



LIRMM



Journée des doctorants du LIRMM

14/01/2026

## AcoustiBioMap

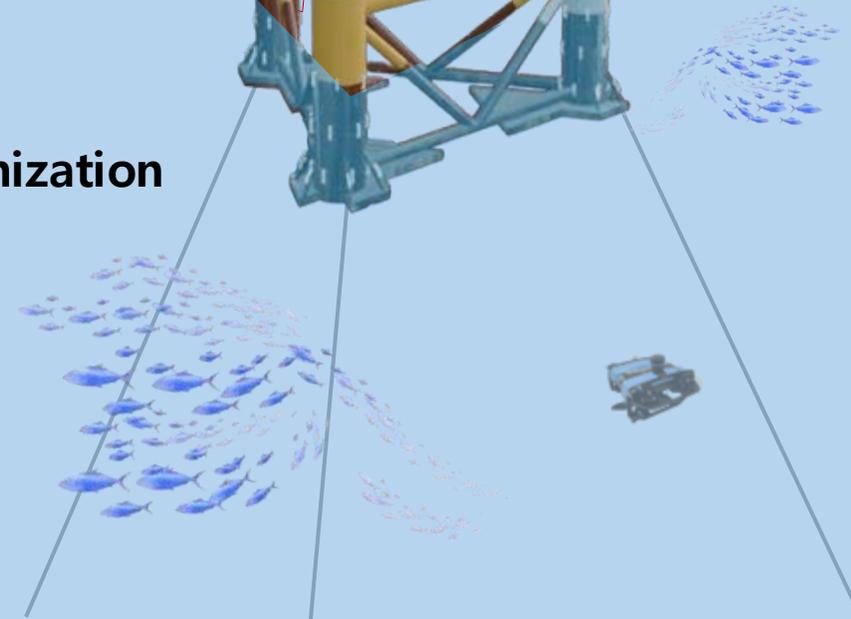
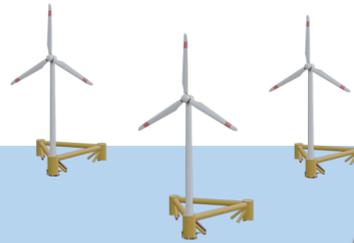
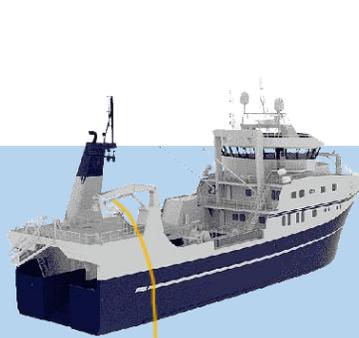
Mapping and monitoring of the surface condition and biological colonization of submerged parts of offshore wind turbines using acoustic imaging

**Alessandro Puglisi**

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RSM, LIRMM  
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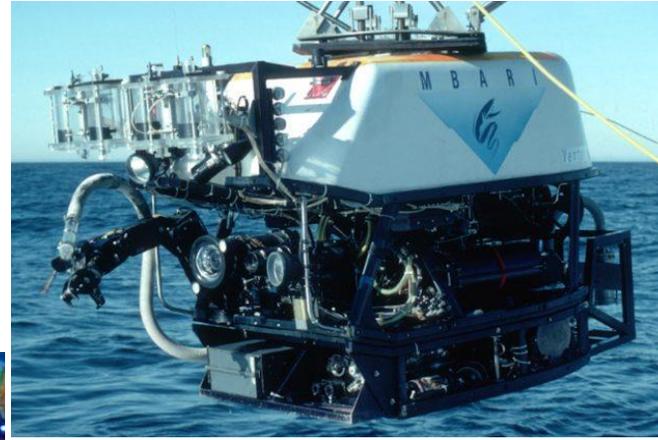
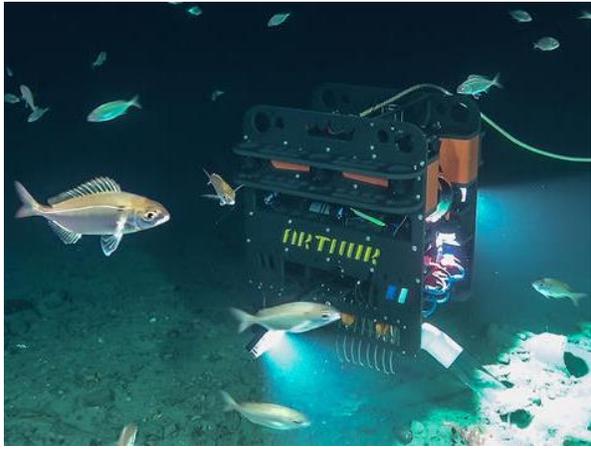
**Advisor:** Vincent Creuze

**Co-Advisors:** Juliette Drupt, Frederic Comby



# About Me

From Sicily, Italy



# About My Background



**Politecnico di Milano**  
BSc Automation and Control Engineering

**Politecnico di Milano**  
MSc Automation and Control Engineering

**Tohoku University (JP)**  
[Space Robotics Lab]  
Exchange research student

 **INSEC TEC**  
Summer Internship  
Robotics containerization

 **Max Planck Institute WildDrone Summer School**  
Drones-based ecology



# PhD Thesis: Mapping and monitoring of the surface condition and biological colonization of submerged parts of offshore wind turbines using acoustic imaging

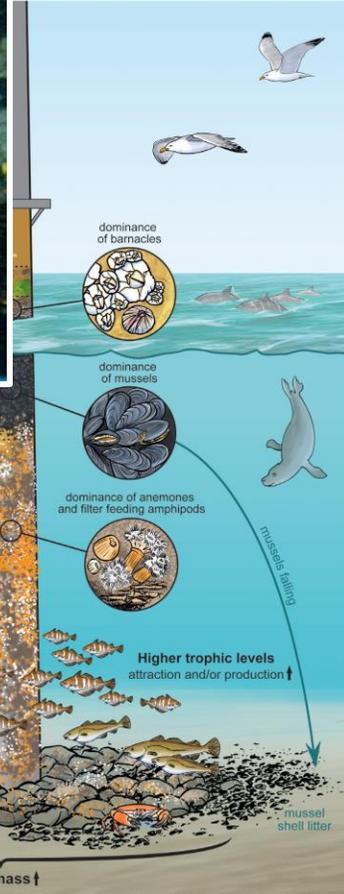
## Research Motivation

- Growth in **Offshore (Floating) Wind Energy**
- **Expensive** and **safety critical** inspection and maintenance
- Side effect in the **marine ecosystem** ?  
(**Artificial reef**, migration behaviour, electromagnetic sensitive)
- **Unsafe close-range** operation
- **Prior knowledge** of the infrastructure  
(Except for new **Biofouling** and **Scratches**)

BVG Associates [1]

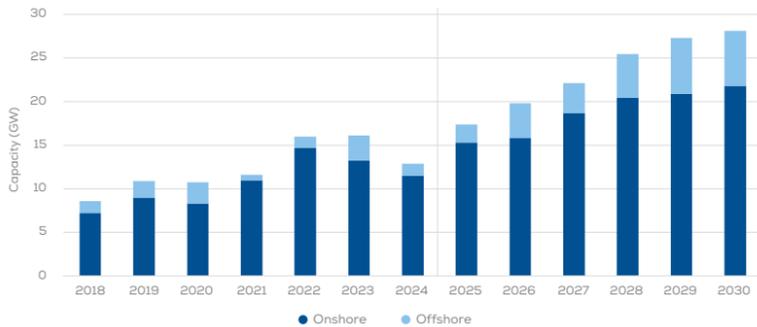


Biofouling [2]



OWF Artificial Reefs [3]

## Use Underwater Robots !



WindEurope Forecast [0]

Ocean Wind OWF



Operations and maintenance 33.8%



# Problem Statement

VideoRay Pro 4 ROV, OWF Inspection



What is my sensors configuration?  
Where am I?  
What am I looking at?

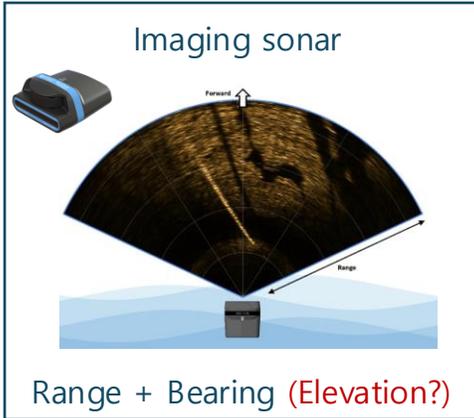
## Exteroceptive:

Camera



Elevation + Bearing (Range?)

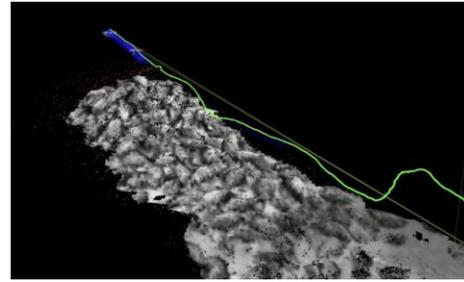
Imaging sonar



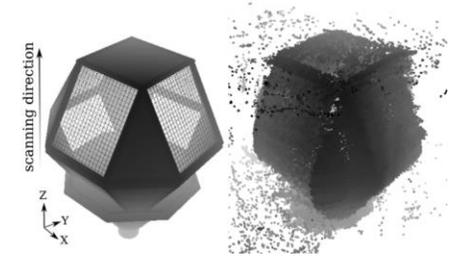
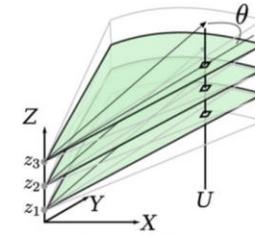
Range + Bearing (Elevation?)

Proprioceptive: IMU, Pressure Sensors, Magnetometer

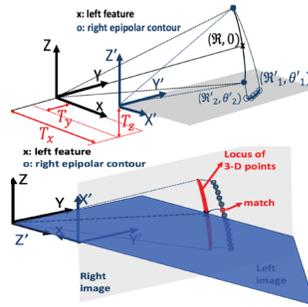
# Related Works ...



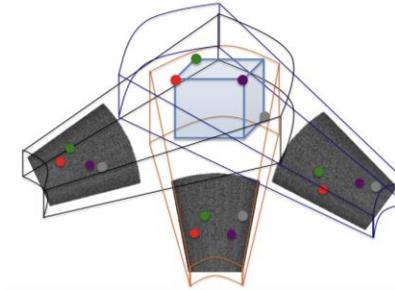
Online Photogrammetry, Ferrera M. [4]



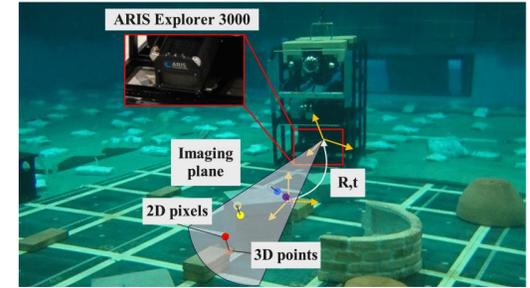
Imaging Sonar 3D Reconstruction, Petillot Y. [5]



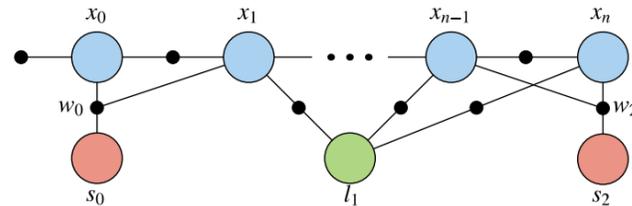
Sonar epipolar geometry, S. Negahdaripour [6]



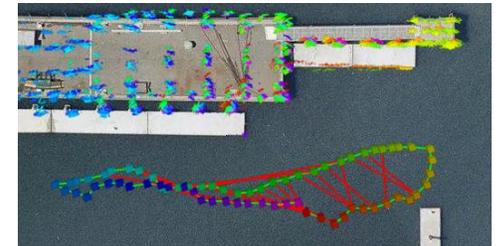
Acoustic SfM, Kaess M. [7]



Acoustic n Point, Y. Wang [8]

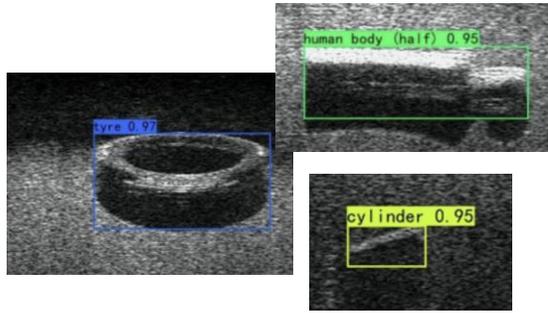


Under-constrained landmarks SLAM, Kaess M. [9]

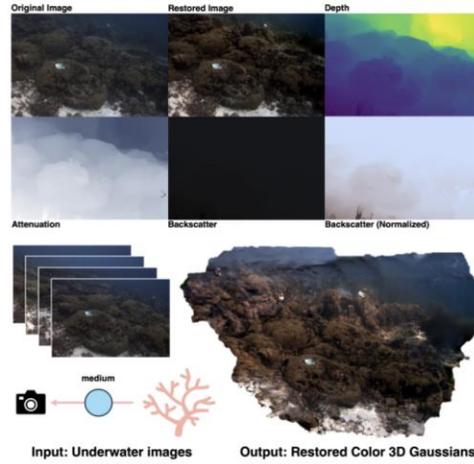


Predictive 3D Mapping, McConnell J. [10]

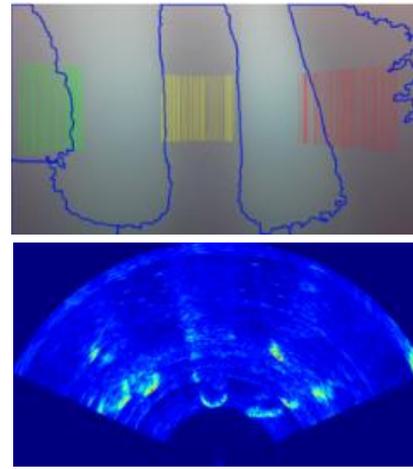
# ... Related Works



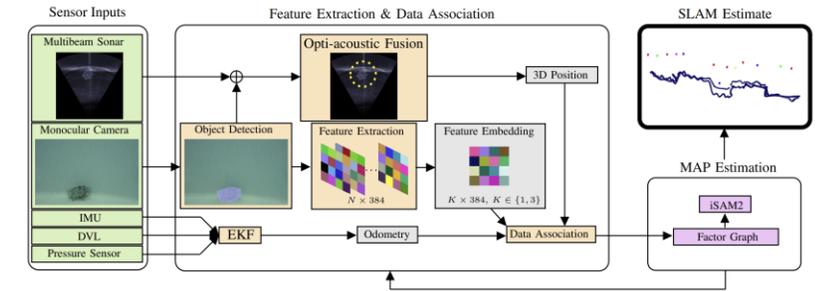
Underwater object detection, Ge L. [11]



Underwater 3D GS, Leonard J. J. [13]



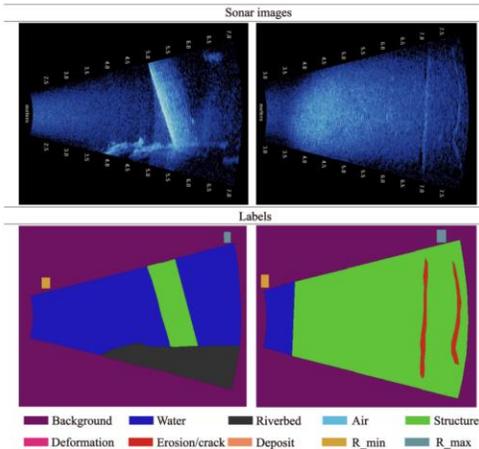
Turbid Opto-Acoustic Reconstruction, Ivana C. [15]



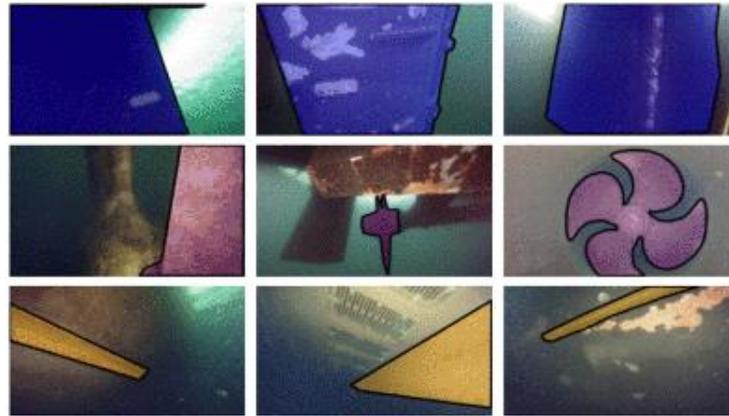
Opti-Acoustic Semantic SLAM, Leonard J. J. [17]



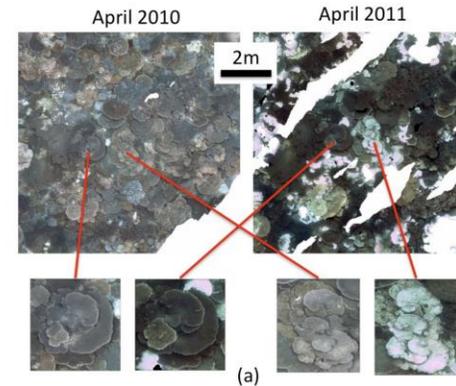
CoralScapes Semantic Reef, Sauder J. [18]



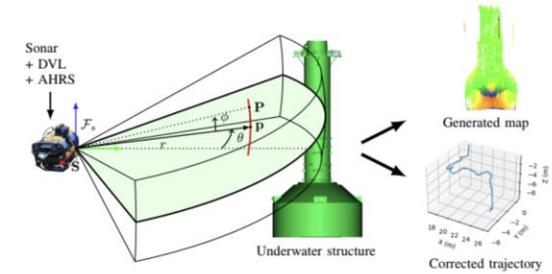
Sonar detection of local damage, Tan H. [12]



Semantic Segmentation in Underwater Ship Inspections, Waszak M. [14]



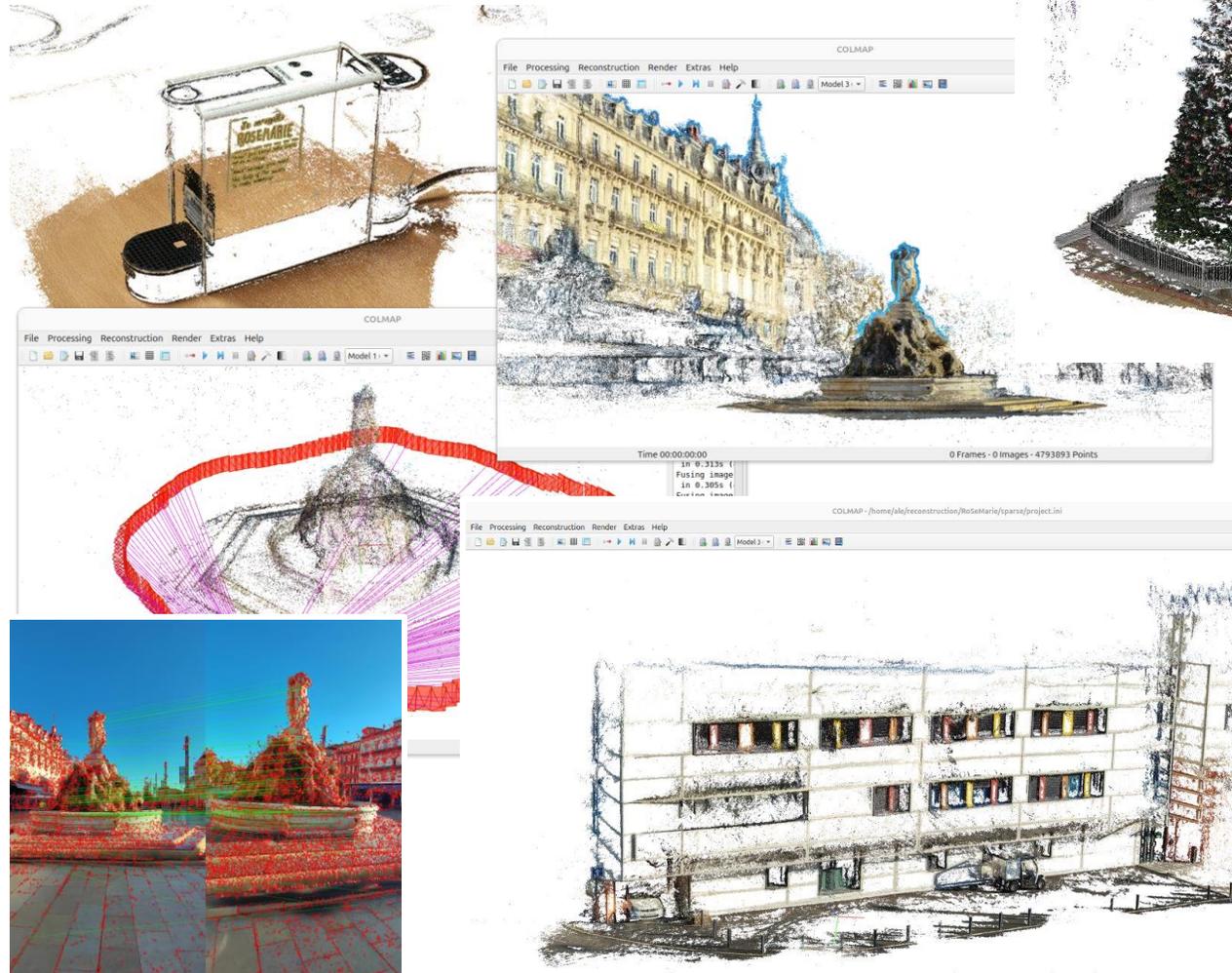
Multi-year benthic habitat survey, Pizzarro O. [16]



3DSSDF, Sonar Signed Distance Function, Simon A. [19]

# 3D Reconstruction (Offline)

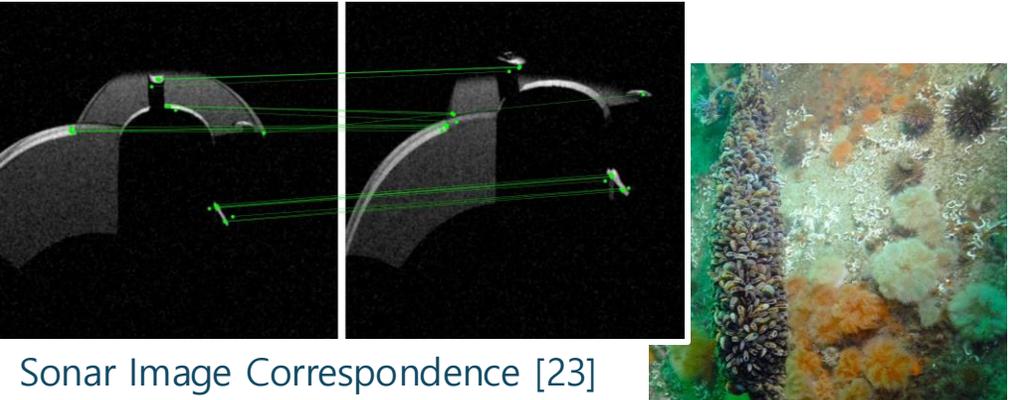
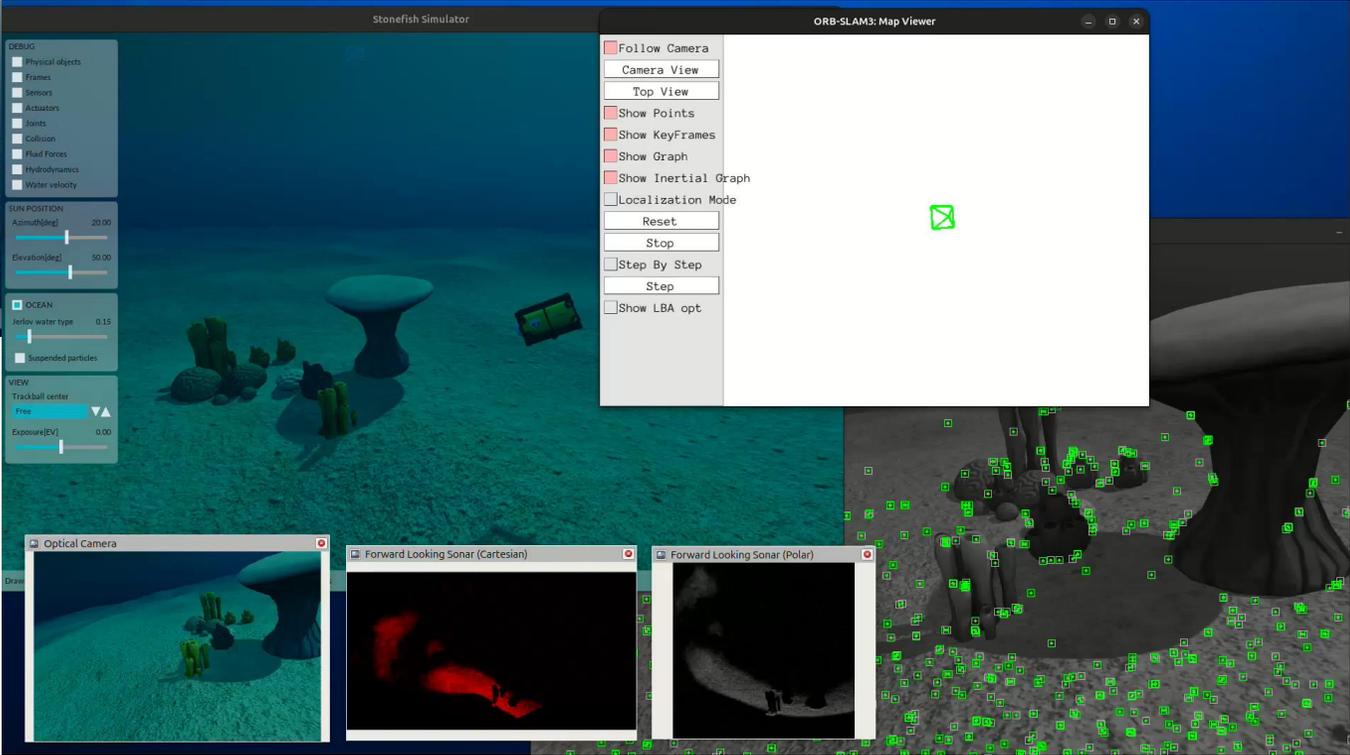
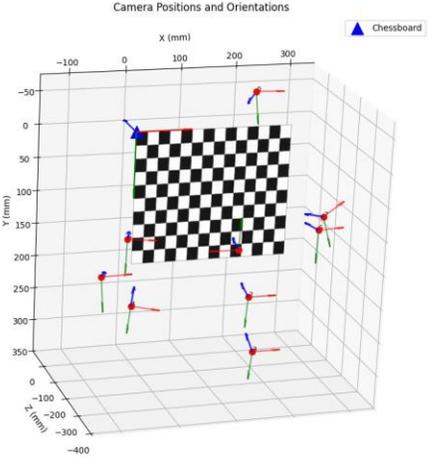
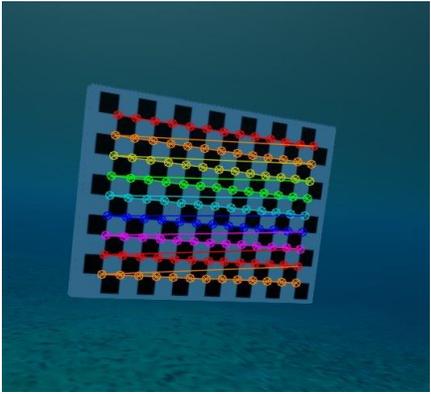
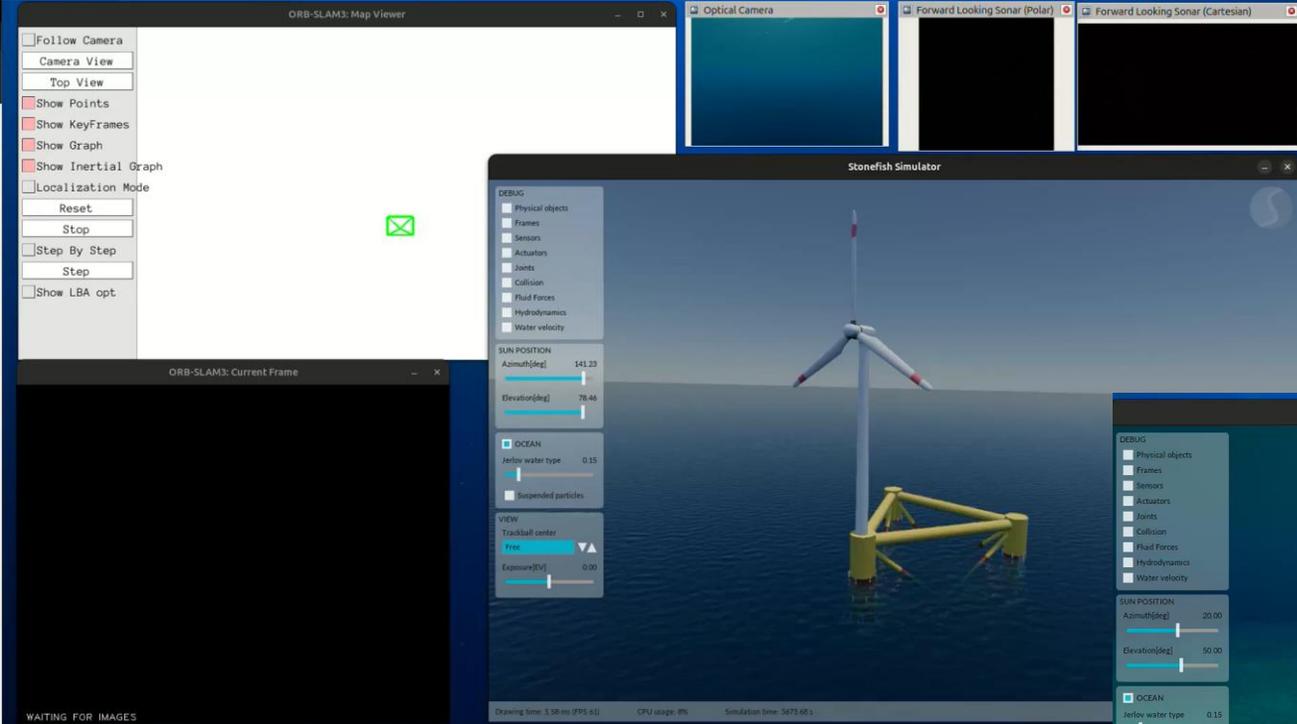
## Colmap [20]: Structure from Motion (SfM)



## Nerfstudio [21]: Neural Radiance Field (NeRF) and Gaussian Splatting (3D GS)



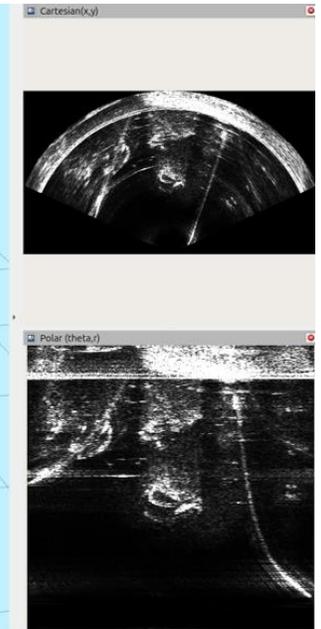
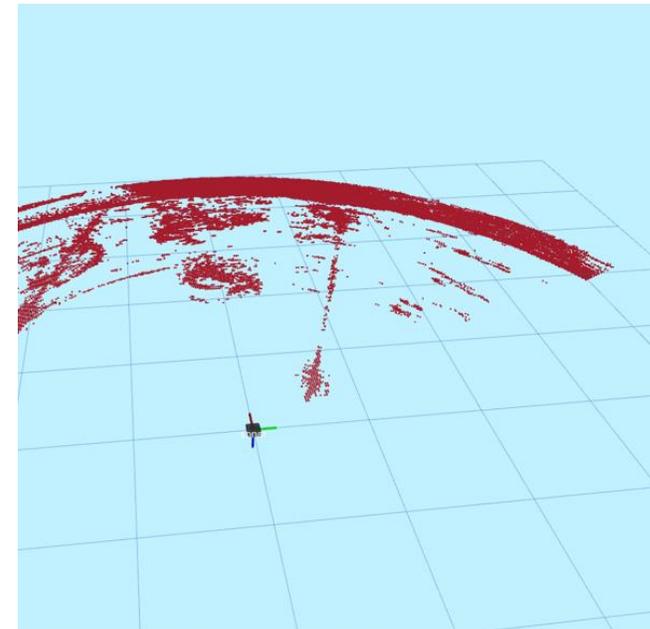
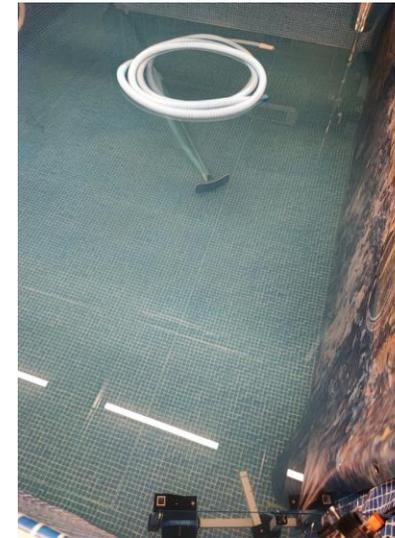
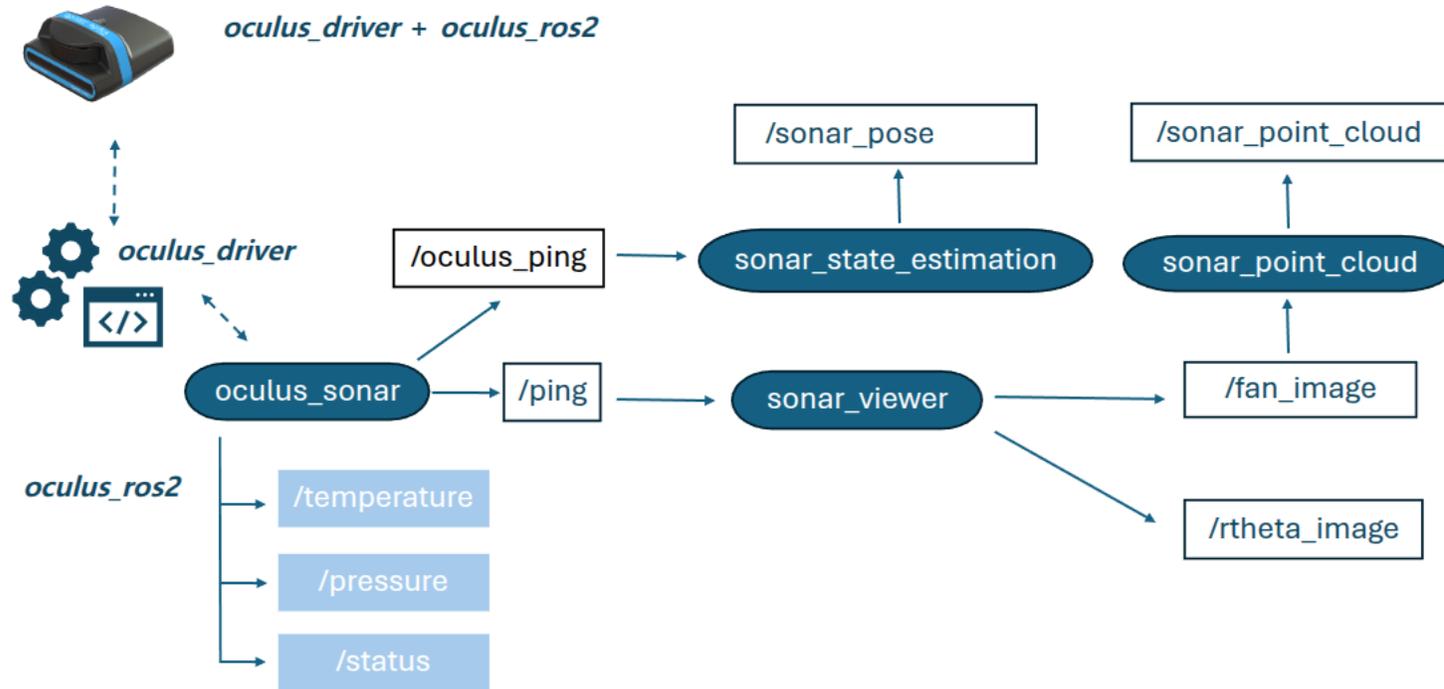
# Simulation ( Stonefish [22] )

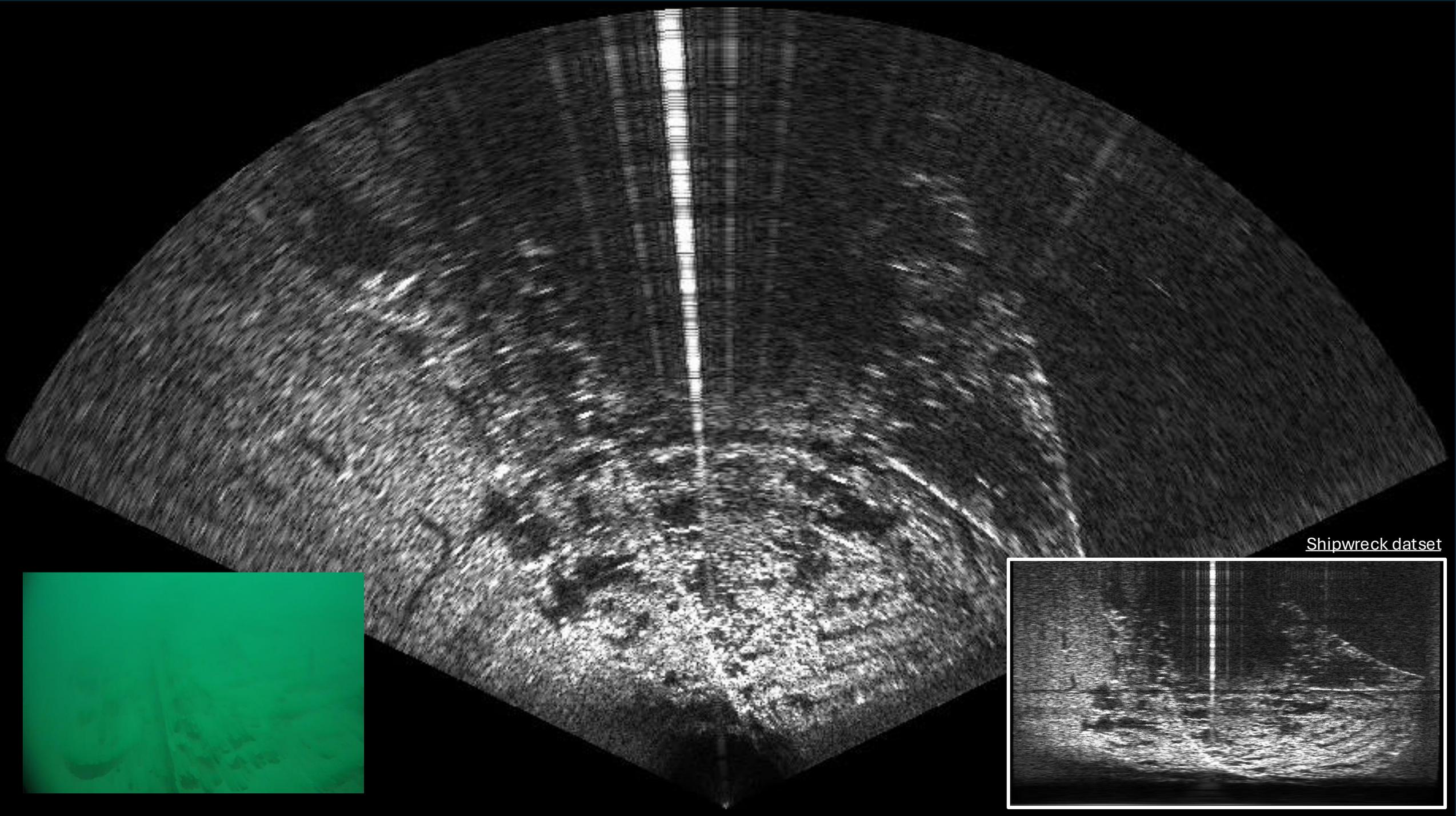


Sonar Image Correspondence [23]

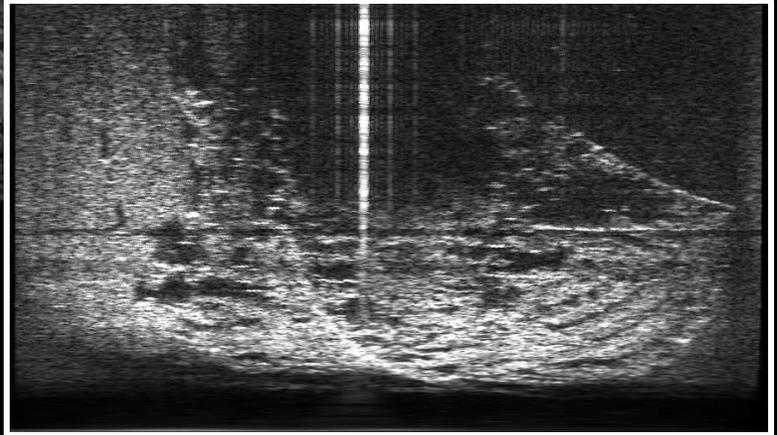
# Setting up my tools

## Sonar Driver



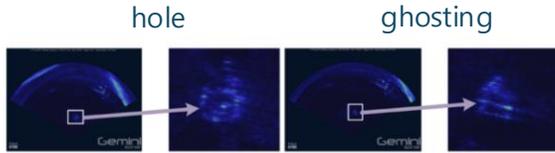


Shipwreck dataset

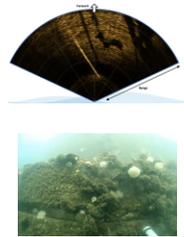


# PhD Project

## Research Plan



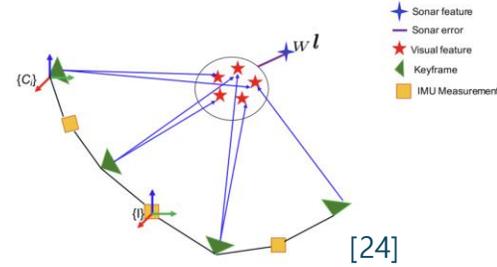
- Image filtering
- Image enhancement



### Pre-processing

### Object Detection Scene Segmentation

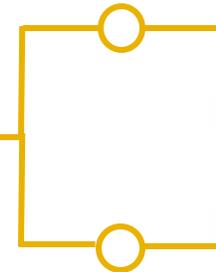
- New Dataset
- Leverage YOLOvX
- Synthetic data
- Biological Survey



### Acoustic Based



- Proprioceptive
- **Calibration**
- Synchronization



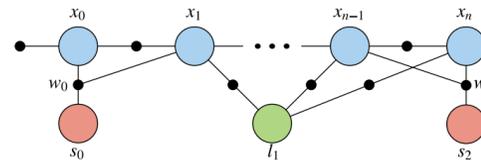
### Vision Based



### Sensor Fusion

### SLAM

- Loop closure
- Multimap
- Semantic landmarks

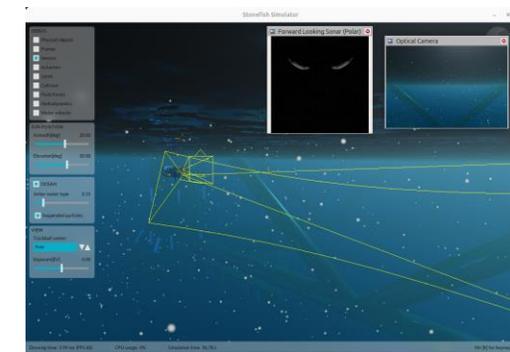


- Prior (Semantic) knowledge Inference
- ICP-based damage evaluation
- Colonization registration

### 3D Reconstruction

### Simulations

### Field



- Synthetic data Enhancement



LIRMM



*"The sea, once it casts its spell, holds one in its net of wonder forever."*

Jacques Yves Cousteau

14/01/2026

**Thank you for your attention!**  
**Discussion and Questions**

**Alessandro Puglisi**

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**Advisor:** Vincent Creuze

**Co-Advisors:** Juliette Drupt,  
Frederic Comby



# References

- [0] [WindEurope Report on Wind Sector Forecast 2025-2030](#)
- [1] [BVG Associates: Strategic Consulting in Renewable Energy](#)
- [2]  Couturier L., Lecaillon G., Lenfant P., Thiriet P., **The reef effect induced by wind farms and their grid connection**, (Report No. COME3T Bulletin n°03), Report by France Energies Marines, 2022
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- [6]  S. Negahdaripour, "Analyzing Epipolar Geometry of 2-D Forward-Scan Sonar Stereo for Matching and 3-D Reconstruction," *OCEANS 2018 MTS/IEEE Charleston, SC, USA*
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- [10]  McConnell J., Englot B., **Predictive 3D Sonar Mapping of Underwater Environments via Object-specific Bayesian Inference**, *2021 IEEE International Conference on Robotics and Automation (ICRA)*, Xi'an, China, 2021
- [11]  Ge L, Singh P, Sadhu A., **Advanced deep learning framework for underwater object detection with multibeam forward-looking sonar**, *Structural Health Monitoring*, 2024
- [12]  Huiming T., Leiming Z., Chicheng Ma, Yi Xu, Yifei S., **Deep learning-assisted high-resolution sonar detection of local damage in underwater structures**, *Automation in Construction, Volume 164*, 2024
- [13]  Yang D., J. Leonard, Girdhar Y., **SeaSplat: Representing Underwater Scenes with 3D Gaussian Splatting and a Physically Grounded Image Formation Model**, 2024
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- [15]  Ivana Collado-Gonzalez and John McConnell and Paul Szenher and Brendan Englot , **Opti-Acoustic Scene Reconstruction in Highly Turbid Underwater Environments**, arXiv, 2025
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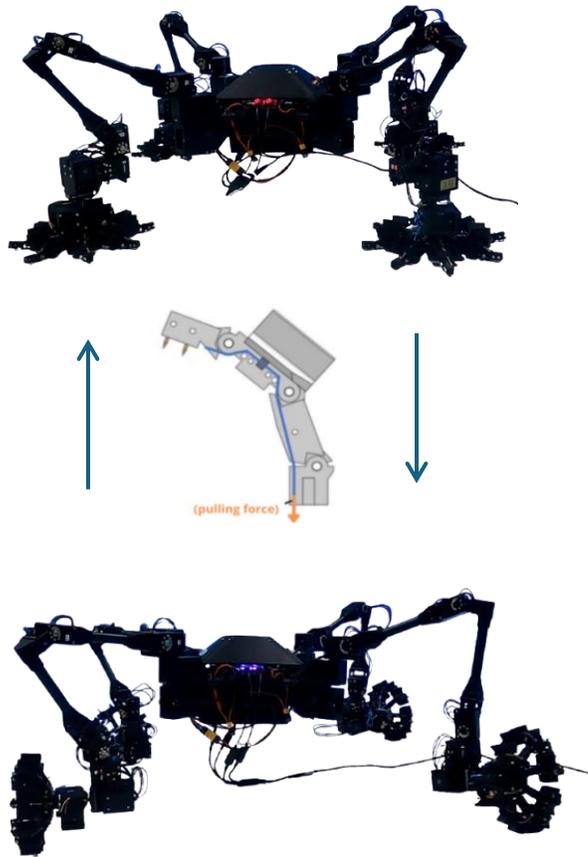
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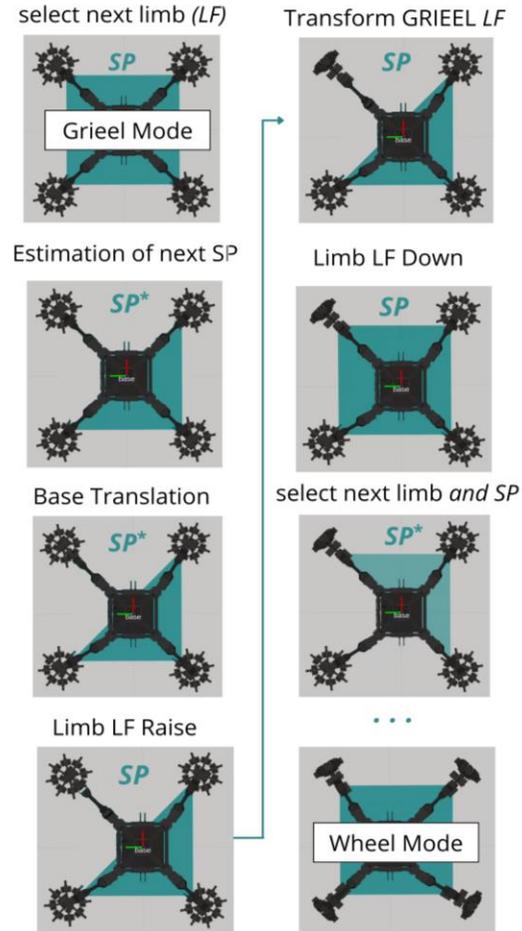
# Master Thesis

## Motion Control and Manipulability Analysis of LIMBERO-GRIEEL: A Multimodal Limbed Robot for Unstructured Environments

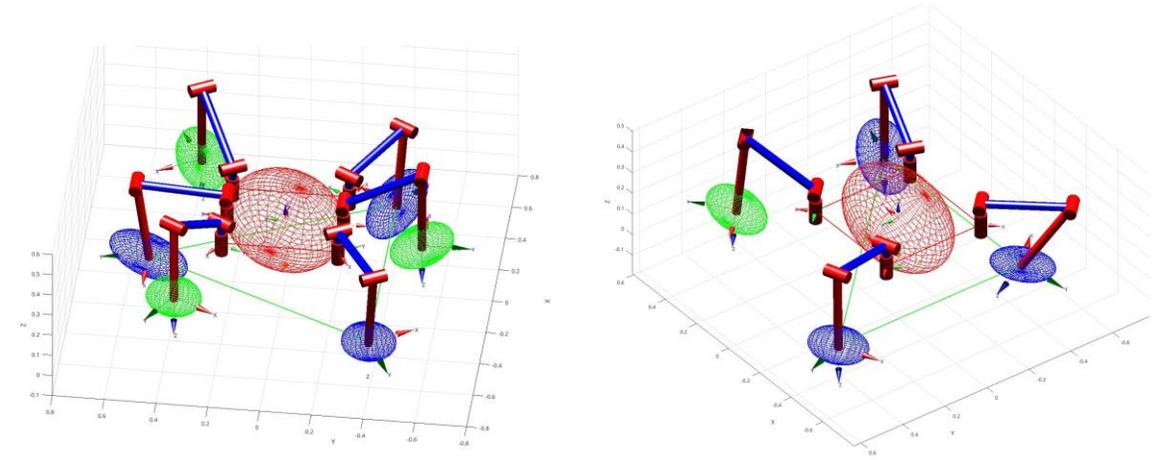
### LIMBERO-GRIEEL



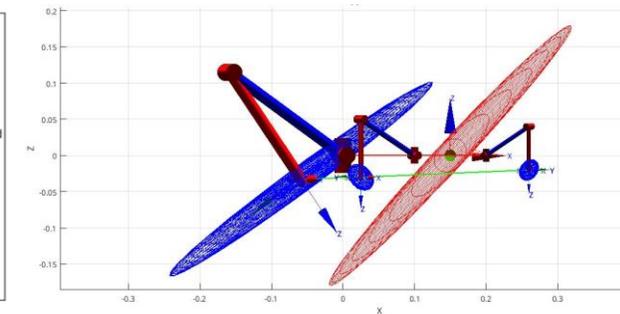
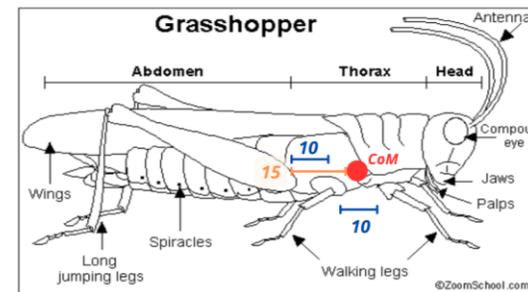
### Stable Transformation



### Manipulability Theory



(bio-inspired validation)



# Motion Control and Manipulability Analysis of LIMBERO-GRIEEL: A Multimodal Limbed Robot for Unstructured Environments

