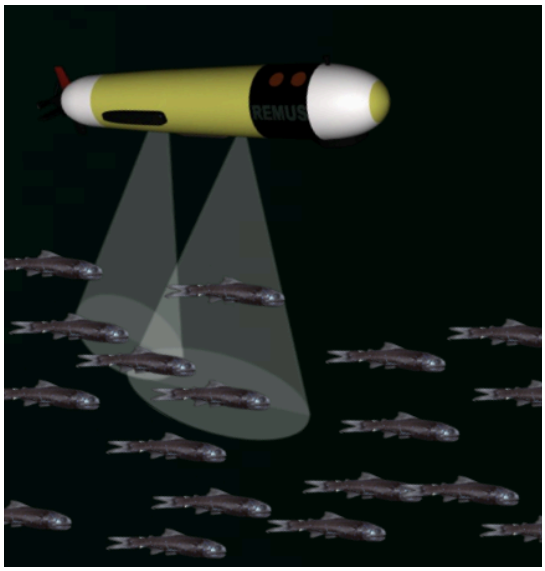
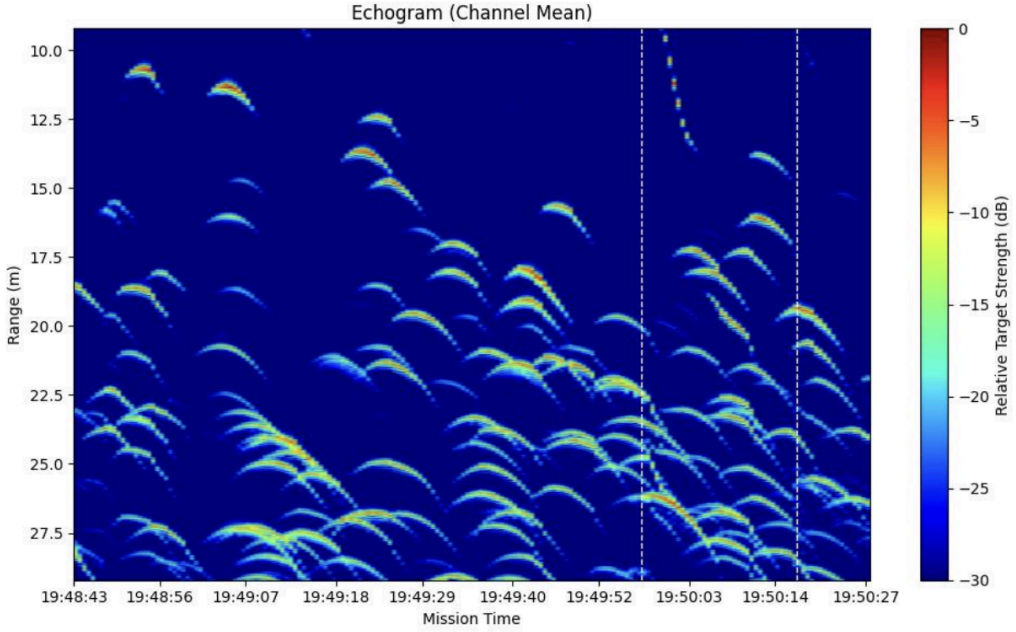


The goal of this project is to generate synthetic echograms using a physics-based model of an Autonomous Underwater Vehicle (AUV)–mounted split-beam echosounder (see diagram on the left). Split-beam echosounders are widely used in fisheries acoustics to estimate target strength and track individual organisms in the water column, but acquiring large, well-labeled datasets is expensive and logistically challenging. A simulation-based approach provides a flexible, cost-effective method for testing algorithms and exploring acoustic sensing scenarios.

An example echogram from field data is shown on the right. The curved traces correspond to individual organisms (most likely fishes), whose movements and behaviors we seek to study. By reproducing these traces in simulation, we can test detection and tracking methods under controlled conditions.



This project will develop a forward model that incorporates:

- **AUV dynamics:** governing the vehicle's motion and sonar orientation, which define the sampling geometry;
- **Target kinematics:** describing individual fish trajectories in the water column, including constant-velocity, diving, or responsive behaviors;
- **Acoustic propagation:** simplified wave or ray-based ODEs to model sound travel time, absorption, and scattering;
- **Echo synthesis:** driven ODEs for the received waveform envelope, producing realistic intensity patterns.