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# Fish Tags Topic

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DOE WPTO – Norway Environmental Topics Webinar June 16, 2020

- ▶ Summary of recent tag development efforts
  - Eel/lamprey, micro batteries, self-powered tag
- ▶ Integrated sensors
  - Lab-on-a-fish
- ▶ Autonomous cloud-based receiver
- ▶ AI applications to data
- ▶ Next frontiers
- ▶ What we can bring to the table

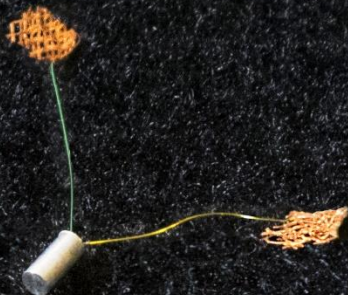
# Suite of Acoustic and Radio-frequency Transmitters



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Eel/Lamprey tag's  
microbattery



Juvenile Sturgeon tag



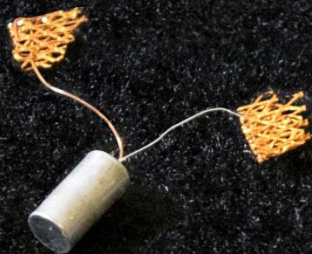
Eel/Lamprey tag



Injectable tag



Injectable tag's  
microbattery



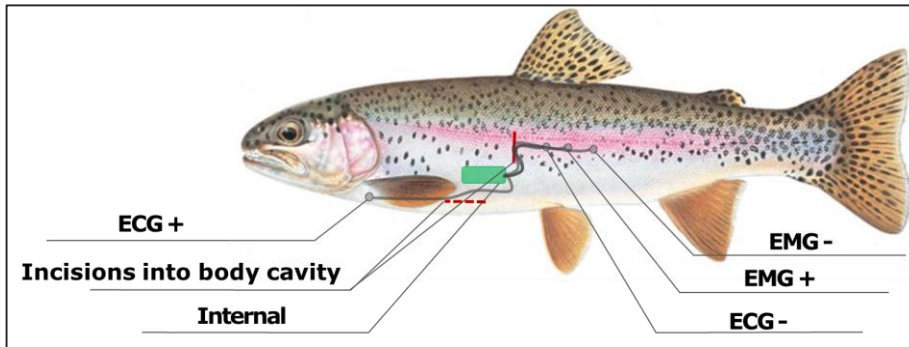
Injectable Radio  
Frequency tag



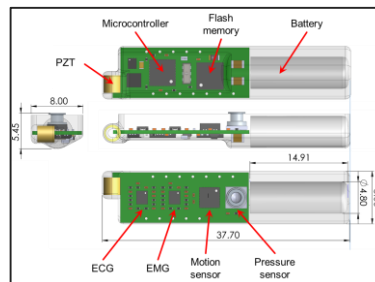
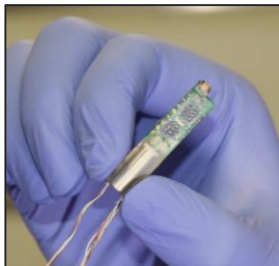
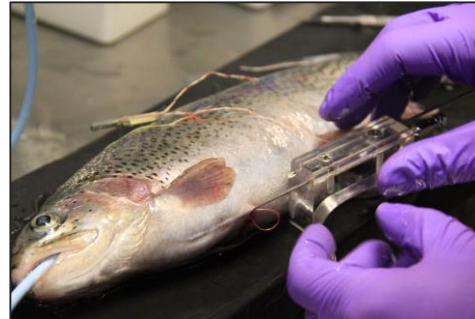
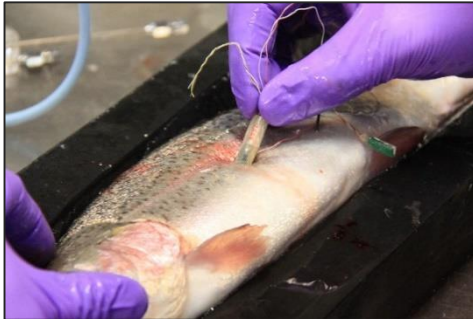
Self-powered tag



# Lab-on-a-Fish Tagging Protocols

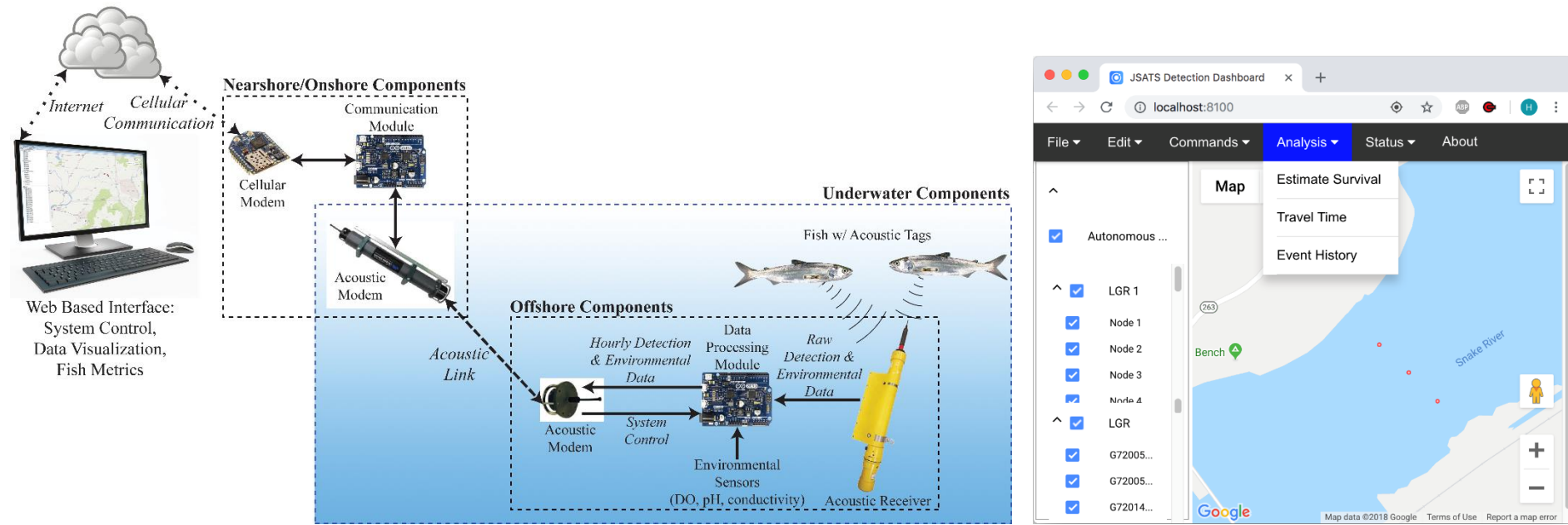


- Vertical incision into the body cavity for the main tag
- A second incision along the abdominal midline for ECG+
- ECG- and EMG+/- were embedded subdermally



# A Cloud-based Autonomous Acoustic Receiver for Monitoring Real-Time Fish Survival

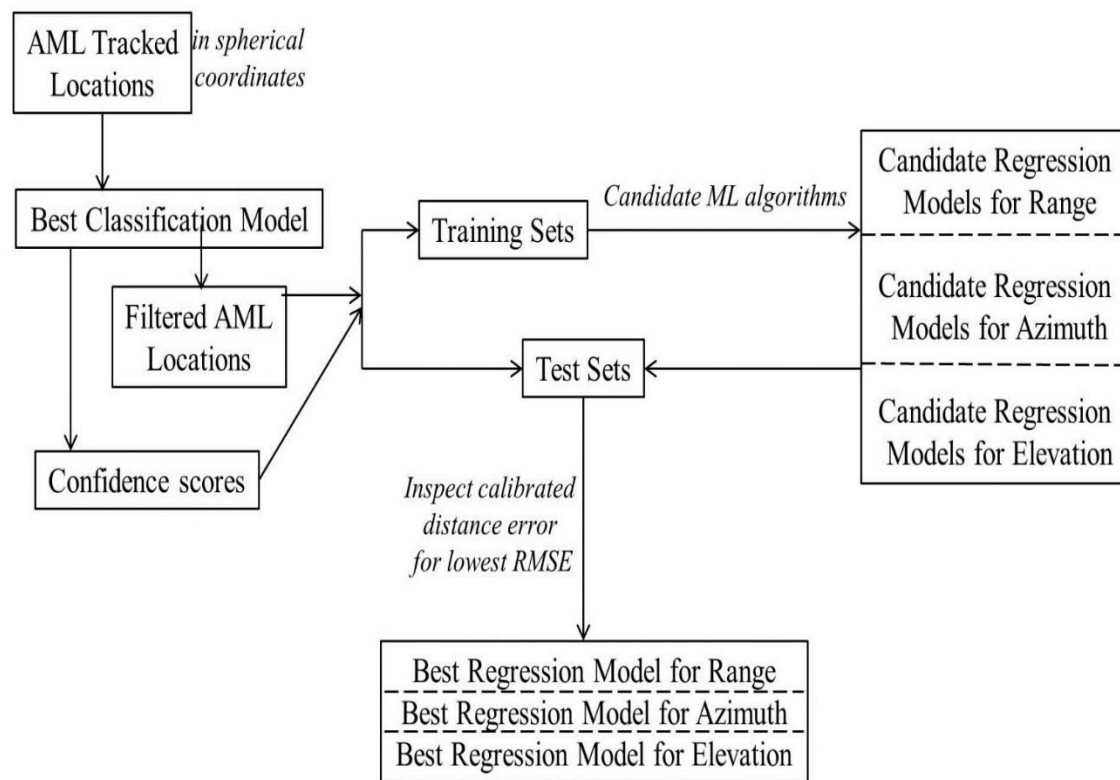
- ▶ Remote and real-time data acquisition
- ▶ Remote health monitoring of acoustic receivers
- ▶ Remote monitoring of environmental conditions
- ▶ User-friendly and real-time info on fish survival metrics



Yang et al. 2019. "Design and implementation of a real-time underwater acoustic telemetry system for fish behavior study and environmental sensing." In Proceedings of OCEANS 2019 Seattle.

# Data analytics: improving underwater localization accuracy with machine learning

- ❑ Significantly improved the localization accuracy, esp. in the depth component
- ❑ Produce unprecedented accuracy
- ❑ Reduce deployment cost and increase deployment flexibility



- ▶ Smaller and lighter transmitter
  - Just started a project to develop a transmitter that can be used to study juvenile American shad
  - Target weight: 0.06 gram
- ▶ More powerful transmitter in detection range
- ▶ Long-lasting transmitter: self-powered platform
- ▶ Bio-logging sensors
- ▶ Flexible or stretchable sensors
- ▶ Cloud-based and real-time system to estimate behavior or survival of tagged aquatic animals using edge-computing
- ▶ Machine learning / deep learning for fish passage and hydro operations
- ▶ Sensing and data telemetry in extreme environments
- ▶ Only way to achieve these goals is multi-disciplinary approach and close collaboration between stakeholders nationally and internationally



## What can we bring to the table



- Acoustic telemetry system development including tags, receivers, and data analytics
- 2D and 3D telemetry studies
  - various fish species and life stages in
  - Various challenging conditions
  - Freshwater and saltwater