

Background

- US underwater infrastructure (piers, dams, oil rigs) is aging and requires frequent inspection to ensure proper upkeep.
- Underwater infrastructure inspection is both expensive and dangerous when employing human divers.

Objectives

- Develop a robot controller using MATLAB for underwater infrastructure inspection that is easy to use and configurable to an off-the-shelf underwater robot.
- Simulate the controller functionality in Unreal Engine 5 with the BlueROV2 Heavy robot equipped with Ping360 Scanning Imaging Sonar (\$9,605.00).
- Create a flexible solution for gathering data on a variety of structures.

Methods

- MATLAB / Simulink
- Unreal Engine 5
- MATLAB / Unreal Co-Simulation

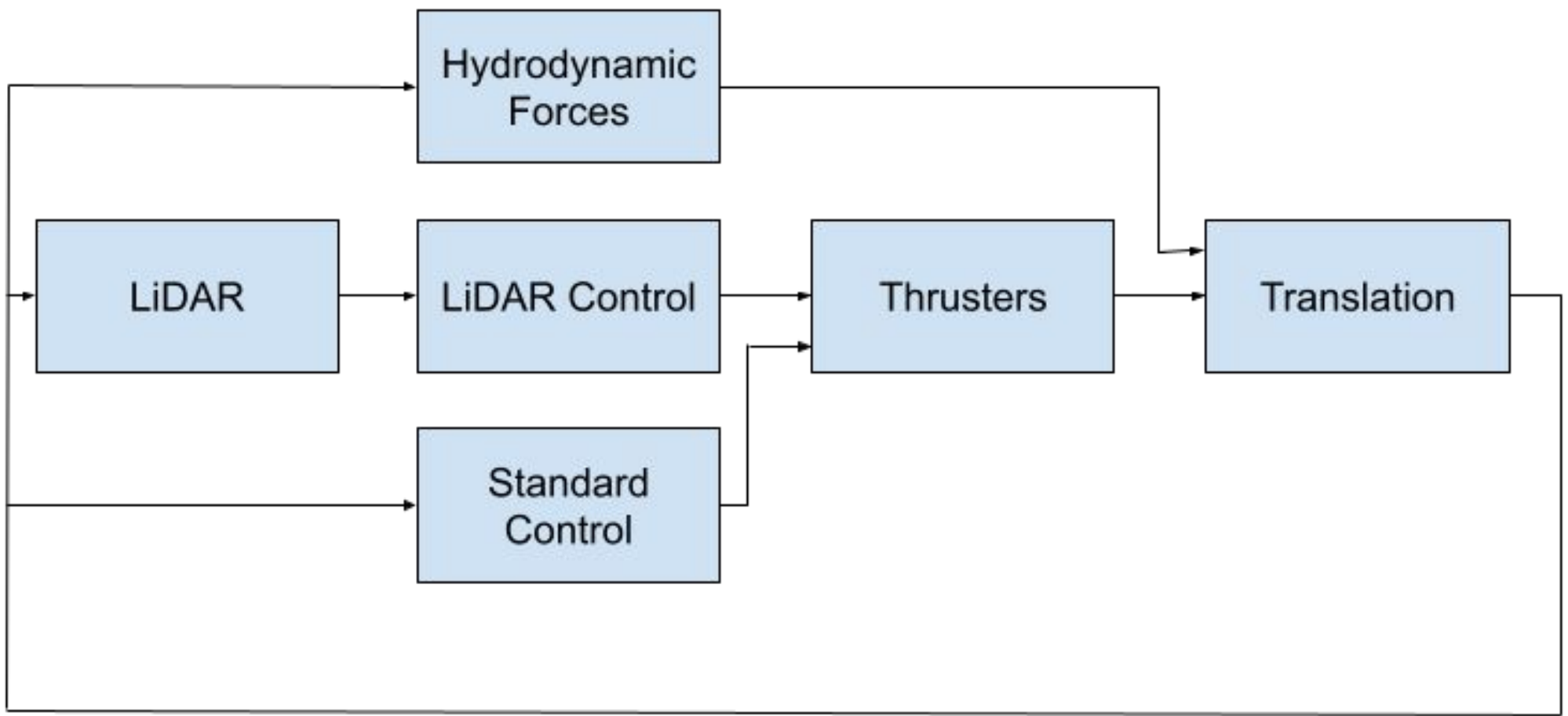
Other Approaches

- HoloOcean Underwater Simulator (BYU)

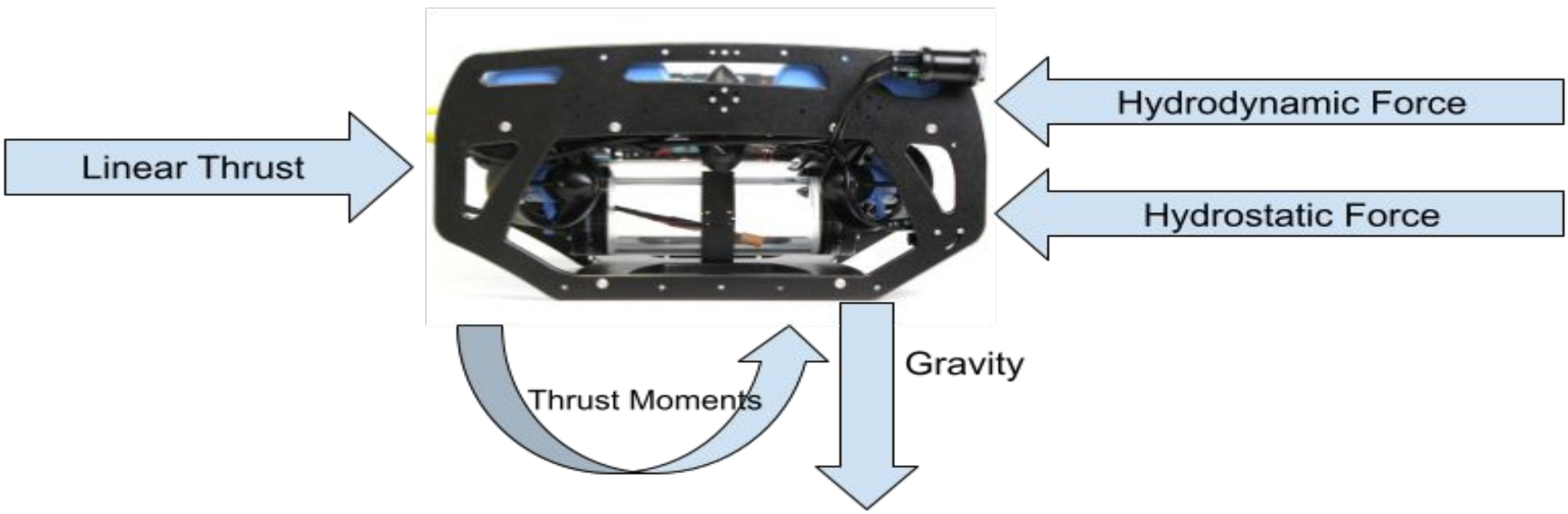
	HoloOcean	MATLAB Co-Simulation with Unreal Engine 5
Extensive Documentation and Support	✗	✓
Easy-to-use Interface	✗	✓
Adaptable Simulation	✗	✓
Lightweight Visualizations	✗	✓

System Architecture

- Simulated lidar sensor used to model 360° Imaging Sonar on BlueROV2.
- Robot has multiple preprogrammed modalities for different underwater infrastructure such as dams and concrete pillars.
- Live point cloud data transmitted using lidar sensor.
- Processes point cloud data from lidar to inform its decision making.
- If a fault is detected in the structure, robot can stop and gather more data.

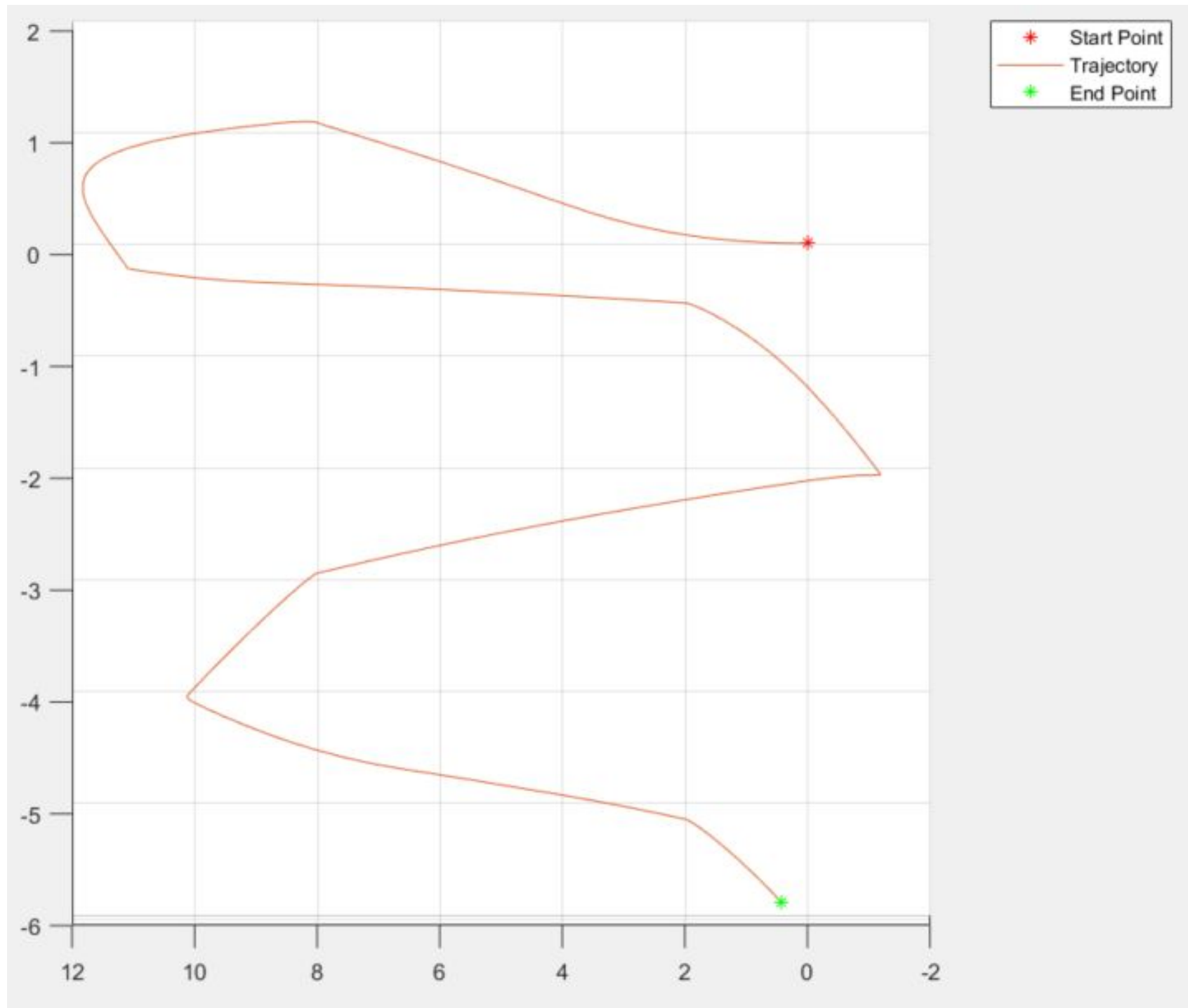


Simulator Data Flow

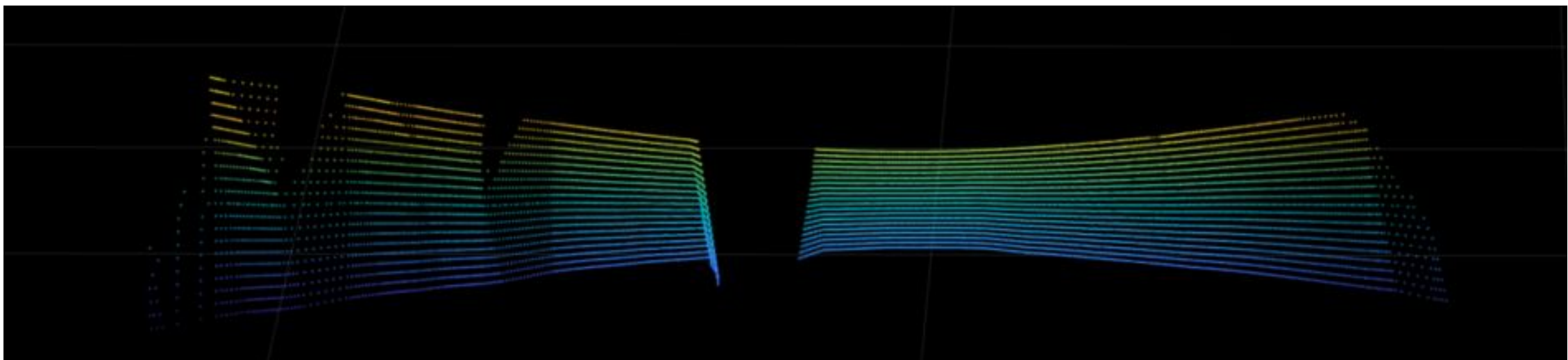


Free Body Diagram of Forces on Robot

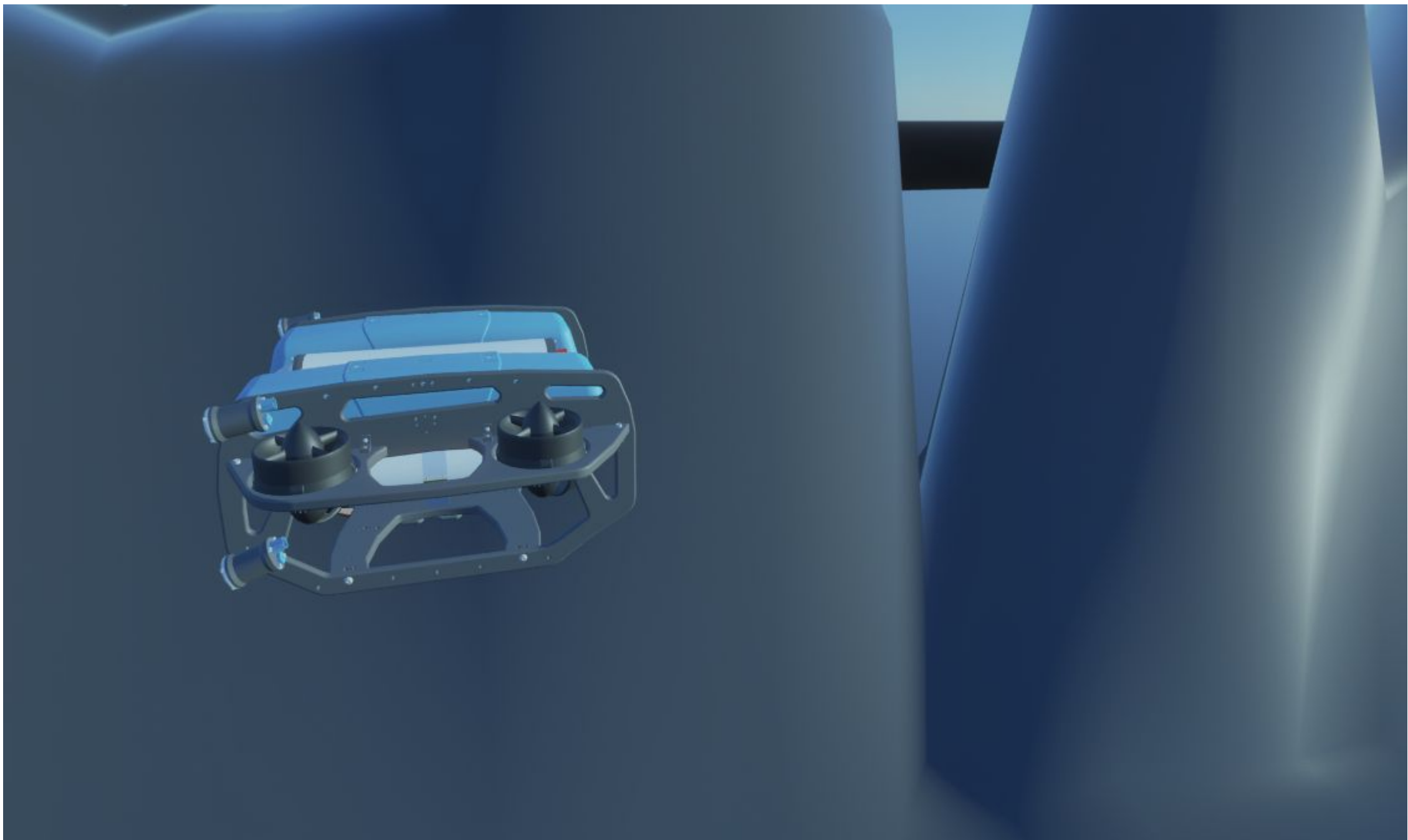
Results



Dam Scanning Path Generated with Environmental Forces Modeled



Point Cloud Visualization Generated in MATLAB



Snapshot of Unreal Simulation Environment

Future Work

- Automatic infrastructure fault detection and snapshot.
- Functionality for scanning additional structures.
- Low-level obstacle avoidance for fish and debris.