



Video Analysis Software Development

WBS: 1.6.0.602

Marine and Hydrokinetics Program

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Project Overview

| Project Summary | Project Information |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| <p>The project goal was to develop software to expedite underwater video analysis. Underwater video camera systems are effective for recording fish and wildlife activity near MHK devices. But the process of reviewing and quantifying the information in underwater video is time-consuming and costly due to the labor-intensive nature of the analysis. There is a need for automation to reduce labor costs. The PNNL EyeSea software was developed as a framework for the underwater video analysis workflow, to make manual analysis more efficient by incorporating automated detection of the presence of wildlife.</p> | Project Principal Investigator(s) |
| | Shari Matzner |
| | WPTO Lead |
| <p>The objective was to develop PNNL's EyeSea software to enable semi-automated analysis of underwater video for MHK applications. This capability reduces the human labor required for monitoring, which reduces time and costs. It makes underwater video a viable solution for projects and will ultimately result in a cost-effective, standardized method for monitoring that regulators have confidence in.</p> | Dana McCoskey |
| | Project Partners/Subs |
| | None |
| | Project Duration |
| | <ul style="list-style-type: none">• Project Start Date: Oct 1, 2017• Project End Date: Sept. 30, 2018 |

Marine and Hydrokinetics (MHK) Program Strategic Approaches

Data Sharing and Analysis

Foundational
and
Crosscutting
R&D

Technology-
Specific
Design and
Validation

Reducing
Barriers to
Testing

Reducing Barriers to Testing

- Enable access to world-class testing facilities that help accelerate the pace of technology development
- Work with agencies and other groups to ensure that existing data is well-utilized and identify potential improvements to regulatory processes and requirements
- **Support additional scientific research as needed, focused on retiring or mitigating environmental risks and reducing costs and complexity of environmental monitoring**
- Engage in relevant coastal planning processes to ensure that MHK development interests are equitably considered

The EyeSea software has already enabled an MHK pilot projects to move forward so that the effects on wildlife can be studied and adaptive management practices employed. On June 5, 2019, the Federal Energy Regulatory Commission (FERC) and Alaska Fish & Game approved Ocean Renewable Power Company's instream turbine monitoring plan that is based on using underwater video in conjunction with the EyeSea software to monitor fish interactions with the device.

Project Budget

| FY17 | FY18 | FY19 (Q1 & Q2 Only) | Total Project Budget FY17–FY19 Q1 & Q2 (October 2016 – March 2019) | |
|--------|---------|---------------------------|-----------------------------------------------------------------------------|---------------------|
| Costed | Costed | Costed | Total Costed | Total Authorized |
| - | \$300K* | - | \$300K | \$300K |

*This project was a 1-year TCF award for \$150K with \$150K matching from PNNL.

Management and Technical Approach

Q1 Milestone Build
Development
Datasets



Q2 Milestone Define User
requirements



Q3 Milestone Demonstrate
Prototype
Software

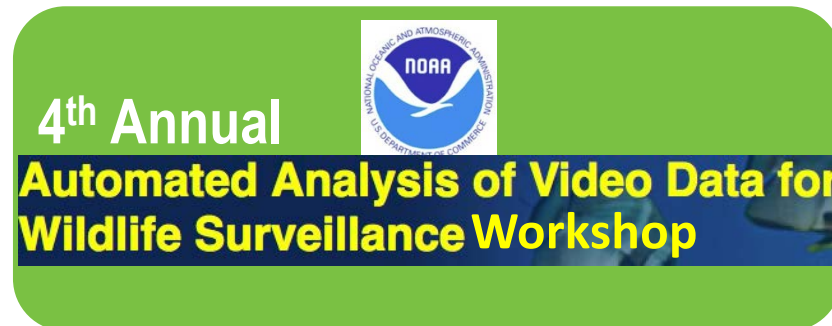


Q4 Milestone Report
Automation
Results

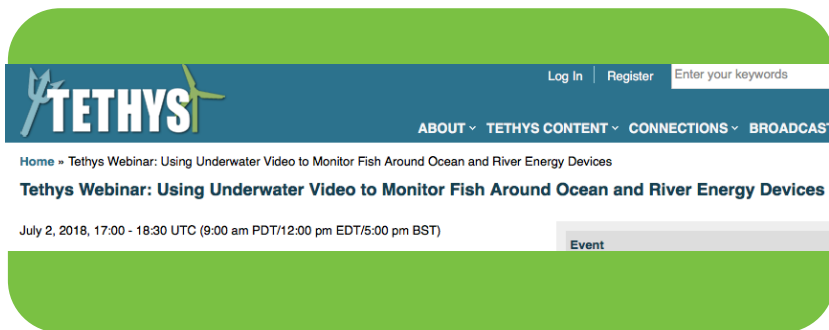




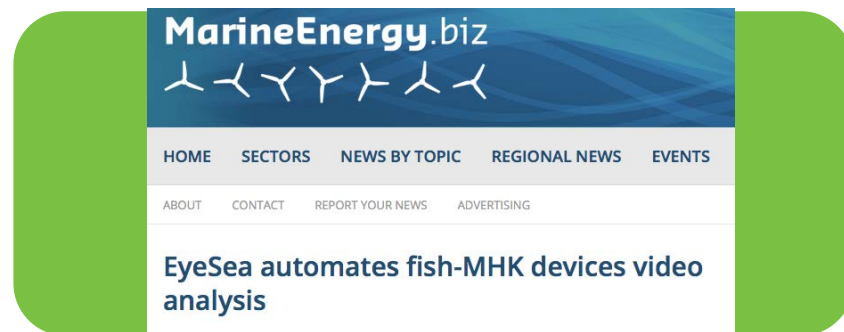
Stakeholder
discussions



Workshop
Invited Talk



Webinar
presentation

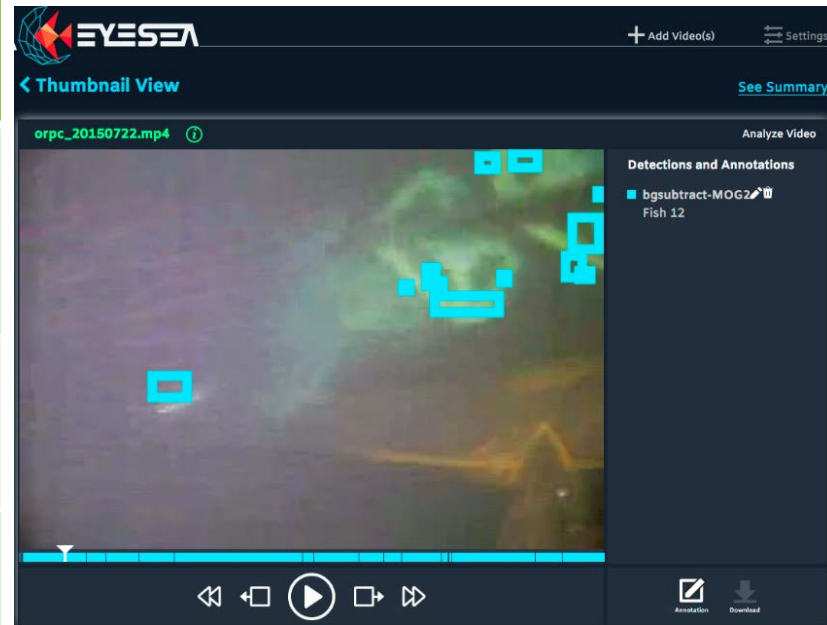


News
releases

Technical Accomplishments

- The generation of an annotated underwater video dataset for algorithm development, where none existed before.
- The creation of the EyeSea open source software for analyzing underwater video.
- The development of a deep learning model for detecting fish in underwater video.

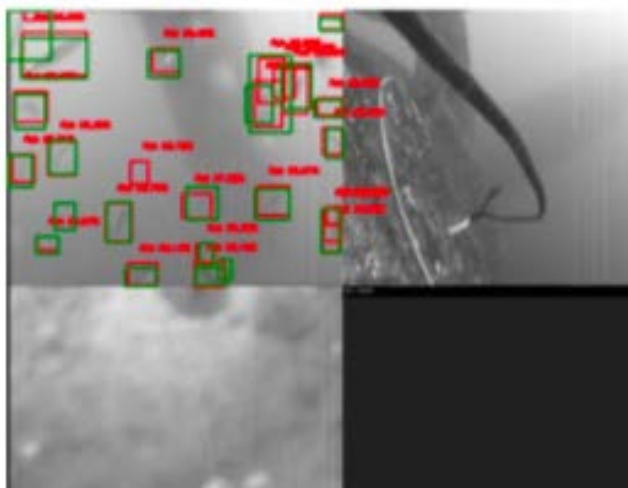
| Dataset | Species | Video Resolution | Frames with fish |
|--------------------------|-------------------------|------------------|------------------|
| Voith Hydro turbine test | juvenile fish | 720x576 | 7663 (48%) |
| Well Dam fish passage | Chinook, Sockeye | 1280x960 | 13405 (55%) |
| ORPC instream turbine | salmon (adult & smolts) | 320x240 | 1002 (3%) |



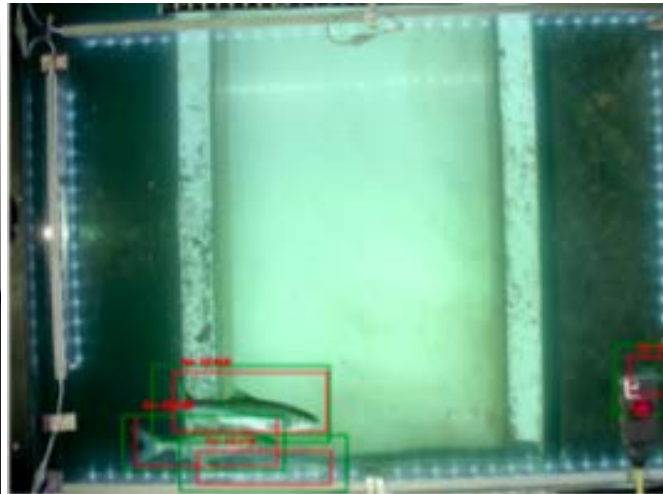
Technical Accomplishments (Cont.)

- W. Xu and S. Matzner, “Underwater fish detection using deep learning for water power applications,” IEEE Computational Science and Computational Intelligence (CSCI) 2018, Las Vegas, NV, 2018.

A deep learning model trained on the EyeSea datasets achieved a 62% detection rate with 30% false positives. Green boxes are human annotations; red boxes are algorithm detections.



Voith Hydro turbine test data
provided by Aquatera, UK



Hydroelectric dam fish passage
data provided by Douglas County
Public Utility District, WA USA



Instream turbine demo data
provided by Ocean
Renewable Power Co. USA

- EyeSea will be used to monitor the spring salmon migration in 2020 for the latest ORPC RivGen deployment in Igiugig, AK.
- PNNL is refining the video analysis algorithms and the EyeSea software to support the project.
- The updated software will be made available to the MHK industry.

