TRIPLE-Sim : Underwater Exploration of an Icy Moon in a Virtual Environment

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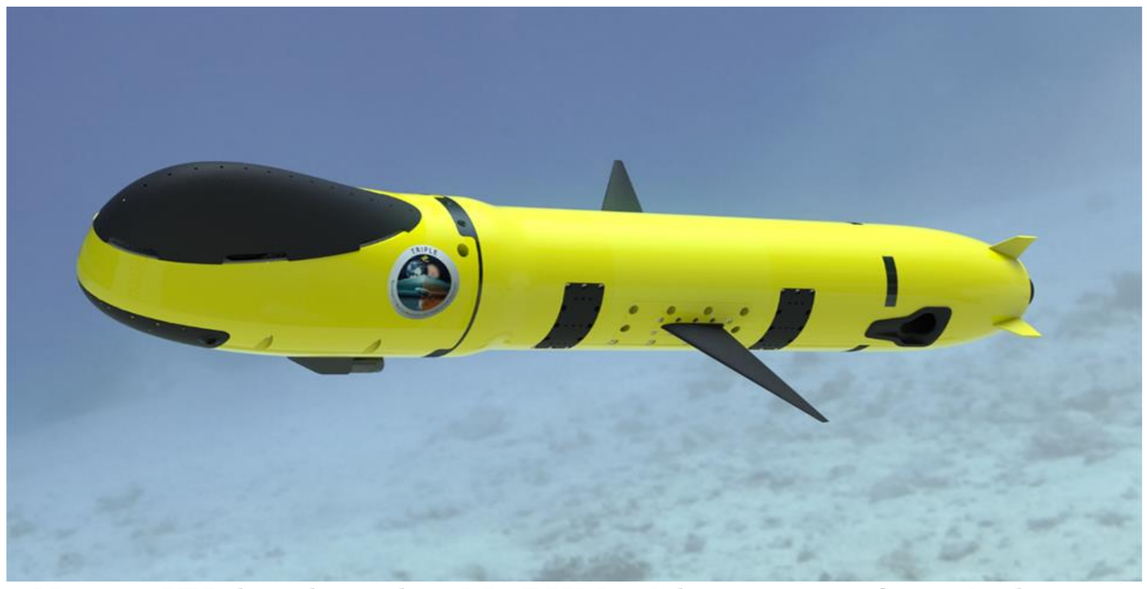
Motivation

- Huge oceans under icy moons around Jupiter and Saturn
- Potential targets for future exploration missions by ESA, NASA, DLR
- Development of a simulated environment for the Triple project mission

Objectives

- Sensor data simulation
- Visualization in a realistic environment using Unreal Engine 5
- Including external dynamics vehicle model and trajectory planning with ROS2
- Particle simulation and detection
- Ocean current simulation
- Provide an information display to track data at runtime and export via ROS2 for later use

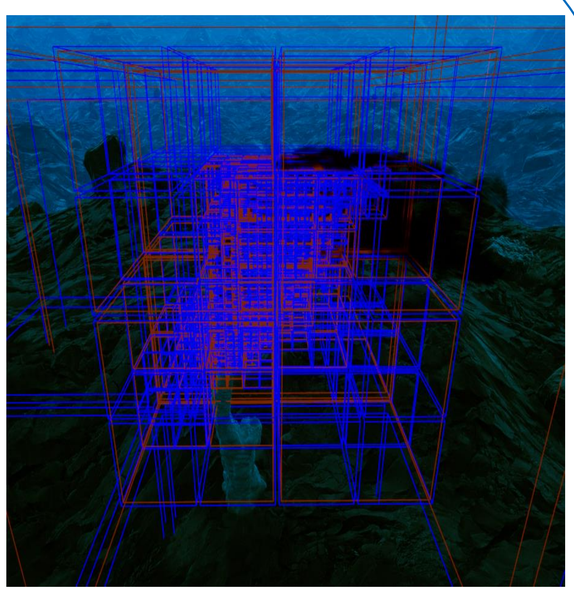


Nano AUV developed at MARUM with partners from industry
https://www.marum.de/Entdecken/Zwischen-All-und-Antarktis-Wie-Mini-Roboter-unter-Eis-forschen-sollen.html

Features

Black Smokers

- Can be found on the seabed
- Eject particles
- Interaction with laser

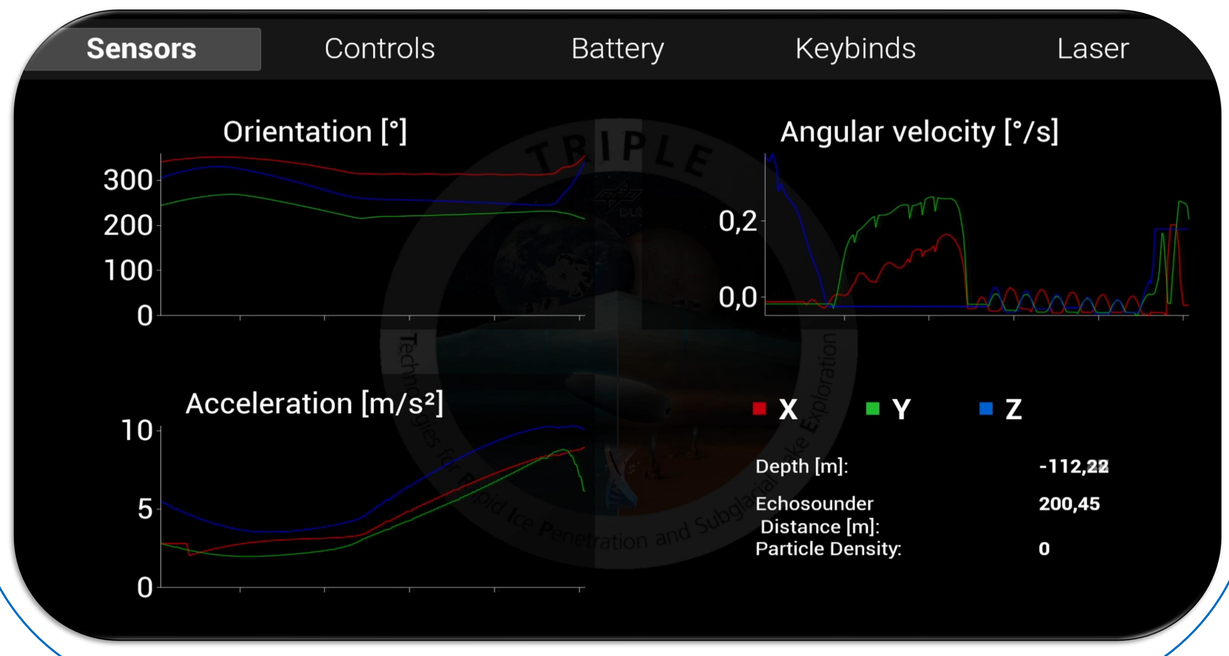


Ocean Current Map

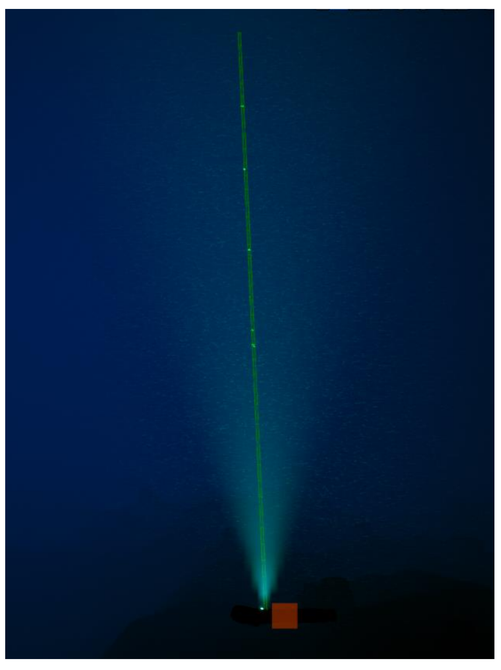
- Pre-computed velocity map
- Sparse octree
- Trilinear interpolation to smooth cell transitions

Information Display

- Shows the current information of the sensors
- Can be used to interact with the system

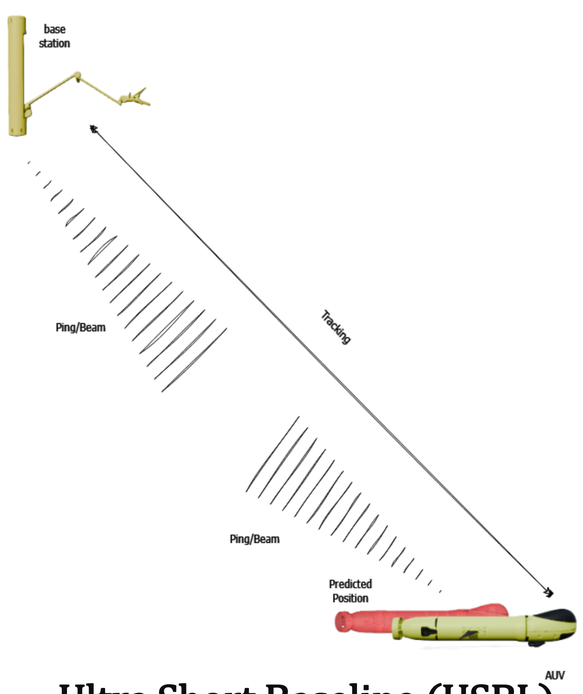


Features



Laser & particles

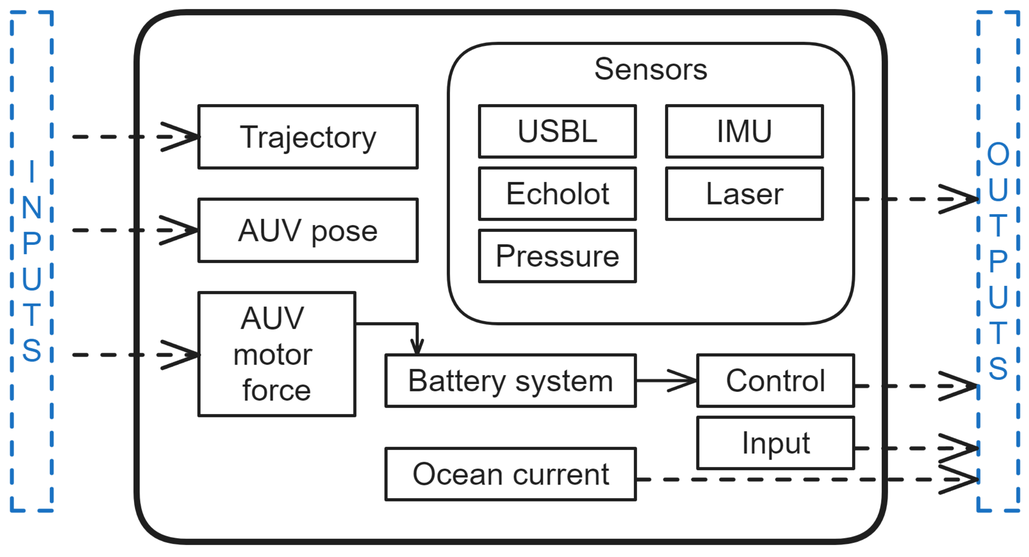
- Visualization
- Laser light backscattering
- Particle movement
- Particle detection
  =>Heatmap



Ultra Short Baseline (USBL)

- Acoustic positioning system
- Uses acoustic signals to communicate
- Determines position

ROS2 communication of UE project



Challenges

- Understanding sensor behavior and interaction with environment
- Modeling of various sensor types
- Limited resources and information about the environment

CGVR – Computer Graphics and Virtual Reality, MARUM – Center for Marine Environmental Sciences
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