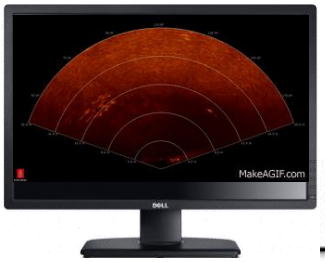
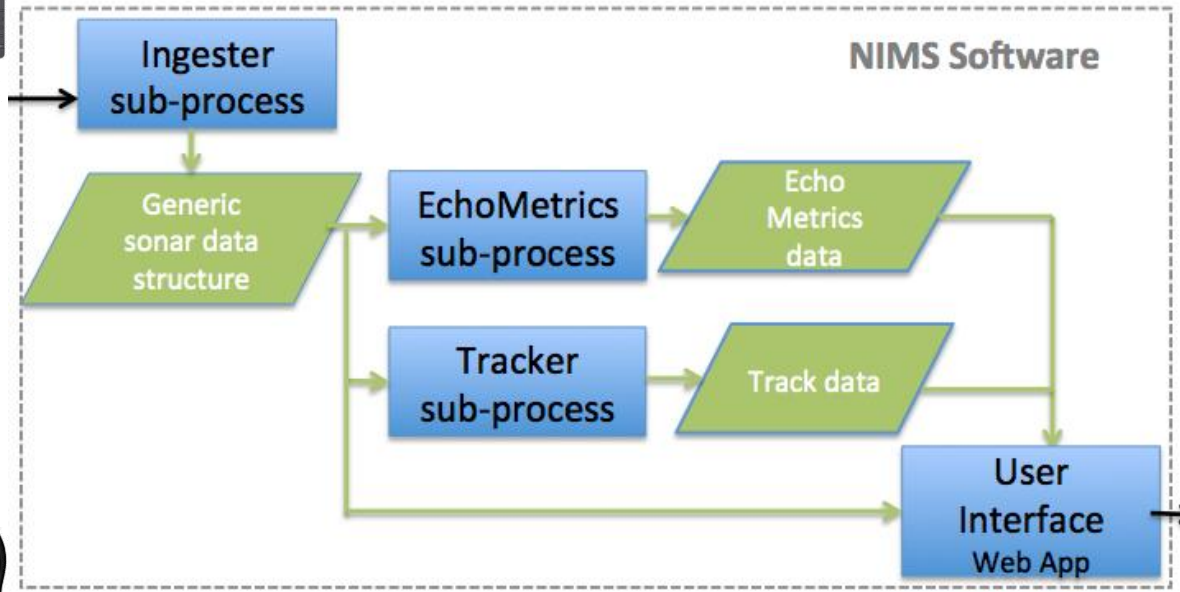
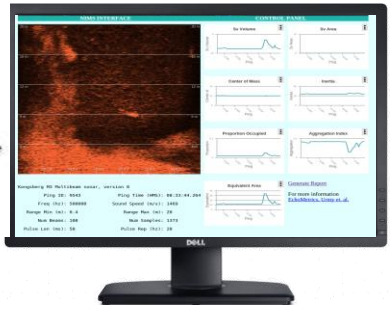






Nekton Interaction Monitoring System

Kenneth D. Ham, Ph. D.

Pacific Northwest National Laboratory
Kenneth.Ham@pnnl.gov, 509.371.7156

February 2017

Project Overview

Nekton Interaction Monitoring System (NIMS): Tool to characterize biological activity and interactions at marine energy sites with metrics standardized across sonar instrument types and accelerated processing to avoid “data mortgages”

The Challenge: Lack of information about interactions with marine organisms can be a challenge for siting and permitting marine energy development. Sonar is uniquely suited to characterizing interactions, but tools were needed to extract information from the vast streams of data that these instruments produce.

Partners: University of Washington, EchoMetrics and Interface development; Kongsberg Underwater Technology, Inc., Sonar hardware expertise

Who Benefits: Developers, regulators, and stakeholders gain a practical, common basis for quantifying and monitoring the potential for impacts to biota.

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

Program Strategic Priorities

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

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

The Impact

- NIMS provides standardized metrics for characterizing marine communities and interactions
- Standardized metrics are more easily communicated and understood by developers regulators, and stakeholders
- Standardization allows metrics to be vetted so that interested parties become comfortable with their meaning and use
- Improved communication and understanding lead to more rapid development timelines, reduced costs, and improved outcomes

Program Strategic Priorities

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

The Impact

- NIMS enables rapid delivery of environmental assessments
- Avoiding costly and time consuming manual processing of sonar data helps identify and mitigate environmental risks early in the development process
- Rapid turnaround of site characterization and monitoring information enables better-informed decision making
- Better-informed decision making improves outcomes while mitigating environmental risks

Technical Approach

NIMS provides sonar hardware independent processing to produce standardized metrics characterizing biota and interactions.

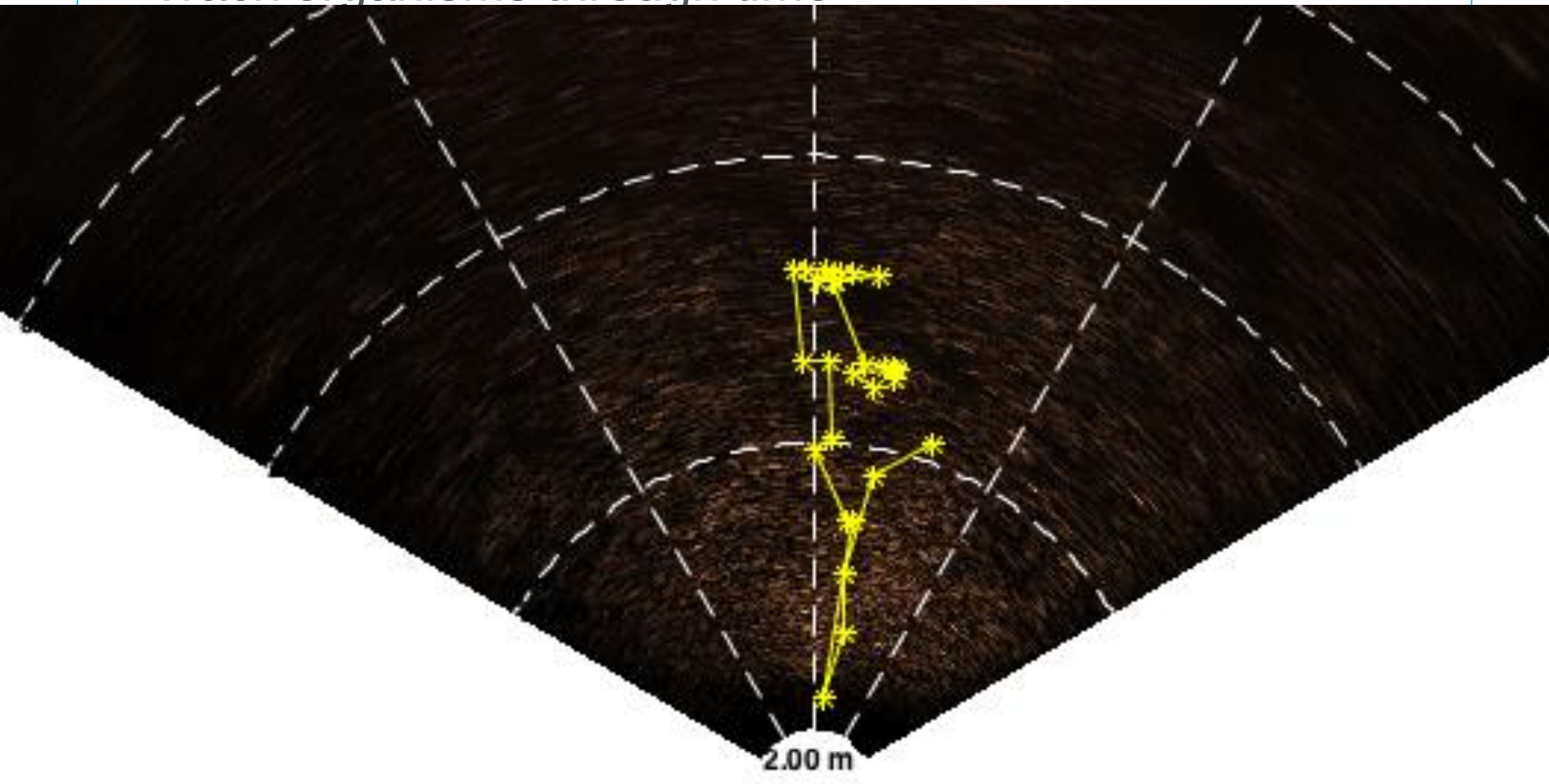
NIMS incorporates “wrappers” to translate proprietary sonar data into hardware independent structures for processing. Additional wrappers can be developed without requiring modification to the core NIMS software.

Sonar can produce over a terabyte of data per week, so it was essential that NIMS produce output as fast as data were acquired. Such performance avoids delays in providing feedback on environmental conditions and prevents the buildup of backlogs or “Data Mortgages.”

Technical Approach

Custom algorithms were developed to:

- Track organisms through time



Accomplishments and Progress

FY15

- Successful processing of sonar data streaming over network connection
- Data reduction of 1000:1 or more
- Web display of EchoMetric and track outputs and system controls accessible from any internet connection

FY16

- Successful processing of live data streams from multi-beam or split-beam sonar deployed in field conditions dockside and shipboard in Puget sound
- Peer-reviewed publication on NIMS system

Project Plan & Schedule

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

- Project awarded on 09/14/2014 and ended on 09/30/2016
- FY15 Q1: Prototype development systems built and baseline for evaluating performance developed. **Delayed 1.5 months due to hardware supply constraints**
- Q2: Computing framework designed, built and tested. Initial consultations with regulators. **Delayed 5.5 months due to scheduling challenges with regulators**
- Q3: System control interface capable of remote operation and demonstrated to DOE. **Delayed 2 months due to hiring delays**
- Q4: Annual technical report delivered to DOE. **On Time**

- FY15 Q4: Go/No-Go:Tracker and EchoMetric modules operate in near real-time., **Go/No-Go criteria met**

- FY16 Q1: In-river measurements complete, user interface upgraded to display tracking information and allow the user to configure the NIMS system. **On Time**
- Q2: NIMS supports the processing, tracking, and display of data from the Simrad EK60 sonar device. **On Time**
- Q3: Sampling plan for field test of NIMS in open water: **On Time**
- Q4: Paper reporting the research, development, and evaluation of the NIMS is submitted for peer-reviewed publication and a NIMS user manual is delivered to the Water Power Program. **On Time**

Project Budget

Budget History					
FY2014		FY2015		FY2016	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
		$287k	$58k	$214k	

- The project is complete and all funds have been expended.
- Matching Funds were provided by Kongsberg Underwater Technology, Inc., and the University of Washington.

Research Integration & Collaboration

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

Partners, Subcontractors, and Collaborators:

Subcontractor:
University of Washington, John Horne and Ross Hytnen, Echometric algorithm, user interface development, and ocean research vessel
Collaborators: Kongsberg Underwater Technology, Inc., Jeff Condiotti, sonar hardware supplier and expert; Alaska Hydropower Energy Research Center, Jeremy Kaspar, data collection at active hydrokinetic energy site

Communications and Technology Transfer:

Presentations:

International Council for the Exploration of the Sea Working Group Fisheries Acoustics and Sampling Technologies, Annual Meeting, Vigo Spain, April 19–22, 2016

Acoustical Society of America in Salt Lake City, Utah on May 26, 2016

IEEE OCEANS 2016,Monterey, California, September 21, 2016.

Peer-Reviewed Conference Proceedings:

Matzner S, AR Maxwell, KD Ham, J Horne, and RD Hytnen. In Press. "Observing Ocean Ecosystems with Sonar ." In IEEE Oceans 2016. PNNL-SA-120086, Pacific Northwest National Laboratory, Richland, WA. (In Press)

Next Steps and Future Research

FY17/Current research: N/A

Proposed future research: We envision several approaches that would expand the influence of NIMS:

- Integration into active monitoring systems
- Expansion of compatible instruments
- Development of tools to optimize operating parameters and facilitate analysis of trends in metrics
  - Hydro industry interest in monitoring entrainment
- Outreach to regulators, hardware vendors, and developers