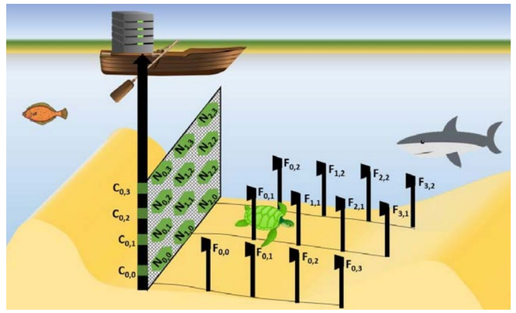
CPS: Machine Learning Enabled "Smart Nets" to Optimize Sustainable Fisheries Technologies

PI: Jennifer Blain Christen, Co-PI: Sule Ozev, Co-PI: Jesse Senko
Collaborators: Wendy Dow Piniak, John Wang, Agnese Mancini | Students: Christopher D. Lue Sang, Janie Reavis, Huseyin Seckin Demir
Arizona State University, Tempe, AZ

Project URL: cps-smart-nets.asubestlab.com

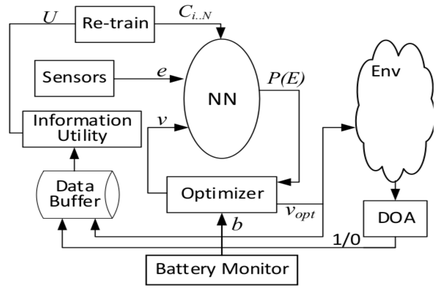
Key Challenges

1. **Bycatch** is the incidental capture of non-target animals in fisheries.
   a. Bycatch decimates marine species & hurts commercial fishing operations.
2. **Bycatch Reduction Technologies (BRTs)** employ sensory stimuli to deter megafauna from being targeted by commercial fishing gear.
   a. Current BRTs are not energy efficient and produce waste which further damages the environment.
3. **Smart Nets** are our proposed solution to understand the effects of BRTs, and optimize the implementation of BRTs.
   a. Smart Nets incorporate machine learning, image recognition and sensory stimuli outputs to provide real-time assessment of BRTs and how they interact with sea life.



Scientific Impact

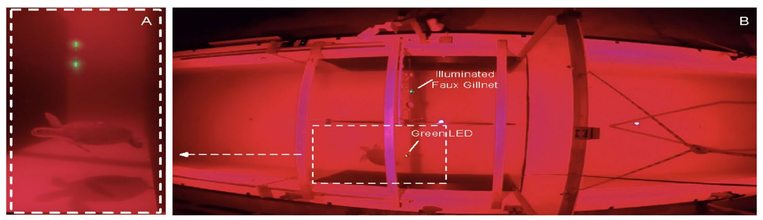
- Modelling Highly Dynamic Marine Environments
- Cataloging Behavior Response in Sea Life
- Developing a Autonomous, Multimodal, Closed-Loop CPS
- Identifying Power Efficient Design Parameters for Bycatch Reduction Technologies



Self-learning Control System for Stimuli Settings

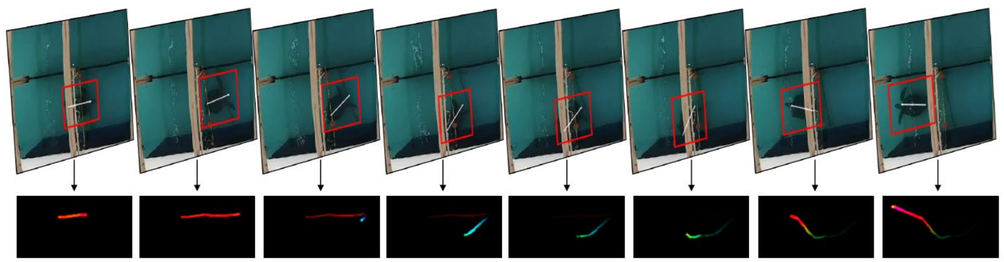
Solution

Experimental Tank Environment



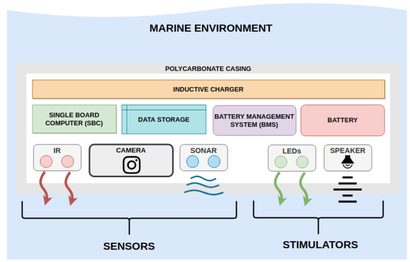
Underwater (A) and overhead (B) views of the experimental tank during a nighttime trial.

Neural Network Behavior Recognition Training



Color coded spatio-temporal feature images are used to classify certain behaviors

"Smart Buoy" In Development



Creating field units to incorporate video capture and a closed-loop deterrent strategy

Continuing Development

- **Past Field Trials**
  - Simple light based bycatch reduction technology (BRT)
  - Shown effective with a significant reduction of bycatch (65%).
  - Renewably powered allowing devices in-the-field to still be operating.
- **Future Field Trials**
  - Currently developing 'Smart' BRTs.
  - Incorporating: machine learning, behavior recognition, and multi-sensory deterrents

Education Outreach

- **Interdisciplinary Research**
  - Conservation Biologists and Electrical Engineers at Arizona State University work together to distill design requirements and implement real-world solutions.
- **Cross-Community Collaboration**
  - Trained local communities on light-based BRT net.
  - Taught principles of sustainable and renewable energy engineering.

Community Impact

- **Field Research**
  - Local stakeholders are consulted in the design and deployment strategy of bycatch reduction technology.
- **Regulatory Collaboration**
  - Consulting with national regulators to understand the context of commercial fishing.
- **Building Multi-national Partnerships**
  - Working with regulatory bodies in Trinidad & Tobago to establish an additional study sites.

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