An Intelligent Adaptable Monitoring Package for Marine Renewable Energy

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Project Overview

An Intelligent Adaptable Monitoring Package (iAMP) for Marine Renewable Energy: Environmental risks must be identified and either mitigated or retired for marine renewable energy to develop into a commercial industry. The iAMP supports comprehensive monitoring of wave and current energy projects.

The Challenge: Integrating sensors for comprehensive monitoring is necessary, but this is technically challenging and can produce overwhelming volumes of data.

Partners: Pacific Northwest National Laboratory (PNNL), Oregon State University, SMRU Consulting, European Marine Energy Centre

Program Strategic Priorities

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Technology Maturity

- Test and demonstrate prototypes
- Develop cost effective approaches for installation, grid integration, operations and maintenance
- Conduct R&D for innovative MHK systems & components
- Develop tools to optimize device and array performance and reliability
- Develop and apply quantitative metrics to advance MHK technologies

Deployment Barriers

- Identify potential improvements to regulatory processes and requirements
- **Support research focused on retiring or mitigating environmental risks and reducing costs**
- Build awareness of MHK technologies
- Ensure MHK interests are considered in coastal and marine planning processes
- Evaluate deployment infrastructure needs and possible approaches to bridge gaps

Market Development

- Support project demonstrations to reduce risk and build investor confidence
- Assess and communicate potential MHK market opportunities, including off-grid and non-electric
- Inform incentives and policy measures
- Develop, maintain and communicate our national strategy
- Support development of standards
- Expand MHK technical and research community

Crosscutting Approaches

- Enable access to testing facilities that help accelerate the pace of technology development
- Improve resource characterization to optimize technologies, reduce deployment risks and identify promising markets
- Exchange of data information and expertise

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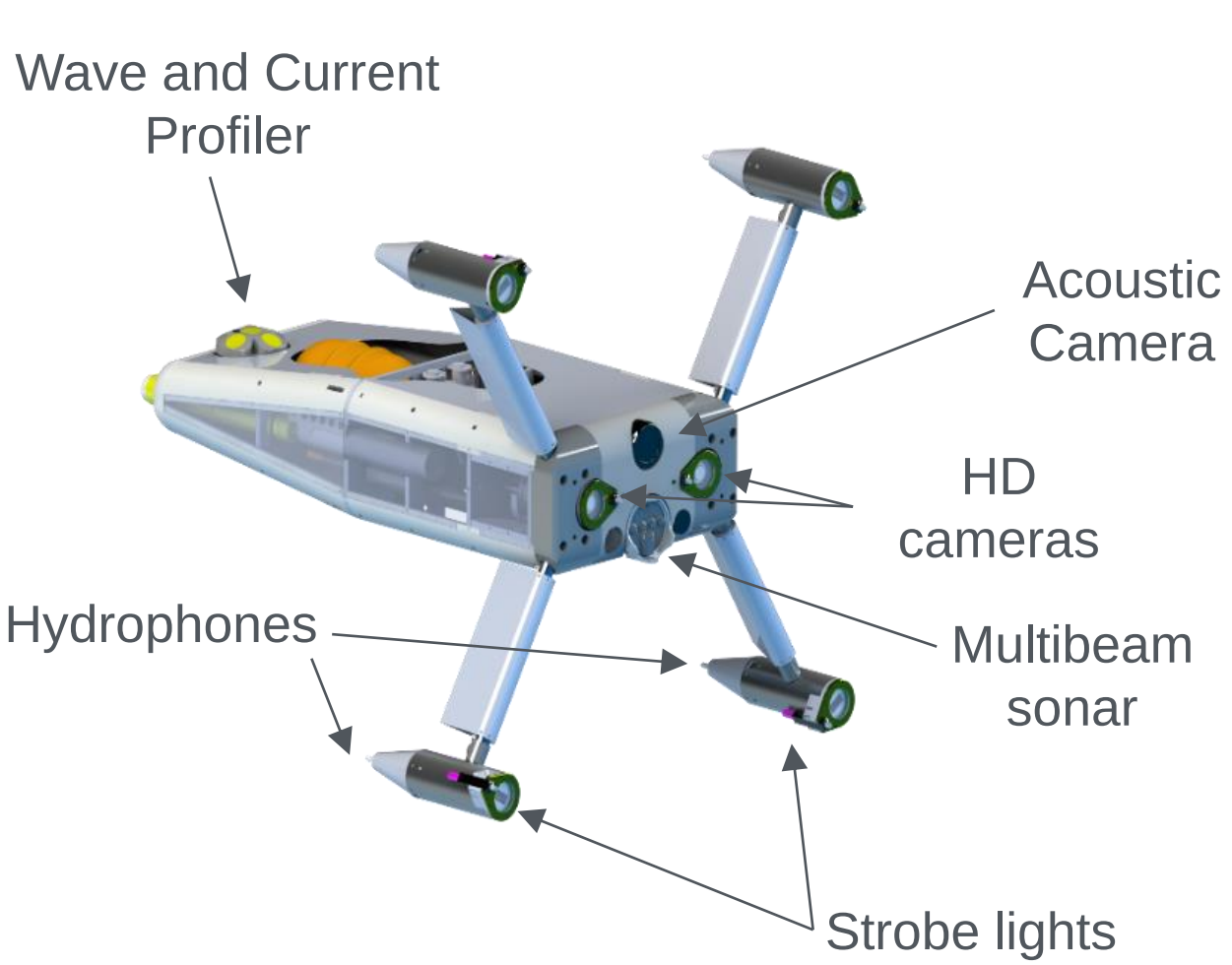
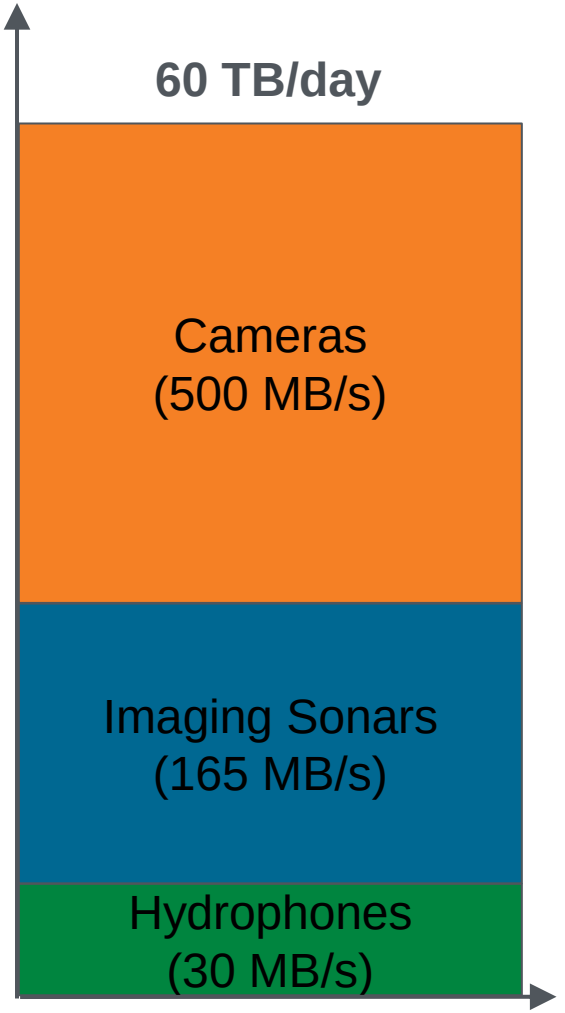
The Impact

- Demonstrated feasibility and reliability of integrated instrumentation for comprehensive monitoring of marine energy projects.
  - Successful integration of all sensors
  - Percentage uptime during endurance trials
  - Reduction in data volumes through software integration
- Demonstrated operation in cabled and autonomous deployment modes at current and wave energy sites
- Allow industry to cost-effectively retire or mitigate environmental risks

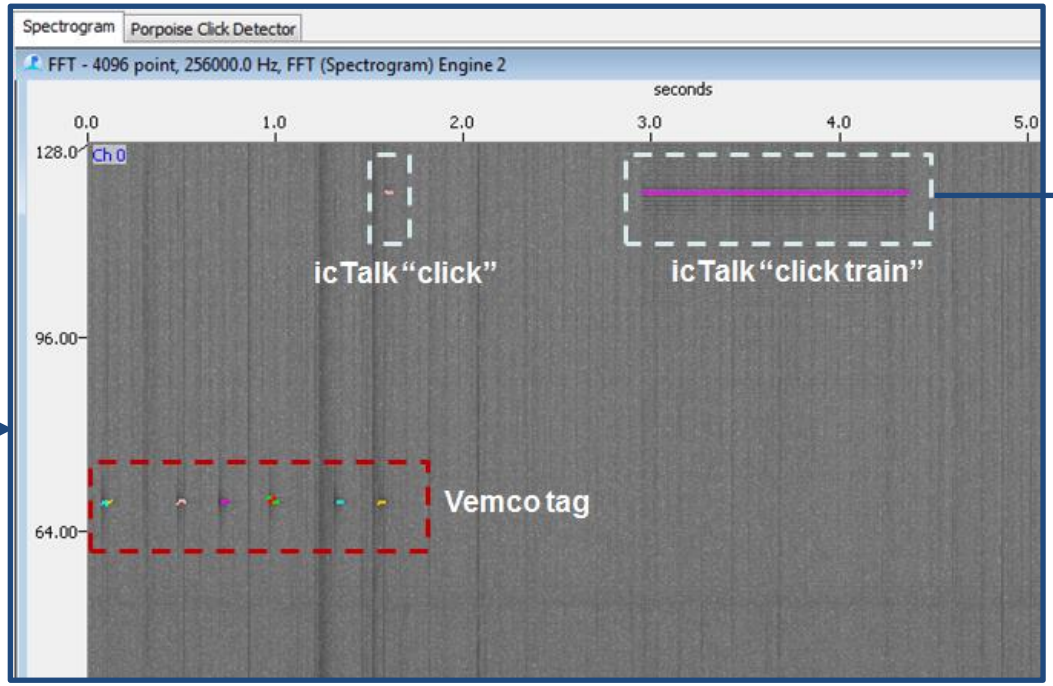
Technical Approach





Technical Approach

Instrument Stream



PAMGuard: Detection & Classification

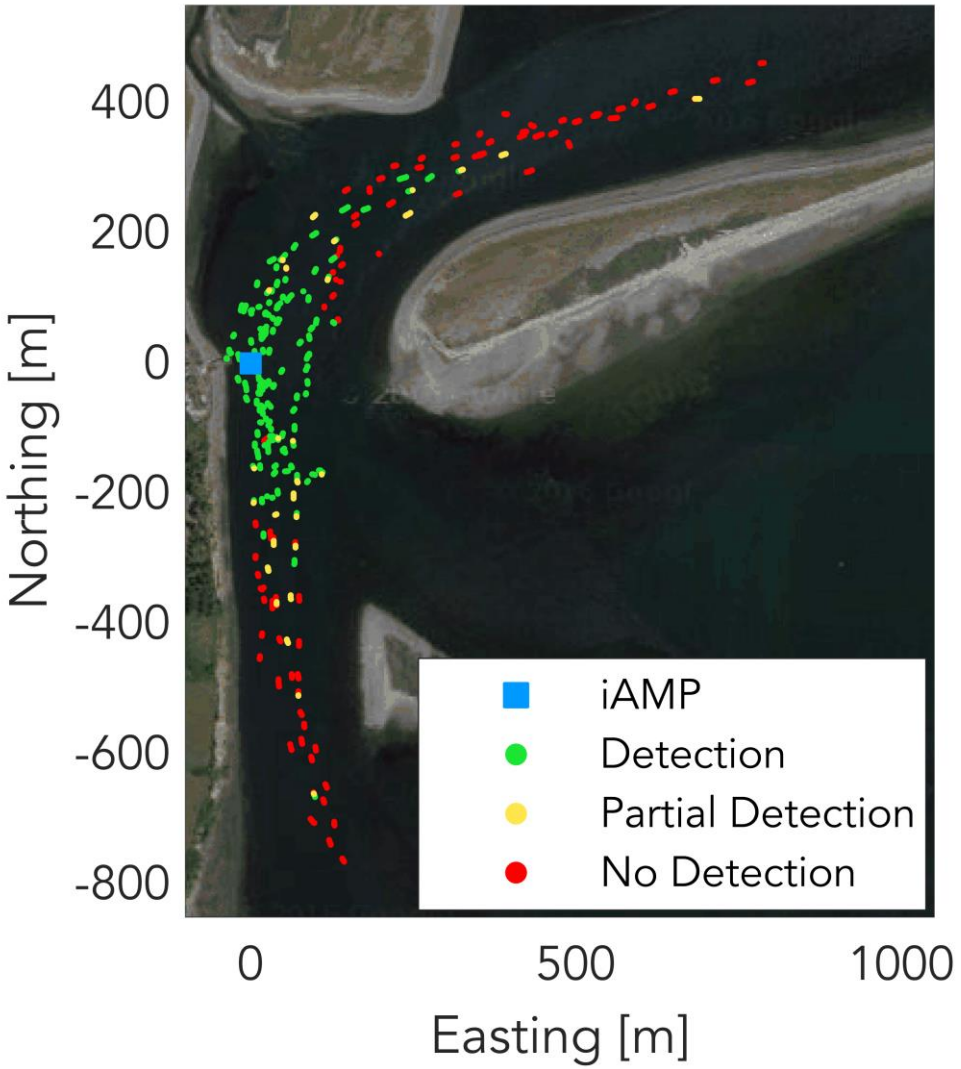
Populate Ring Buffer

Event Detection Trigger

Archival Data

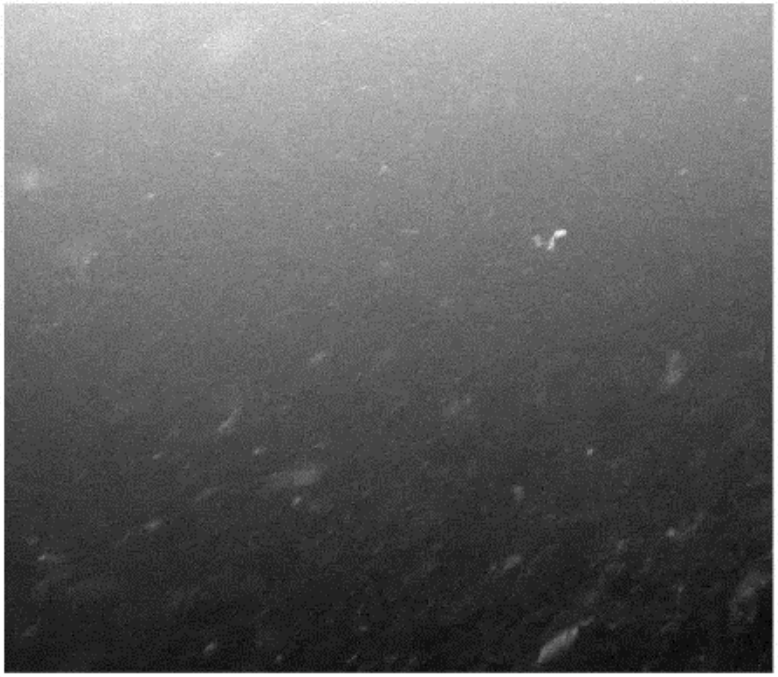
Accomplishments and Progress

- Completed endurance trial at PNNL Marine Sciences Laboratory (MSL) with 90% uptime (over four months)
  - Able to interface with NIMS for automatic detection
  - Foundation for autonomous iAMP ("AutoAMP") development
- Demonstrated passive acoustic detection capabilities using cooperative targets
  - Able to detect fish tags beyond range of other sensors (e.g., sonar)

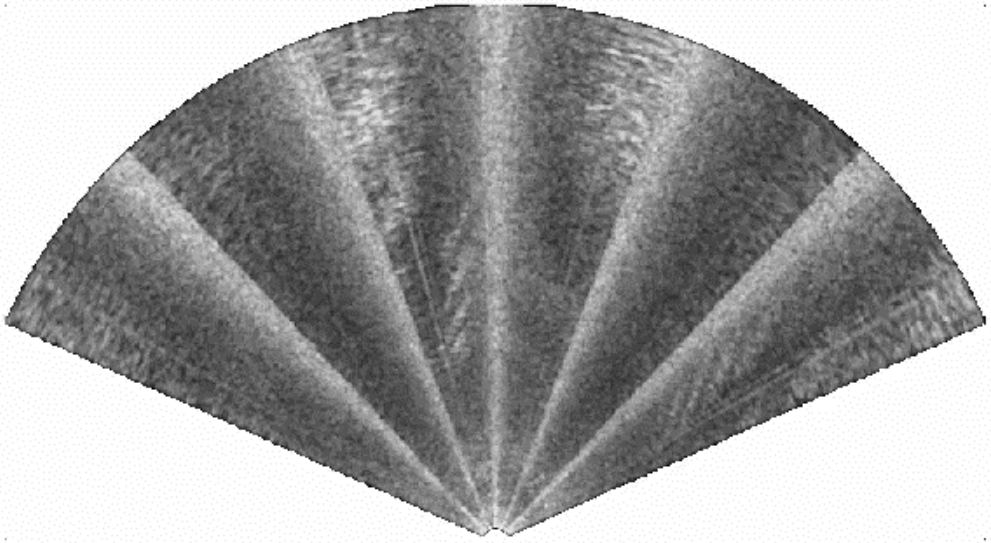


Optical Camera

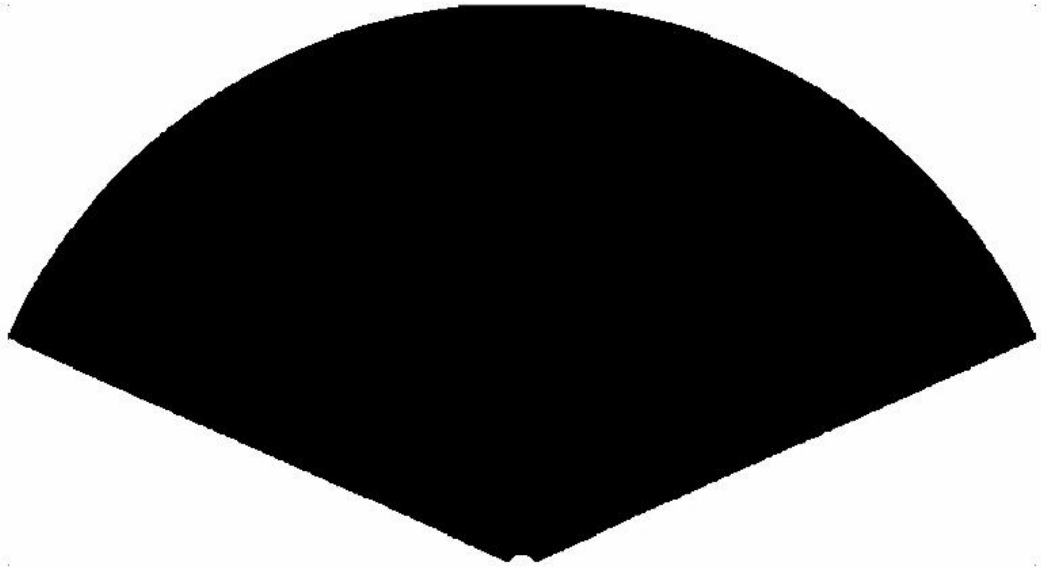
(3x zoom)



Acoustic Camera

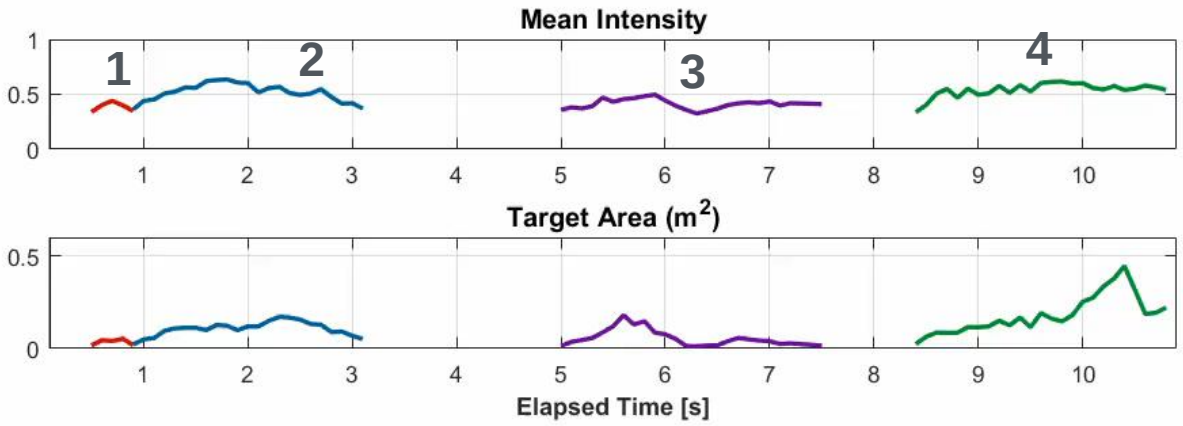


Accomplishments and Progress



Mean Intensity [~]

Target Area [m^2]



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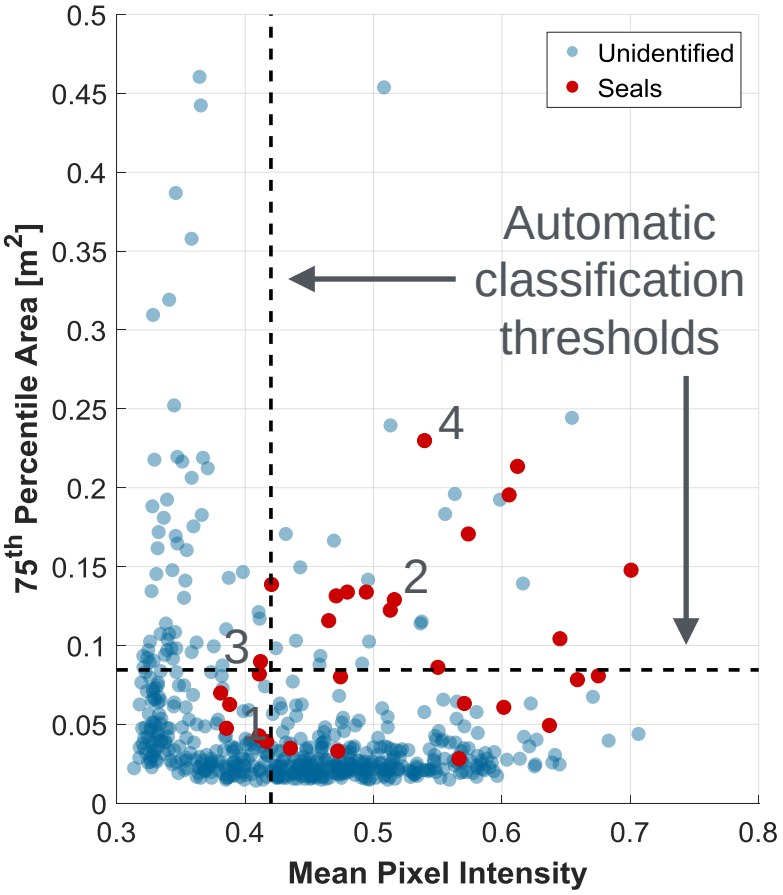

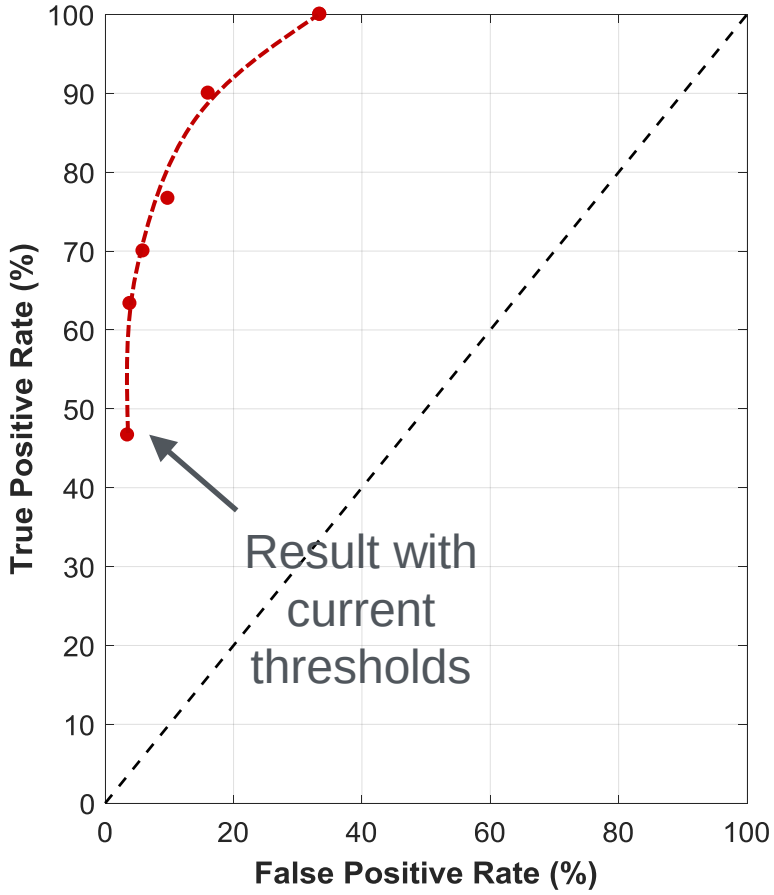

Project Plan & Schedule

- Project awarded in 2014, with expected completion in 2018
- *BP 1 Extension*: Initial endurance test aborted after one month due to detection of ground fault (false alarm, but system damaged during diagnostic and required refit)
- *BP 2 Extension*: Delay in AutoAMP deployment from spring 2016 to autumn 2016 to double battery capacity (and duty cycle) for deployment off Newport, OR, at Pacific Marine Energy Center-South Energy Test Site
- BP 2 Go/No-Go in May 2016
- BP 3 Go/No-Go anticipated in autumn 2017 for autonomous or cabled deployment at Wave Energy Test Site

Project Budget

Budget History					
FY2014		FY2015		FY2016	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$0k	$0k	$287k	$42k	$154k	$21k

- 50% of budget expended to date
- Leveraging support from U.S. Department of Defense Naval Facilities Engineering Command for second-generation hardware development
- Leveraging student support from National Science Foundation Graduate Research Fellowship

Research Integration & Collaboration

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Partners, Subcontractors, and Collaborators:

- University of Washington
  - Mechanical Engineering: Brian Polagye (PI), Emma Cotter, Paul Murphy
  - Applied Physics Laboratory: Andy Stewart (co-PI), James Joslin, Paul Gibbs
- PNNL (Shari Matzner, Genevra Harker-Klimeš)
- Oregon State University (Sarah Henkel)
- SMRU Consulting (Jason Wood)
- European Marine Energy Center (Elaine Buck)

Communications and Technology Transfer:

- Presentations at Marine Energy Technology Symposium 2015/2016; 2016 Coral Reef Symposium, • Acoustical Society of America 2016 (invited)
- Technical interchange with U. of Aberdeen (FLOWBEC)

Next Steps and Future Research

FY17/Current research:

- Complete development of AutoAMP
- Successfully deploy and recover AutoAMP off Newport, OR (PMEC-SETS)
- Finalize plans for cabled or autonomous deployment at U.S. Navy Wave Energy Test Site in Budget Period 3

Proposed future research:

- Move to “third-generation” integrated instrumentation—hardware and software integration that improves certainty in target classification and controls instrument package (under award negotiation from 1418 Funding Opportunity Announcement)