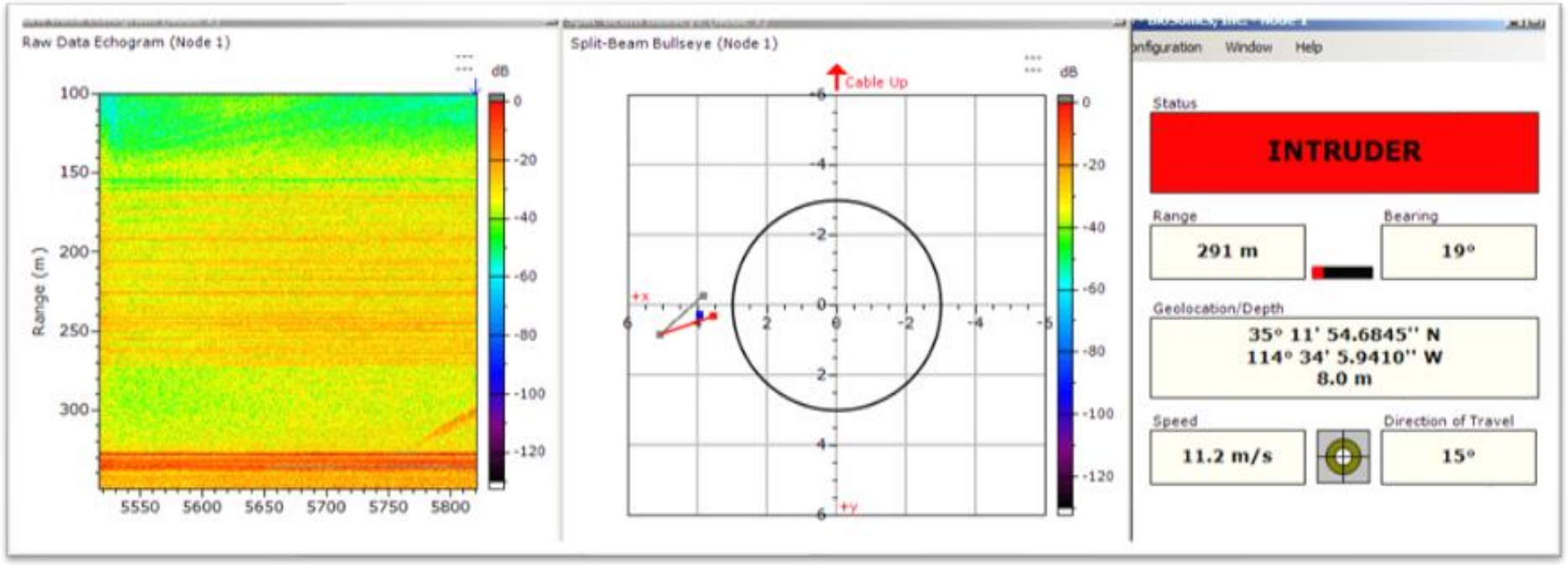
Split Beam Directed Classifier

Automatically aim at a detected target to track the target's position in three dimensions and assess acoustic signatures to provide a classification capability





Split Beam Directed Classifier



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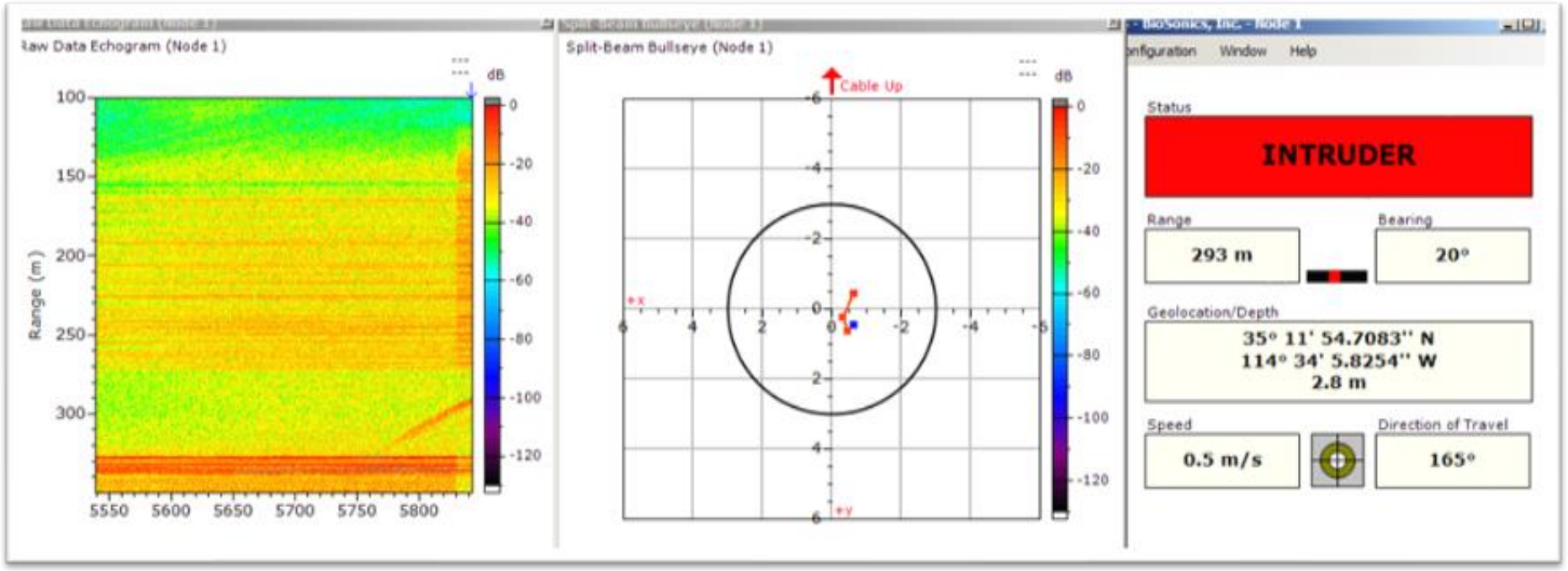

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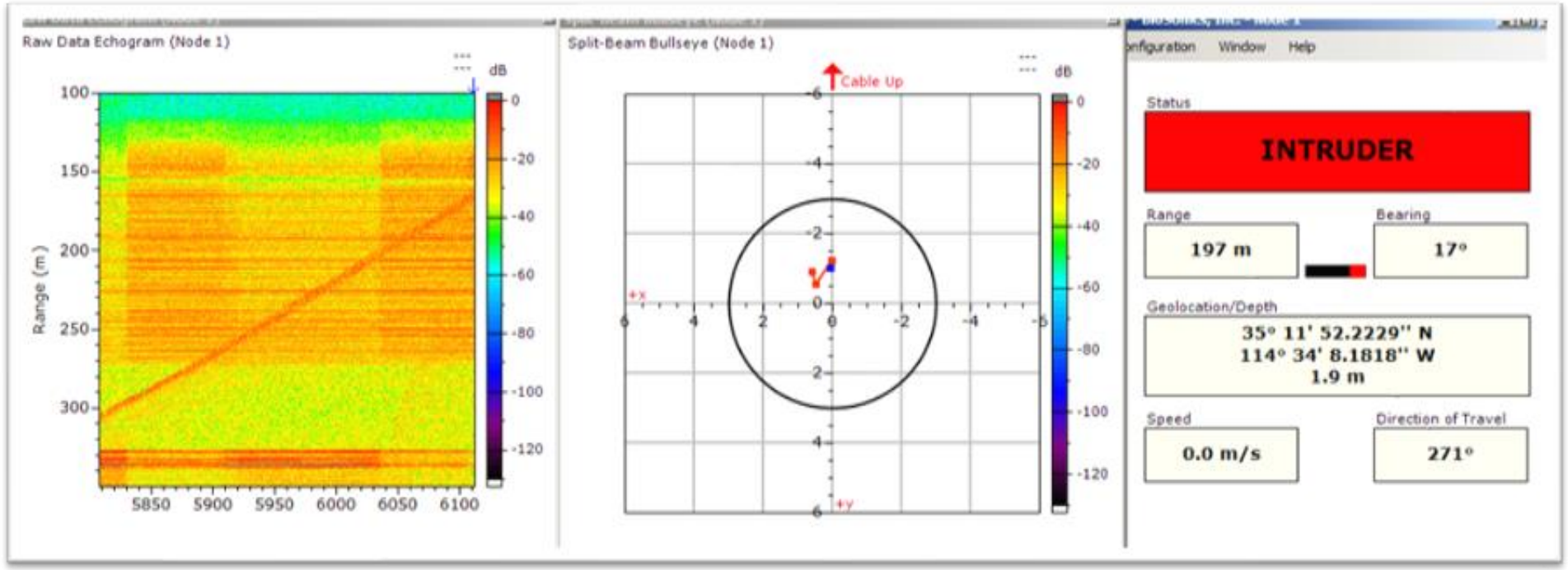
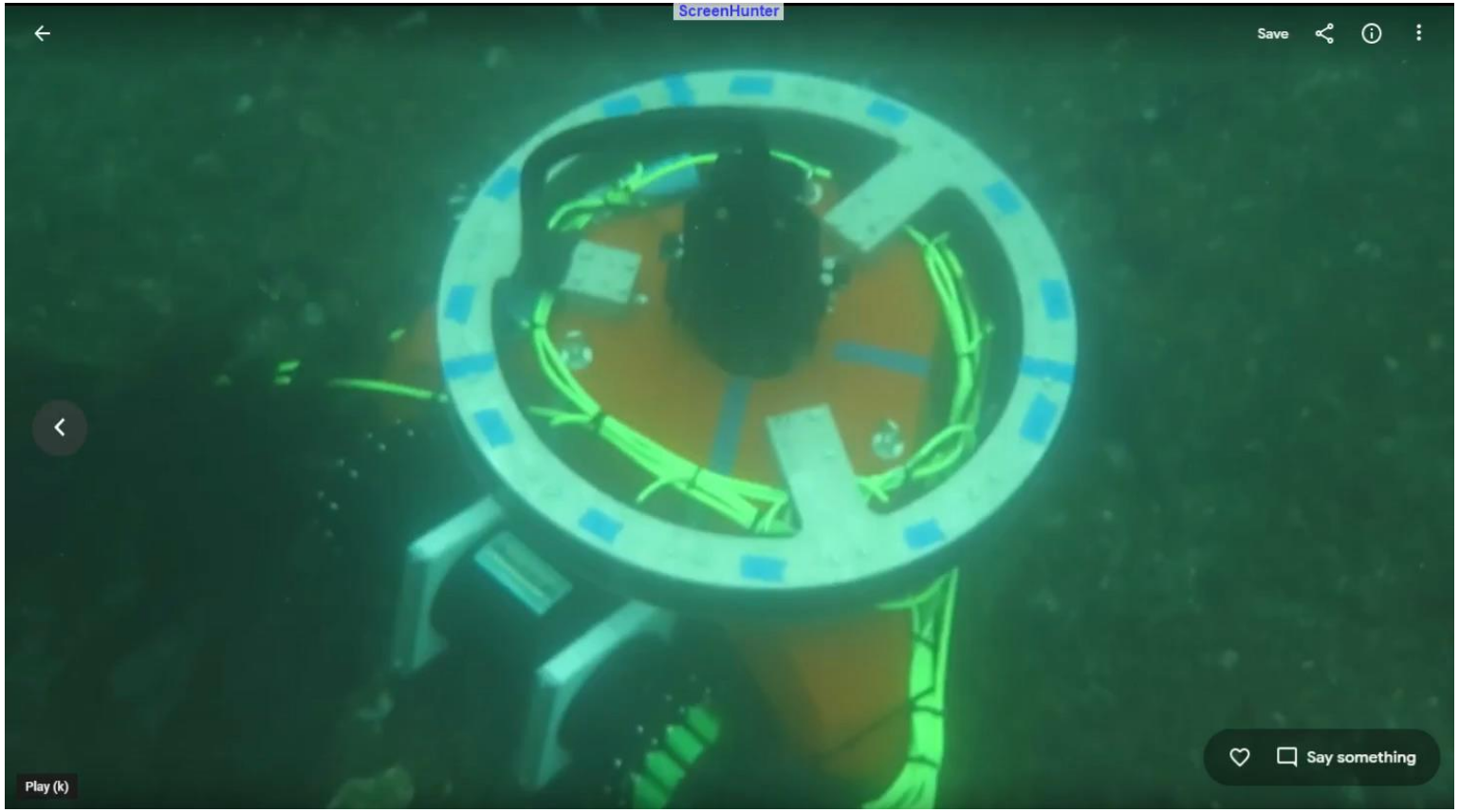


Marine Life Observer Development and Testing

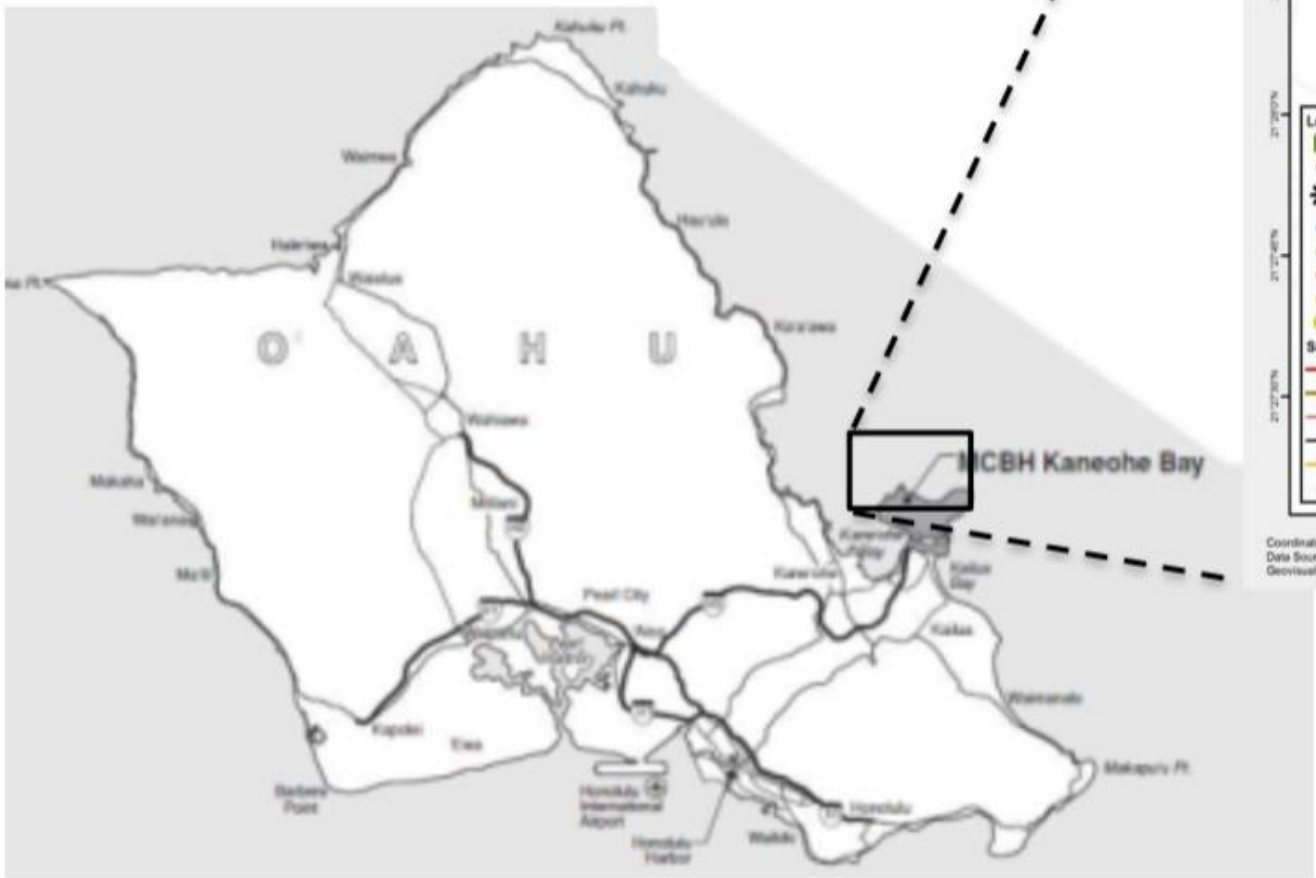
Seabed Mount (10M depth), Cabled to Shore, DOE- PNNL Sequim Lab, WA 2017 - 2019

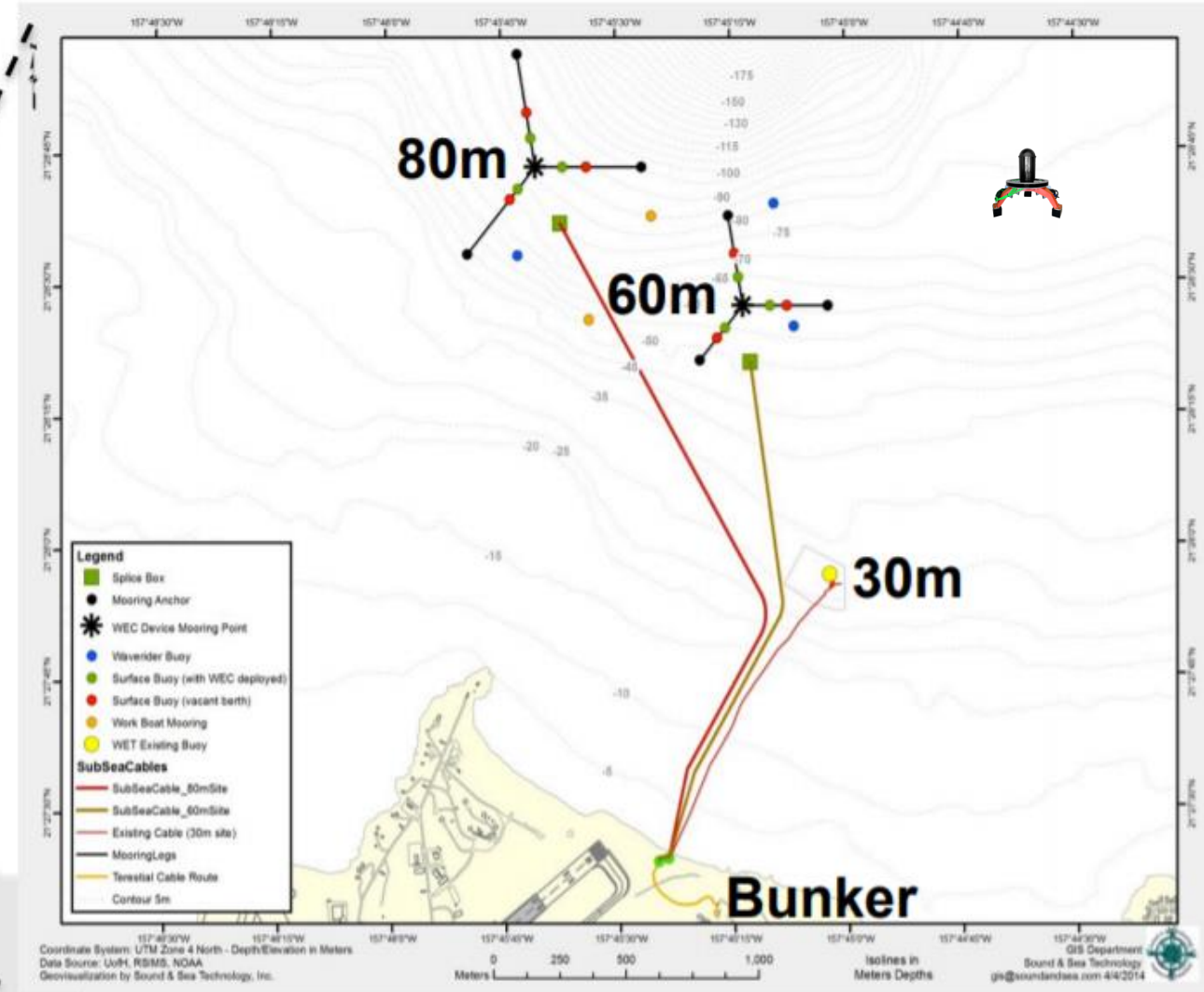


Next Steps

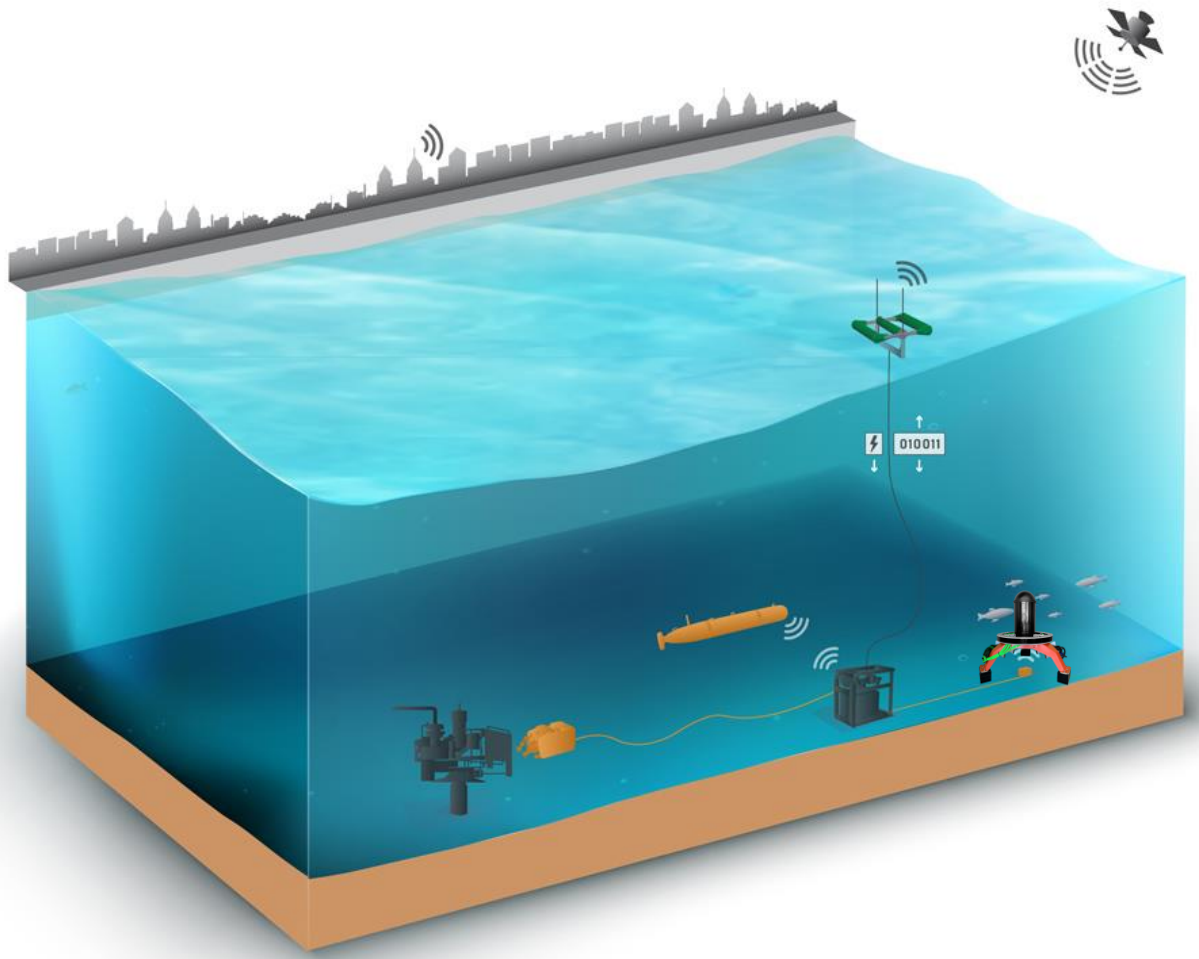
Fall / Winter 2021-2022
Marine Corps Base Hawaii
Wave Energy Test Site (WETS)

Marine Corps Base Hawaii
Wave Energy Test Site (WETS)





- Six Month Deployment Cabled to C-Power SeaRAY WEC for Power and Communications
- Monitor Marine Mammal Behavior out to Hundreds of Meters in all Directions
- Monitor Fine Scale Marine Life Behavior Around SeaRAY and SAAB Seafloor Components



Marine Life Observer

Conclusions

An autonomous, active sonar system, integrating an omni-directional array of strategically aimed and operated single beam transducers, with a directed split beam target classification sonar, is capable of automatically, detecting, geo-locating, tracking and assessing biological targets at candidate Marine Energy sites; before, during or after device deployment and reporting this information to stakeholders in real-time.

Further suppression, or total elimination, of sound energy within the hearing range of marine mammals remains the major obstacle for wide acceptance of this technology, particularly in jurisdictions where marine mammal impact is a priority.

Thank You AFAS 2021

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