Nemo: An Underwater Communication Device

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Abstract

Problem: Marine animals are harmed by fishing line entanglement; **NOAA** mandates ropeless fishing which requires acoustic systems. The current **challenge** is that they cost thousands of dollars due to specialized piezoelectric materials, precision manufacturing, pressure-rated housings, and low-volume production. Our **solution - Nemo:** A reliable underwater acoustic transducer for **<$100**, using off-the-shelf piezo components, a simple custom impedance-matching network, and polyurethane potting instead of expensive pressure-rated housings.

Objectives

- Design and fabricate Nemo for <$100.
- Design and test a custom impedance-matching network for optimal acoustic drive/reception.
- Validate for Main application domain:
  - **Ropeless Fishing**

Materials and Methods

- Prototype & Integration:
  - Programmed drive/receive circuits;
  - added sealed coax and polyurethane potting for waterproofing
- Ocean Testing:
  - Conducted underwater tests and measured signal attenuation vs. distance

Diagrams/Figures/Experiments

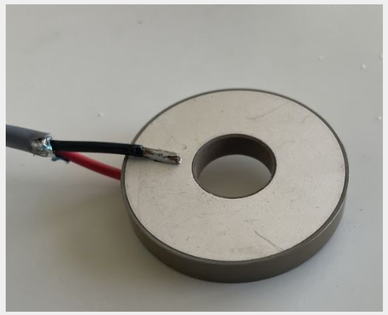


Figure 1: Nemo, a piezoelectric ring soldered to shielded cable, before potted in polyurethane

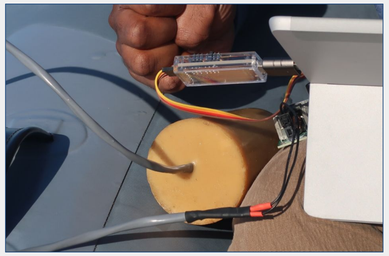


Figure 2: Transducer and Driving Circuit

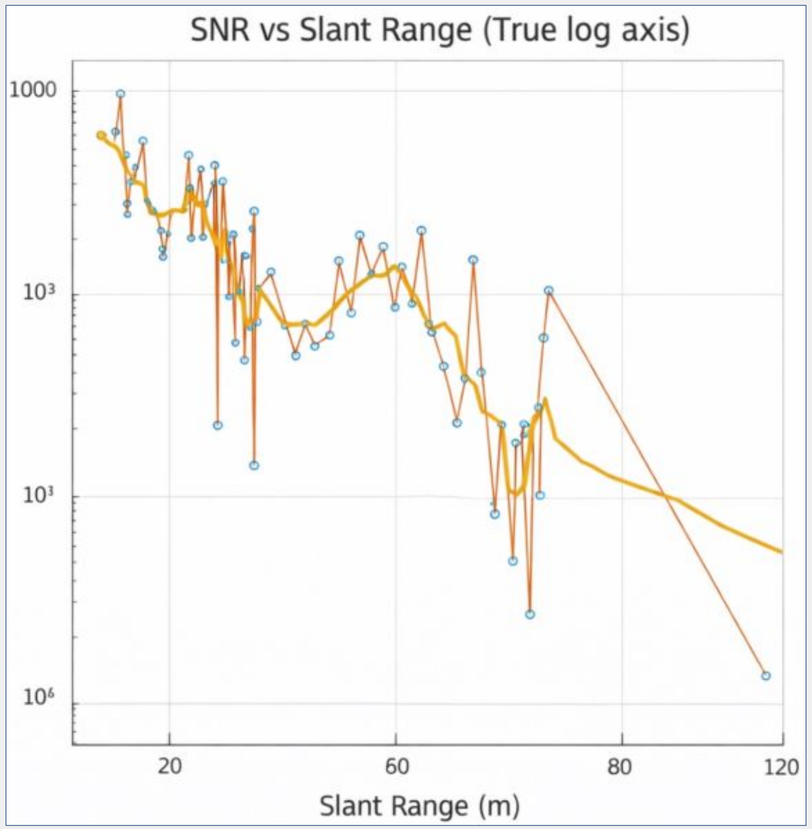


Figure 3: Signal Noise Ratio (SNR) vs Slant Range



Figure 4: Buoy in the water that Nemo is communicating with



Figure 5: Team Members and Faculty Advisor with Nemo (Kaustubh, Ryan, Prof Green, Michelle (from left to right))

Results

- Performance: underwater transmit/receive, **<$100 total cost vs. ~$5,000 competitors**
- Prototype: Waterproofed piezo transducer enabling reliable short-range communication through comparing the signal to noise ratio (SNR) and slant range, the straight-line distance between the submerged transducer and the buoy receiver, accounting for both horizontal separation and depth difference
- Validation: Completed range testing and frequency response characterization as seen in Figure 3

Additional Information

- System overview: core components sourced and integrated on schedule
- Development path: Prototype, underwater testing, and refinement while maintaining low cost
- Next steps: Further optimization for signal strength and extended range

References

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3. Kinsler et al. *Fundamentals of Acoustics.*
4. NOAA Ropeless Fishing Technology Roadmap.
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