Challenges to Integrated Instrumentation for Marine Monitoring

Marine Energy Technology Symposium
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Overview

- Integrated instrumentation background
- The Adaptable Monitoring Package (AMP)
- Initial instrumentation testing
- Implications for AMP development

Motivation

- Necessary to understand the environmental impacts of marine energy devices
- Need for instrumentation to monitor a broad range of environmental interactions
- Environmental monitoring costs are prohibitive to industry

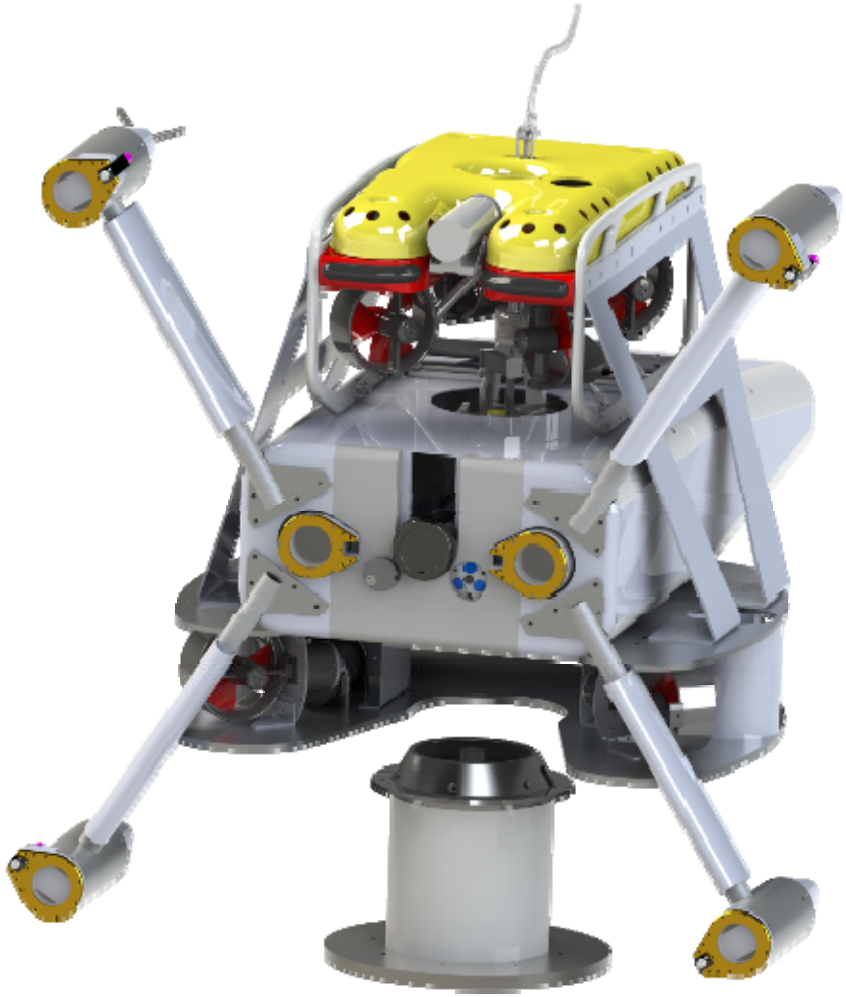
Photo Source: OpenHydro Group Ltd.

Monitoring Objectives

- Direct interaction of marine mammals, fish, sea turtles, and birds with MECs
- Changes in the distribution and use of habitats by marine animals
- Characteristics of the sound produced by marine energy converters

Photo Source: National Geographic

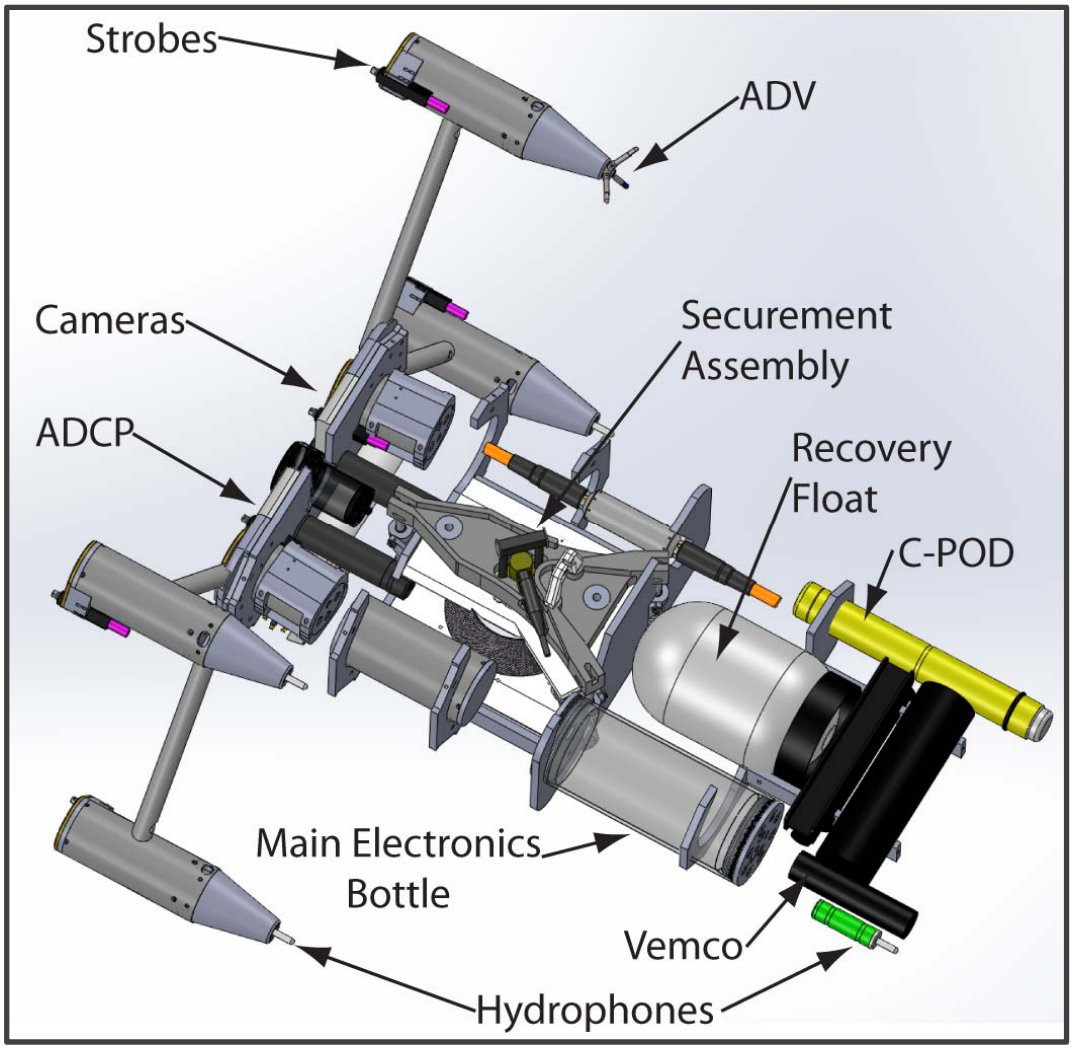
Requirements for Integrated Instrumentation



- Detect frequent, low impact events and infrequent, high impact events
- Withstand tidal environment for long-term deployments
- Deployable in high-energy environments
- Relatively low-cost

AMP Field Trials

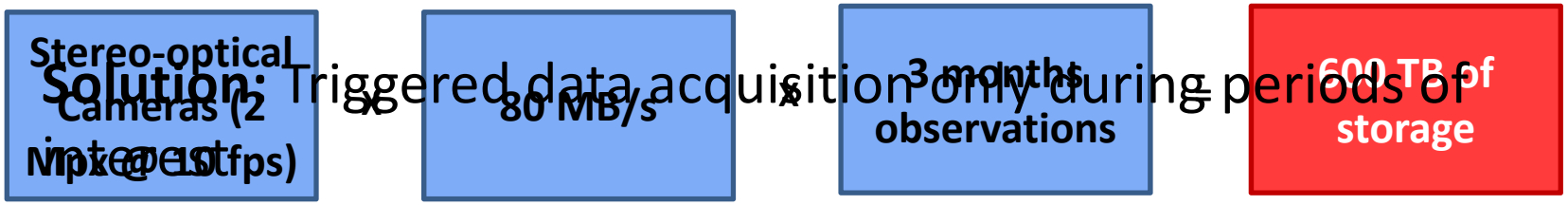
Typical Instrument Payload



- Optical Cameras
- Active Acoustics
  - Kongsberg Multibeam Sonar
  - BlueView Acoustic Camera
- Passive Acoustics
  - Hydrophone Array
  - Vemco Fish Tag Receiver

Instrument Data Storage

- Likely to generate “data mortgages”
- Severe outcomes are rare
- Observing interactions requires continuous monitoring



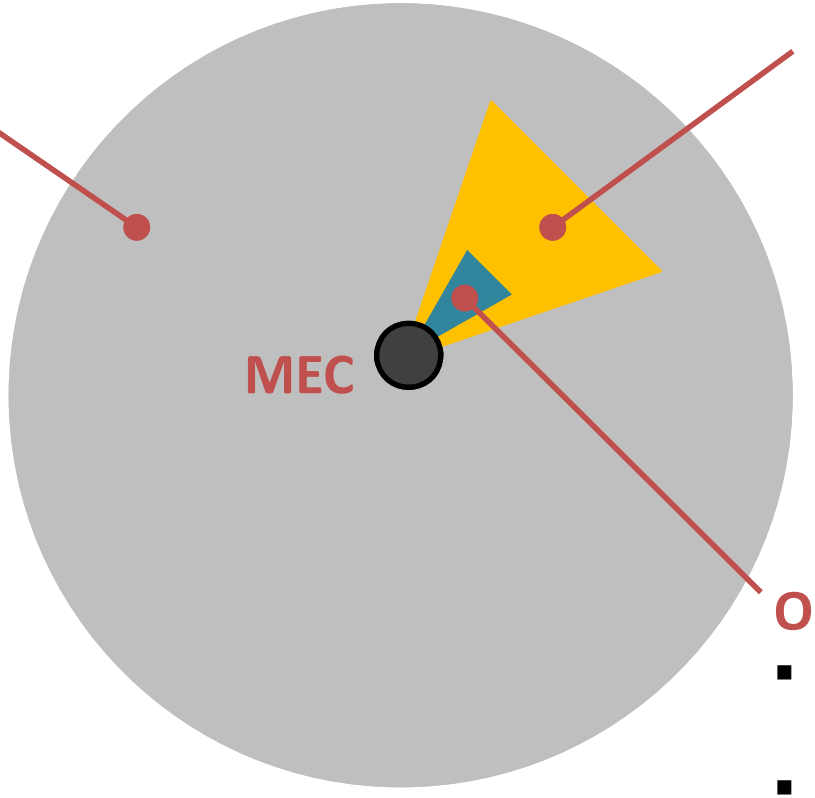
Solution: Triggered data acquisition only during periods of interest

Continuous stereo-optical monitoring for a single camera pair

Instrument Capabilities

Passive Acoustic Detection

- Omni-directional coverage at ranges on the order of 1 km
- Processing in near real-time



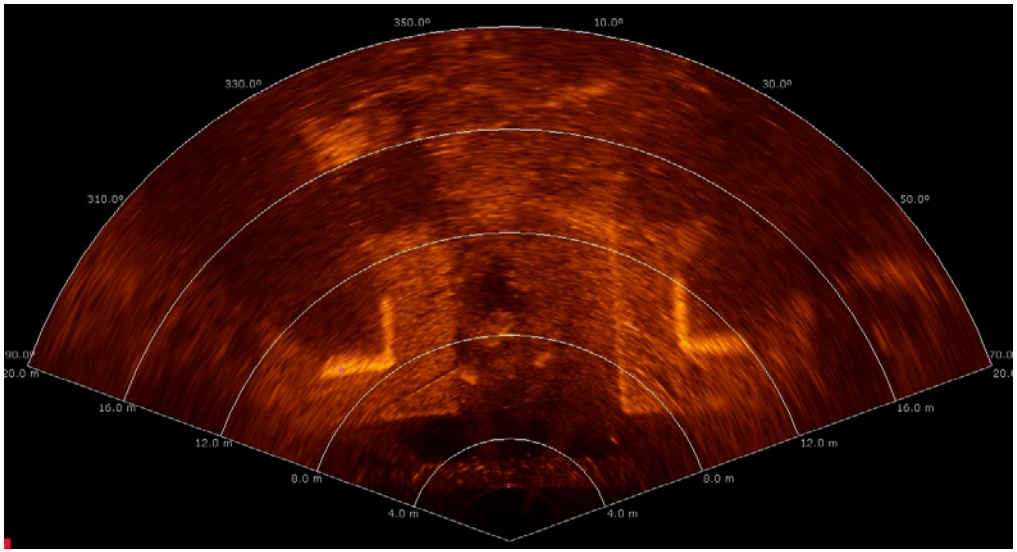
Multi-beam Sonar

- Tracking capability at ranges up to 100 m
- Processing in near real-time

Optical Camera

- Short range and limited field of view
- Requires ambient light
- Requires archival processing

Kongsberg M3 Multibeam Sonar

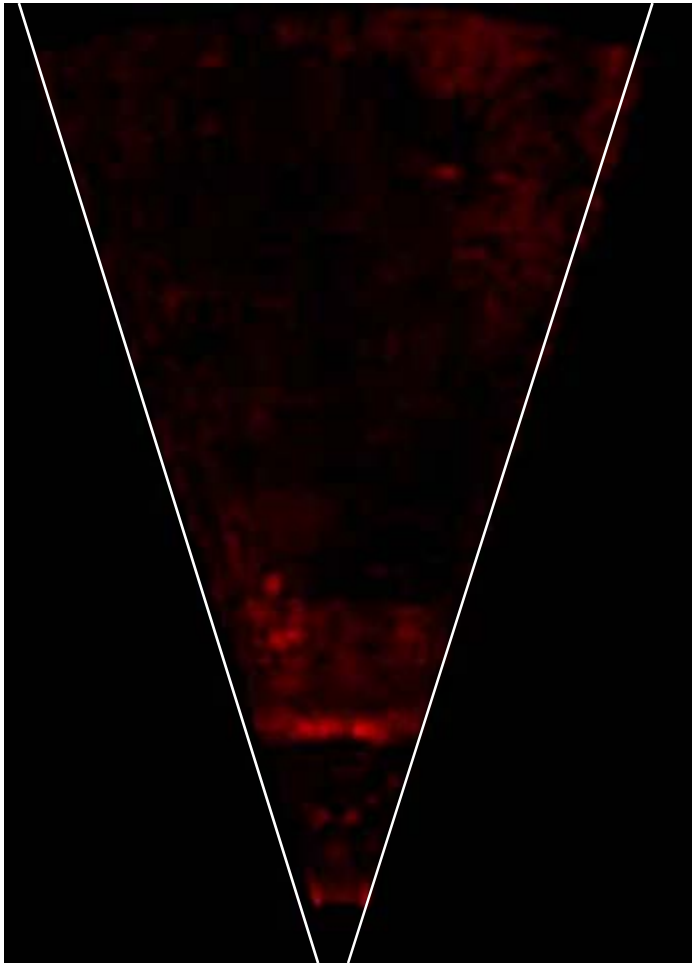


Target Detection on M3 Sonar

Operating Frequency	500 kHz
Angular Resolution	1.6°
Max Range	150 m
Field of View	120° x 30°

BlueView Acoustic Camera

Frequency	900 kHz	2.25 MHz
Angular Resolution	0.18°	0.18°
Range	2-59 m	0.5-5 m
Field of View	45° x 20°	45° x 20°



Target Detection on Acoustic Camera

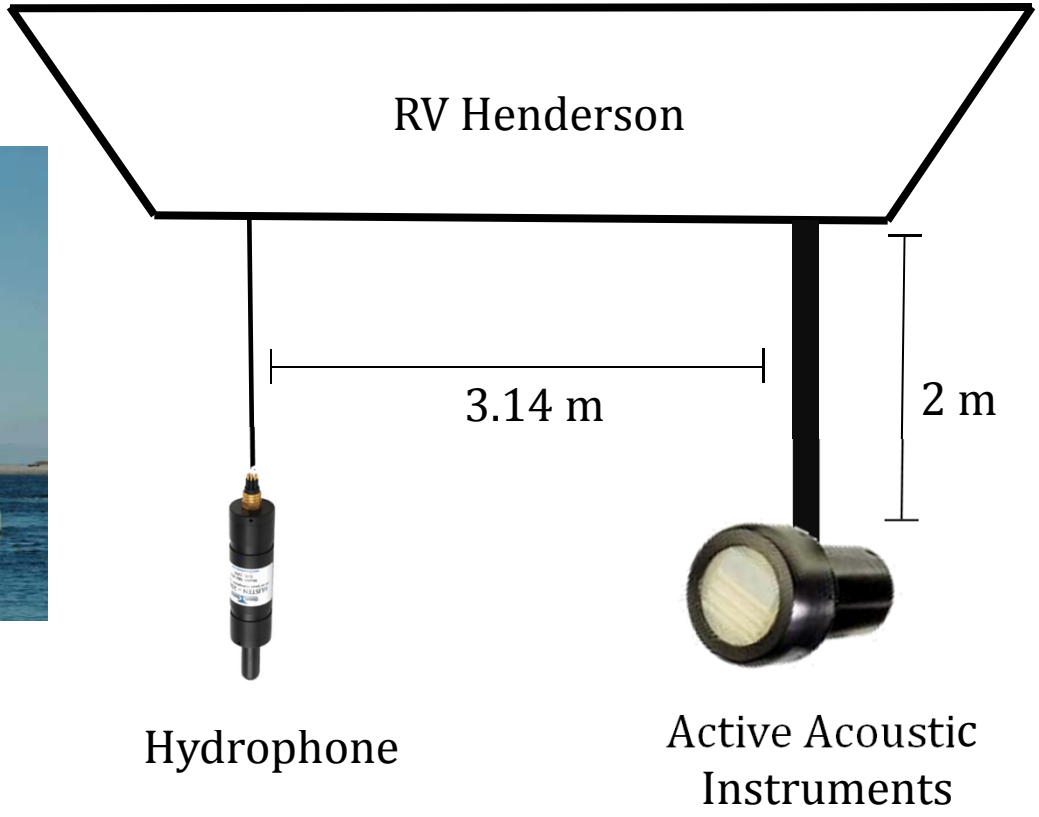
Nortek Signature 1000 ADCP

Operating Frequency	1000 kHz
Max Sampling Rate	16 Hz
Max Range	30 m

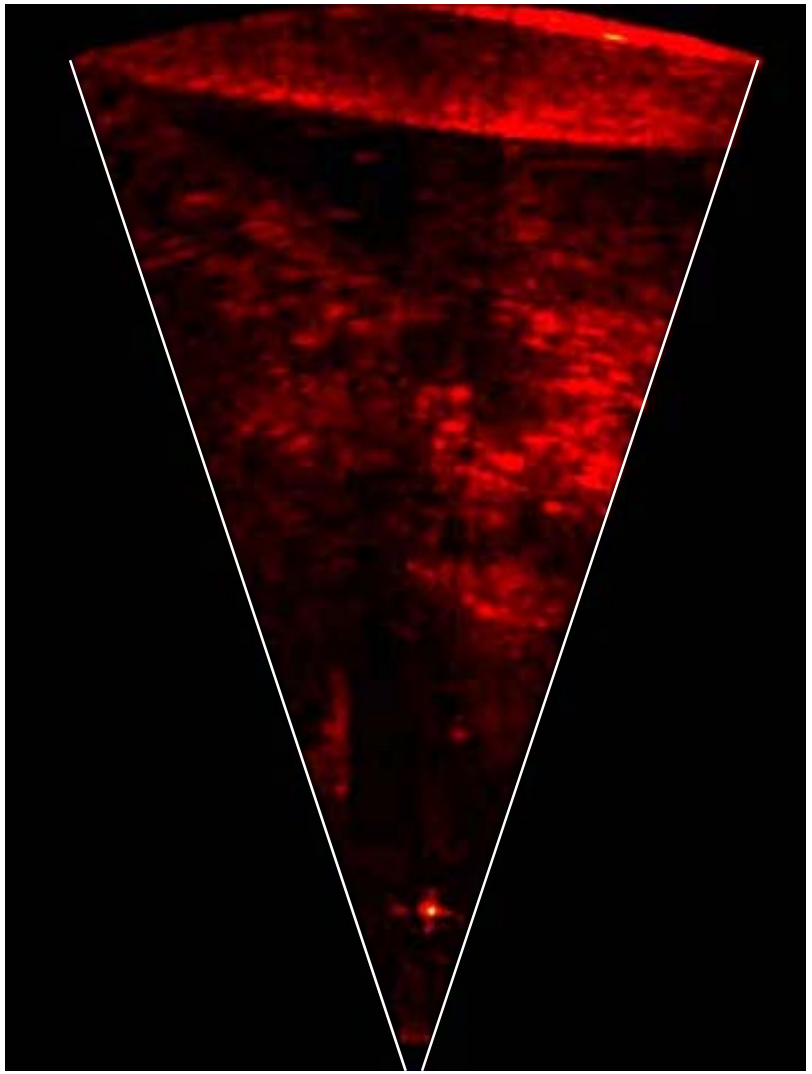
Challenges to Integration

1. Will active acoustic “crosstalk” compromise data?
2. Is triggering possible?
3. Will sound from active acoustic instruments disturb marine mammals?

Initial Integration Test

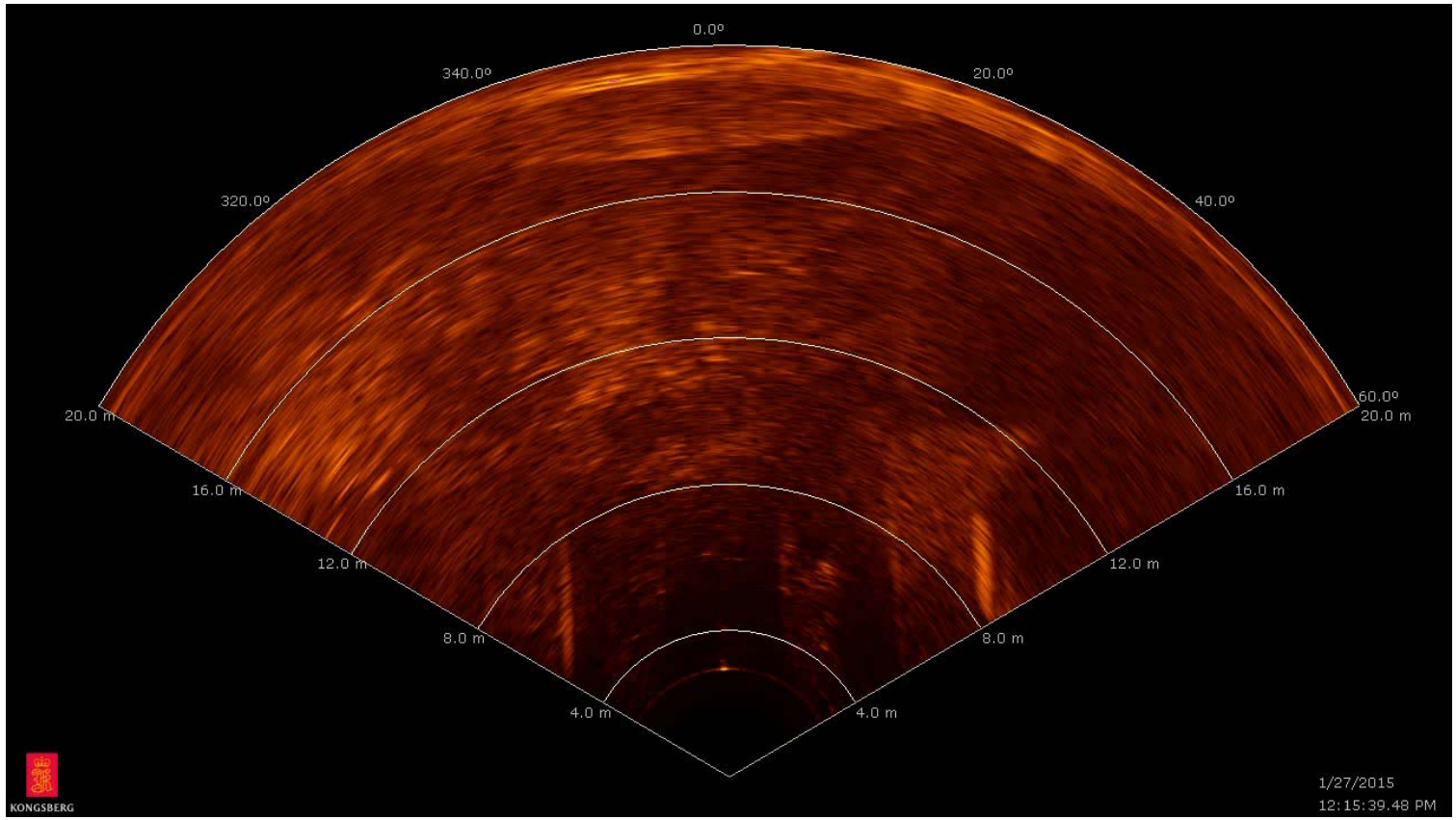


Active Acoustic Interference



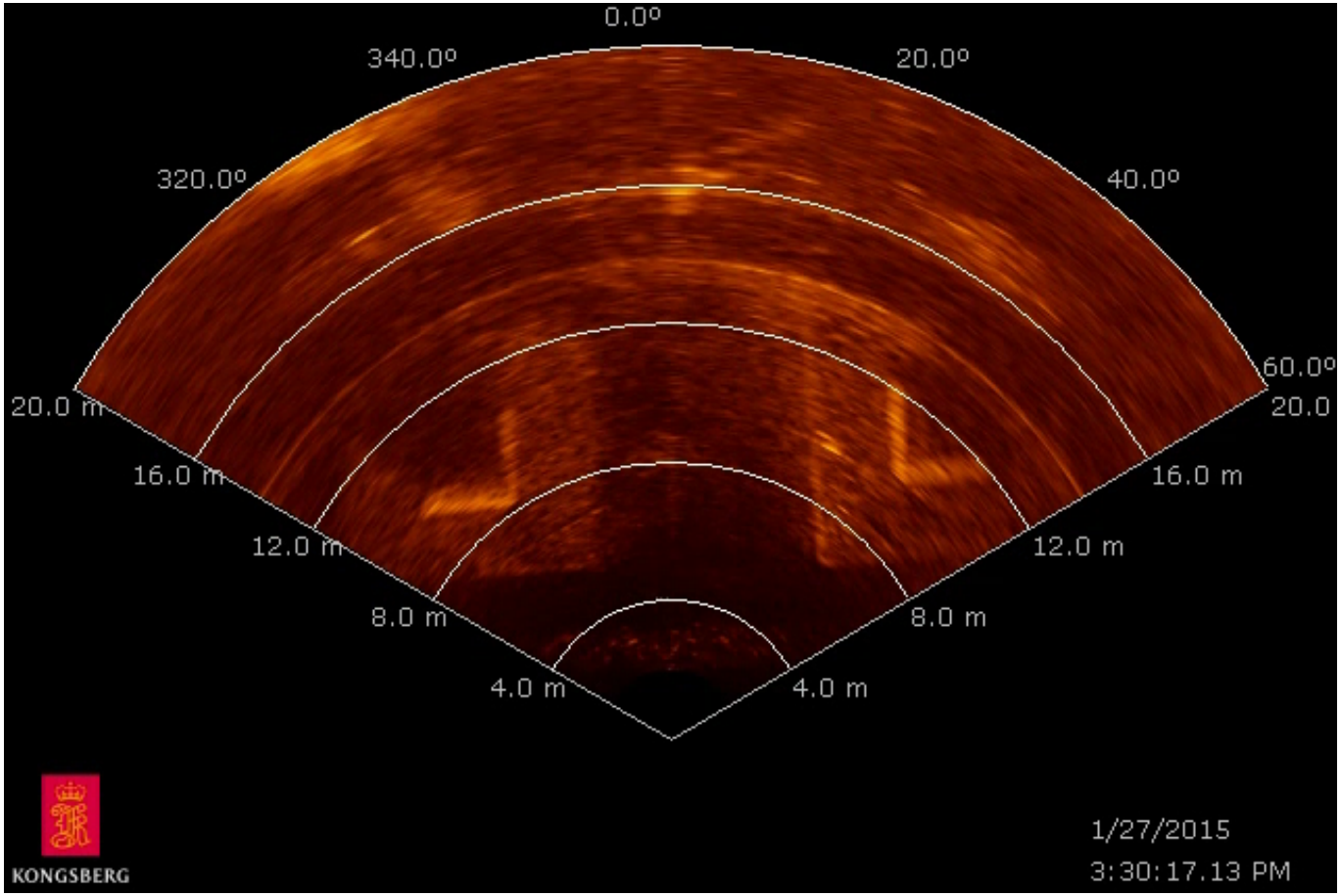
Crosstalk on BlueView Acoustic Camera

Active Acoustic Interference



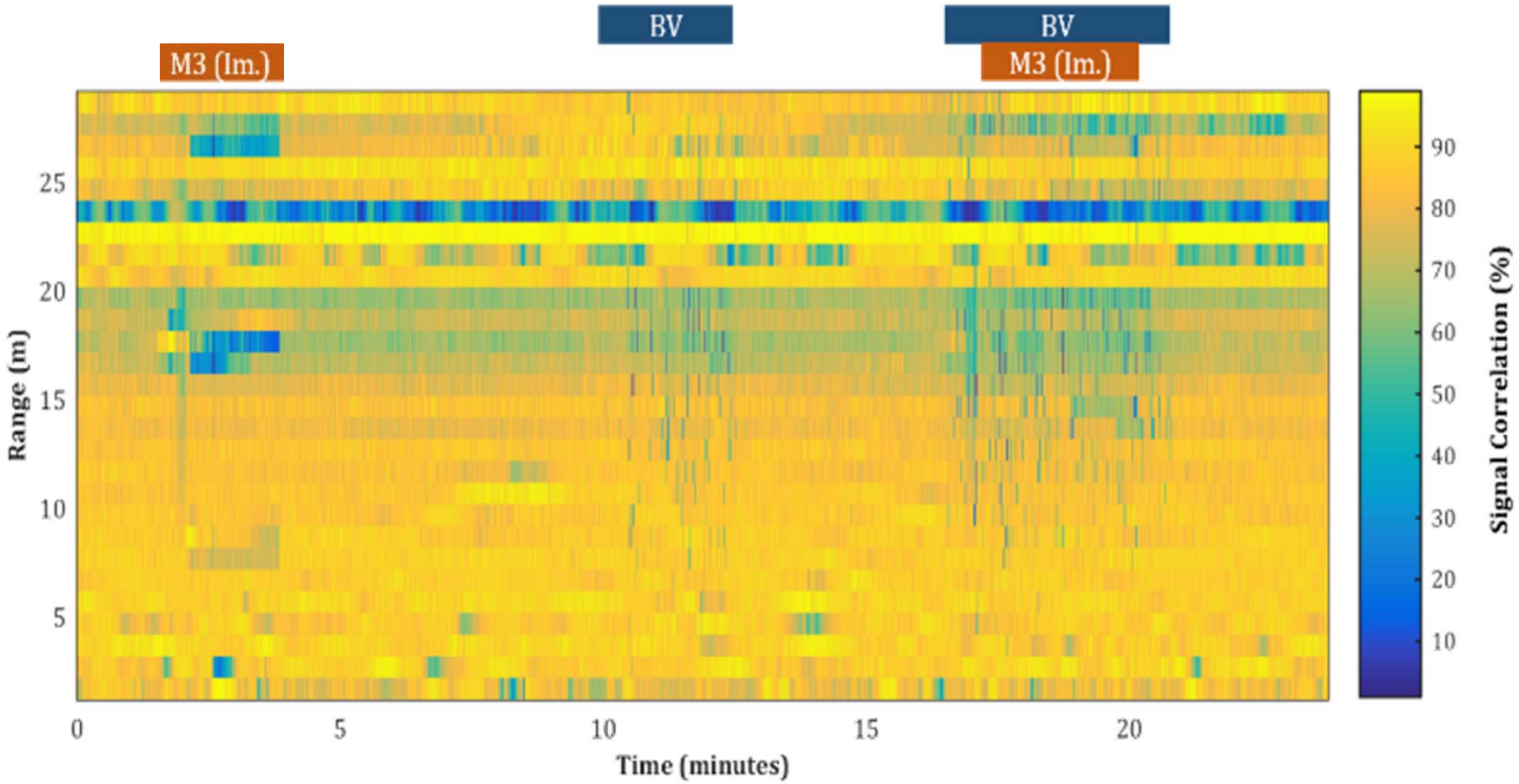
Crosstalk on M3 Multibeam Sonar

Active Acoustic Interference



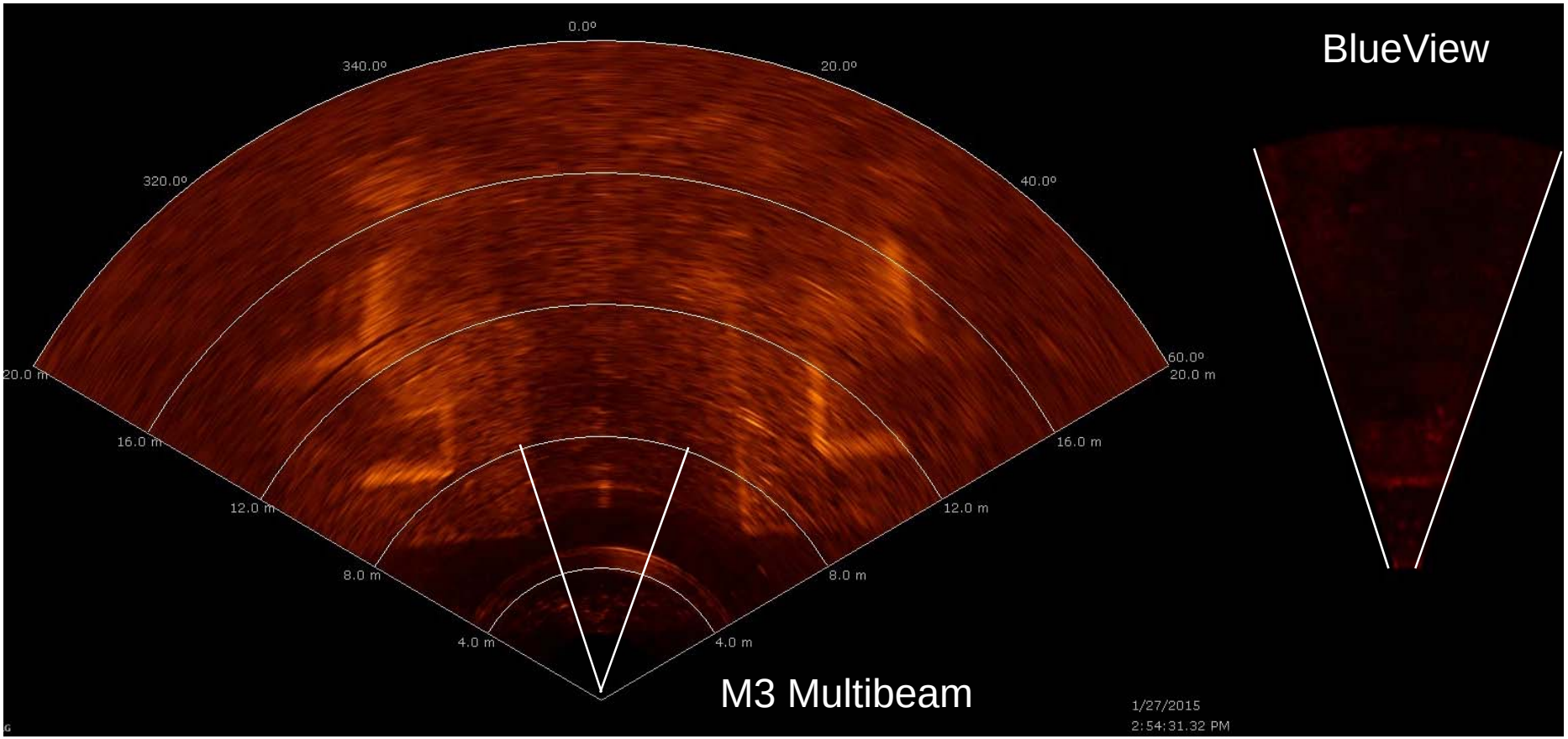
Crosstalk on M3 Multibeam Sonar

Active Acoustic Interference



Crosstalk Present on Nortek ADCP

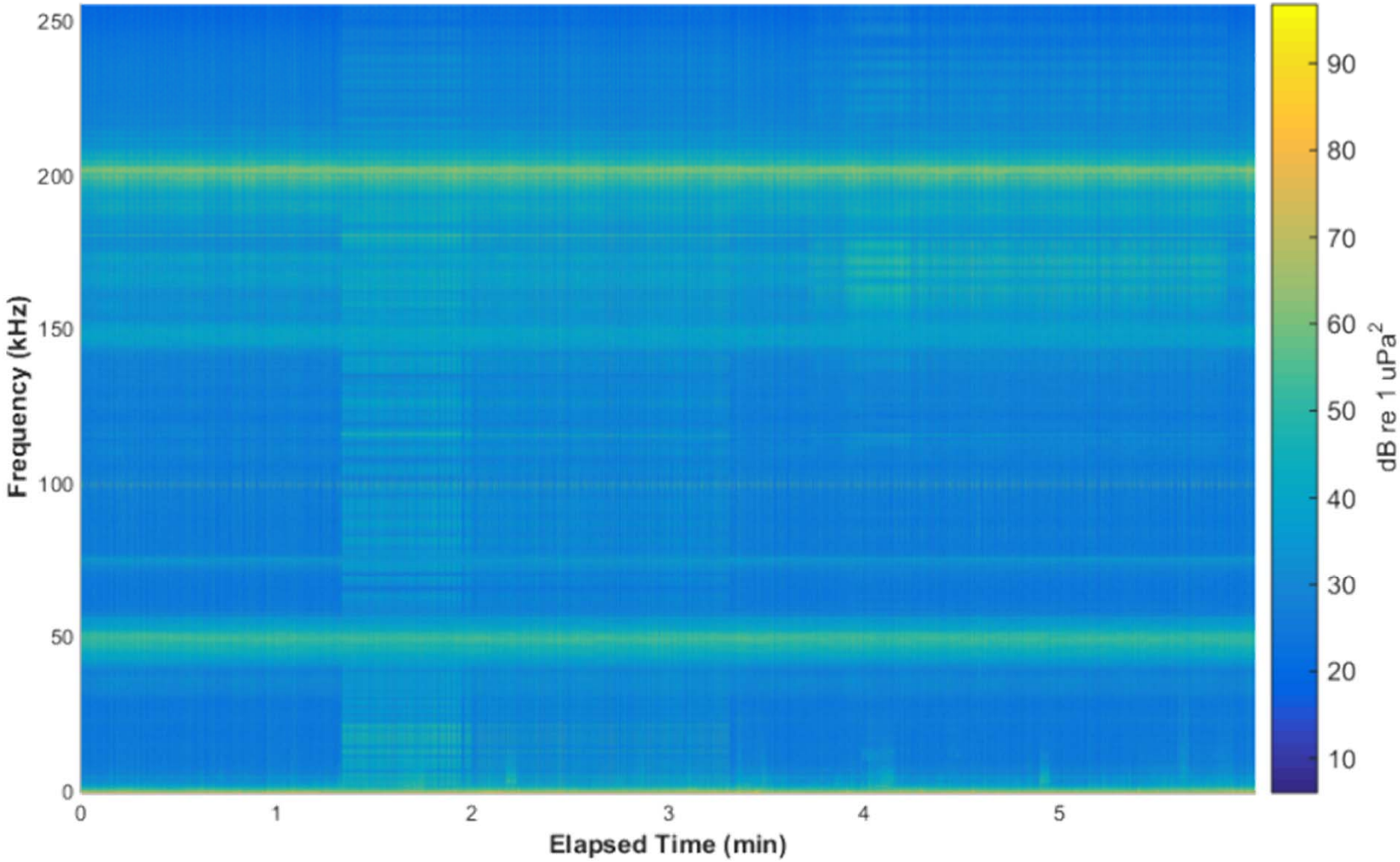
Target Handoff



Passive Acoustic Interference (On-Axis)

900 kHz Head On

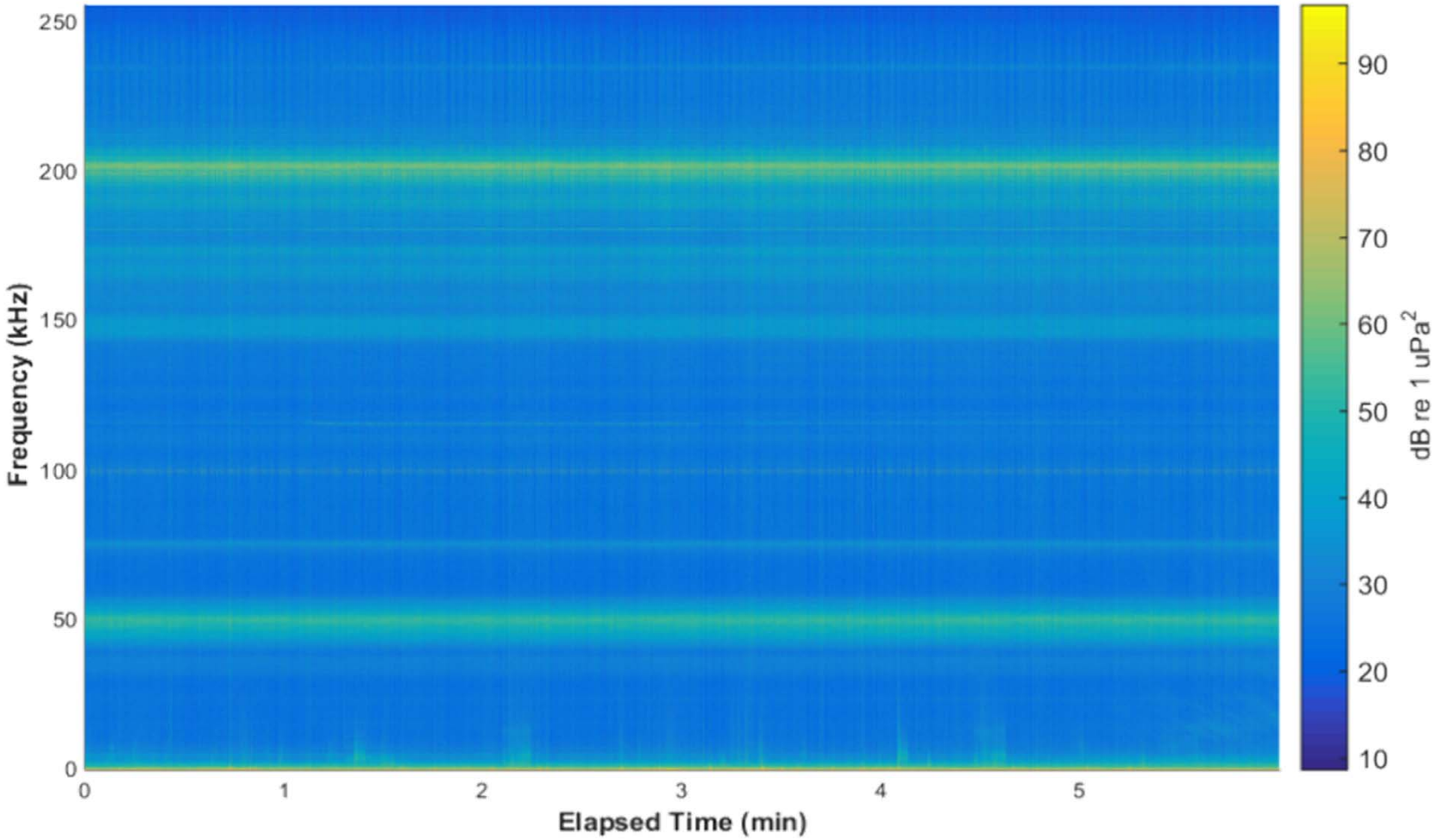
2.25 MHz Head On



Passive Acoustic Interference (Off-Axis)

900 kHz Head On

2.25 MHz Head On



Implications of Initial Testing

- Ping scheduling will be necessary for active acoustics, cross talk could result in false triggers or interference with targets
- Target handoff appears feasible
- Further testing will determine if sound from instruments will deter marine mammals

Acknowledgements

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NAVFAC
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NNMREC
Northwest National Marine Renewable Energy Center

University of Alaska Fairbanks

Oregon State University

University of Washington