Research Presentation

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Introduction

Integration of ROS into underwater/surface robots

Context

Use cases:

- Marine Exploration
- Underwater Mapping
- Environmental Monitoring
- Offshore Industry Activities

Challenges:

- Natural Environment
- Cost
- Bring-up Time
- Lack of Modularity

Robots of Seal

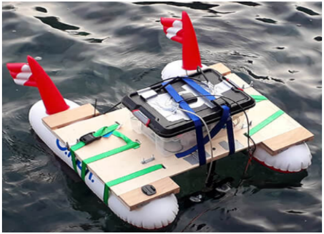
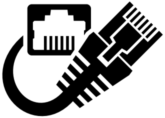


Image : Surface Robot Kraken



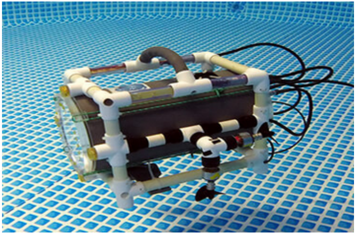


Image : Underwater Robot Ryu

Mission: mapping underwater terrain

Main Challenges

- Communication between underwater and surface

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- Communication between underwater and surface
- Combination of software tools

What is ROS?

Pros

- **Modularity**: reuse of code
- **Efficiency**: Extensive open-source code
- **Compatibility**: Operates across numerous OS and hardware
- **Testing**

Cons

- Not Real-Time
- Lack of Documentation
- Minimal AUV Applications
- Difficult Adoption Cycle

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Main Objective

Challenge: Combination of ROS and Ardupilot:

- Integration issues with ROS.
- Technical challenges and time-consuming setup.

Objective:

- Modular, low-cost robot that relies exclusively on ROS
- Re-assemble step-by-step surface robot

State of art: Combination of Software Tools

	Yellowfin AUV	Modularis	Hybrid System
Mission/Goal	Underwater AUV for research and exploration	Modular AUV design	Hybrid underwater robotic system combining features of ROVs and AUVs
Tools	MOOS XMOS ROS2	ROS1 ROS2	ROS2 ARDUPILOT

State of art: Combination of Software Tools

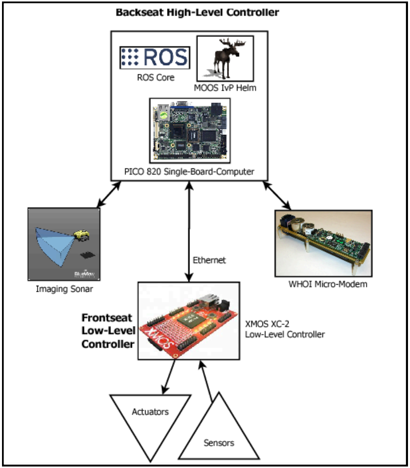


Image : Yellowfin System Architecture

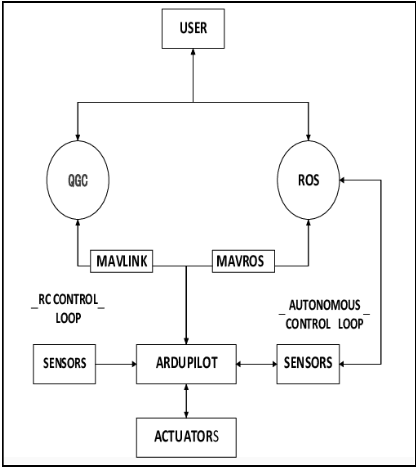


Image : Hybrid Software-Hardware Interaction

Objectives:

- Simulate the surface of a water body:

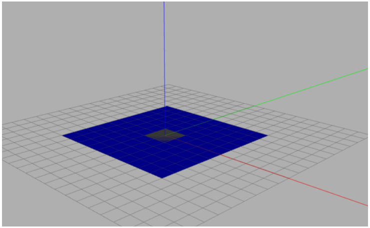
  Step 1: simple still water surface

  Step 2: addition of waves, currents
- Interaction with vehicle: buoyancy forces
- Have a 3D model of the lab's surface robot

Virtual Simulation on Gazebo

World
- Materials
  - waves.material
- Ocean
  - model.config
  - models.sdf
  - sea_surface_1000m_x_1000m.dae
- my_world.sdf

Image : File Architecture



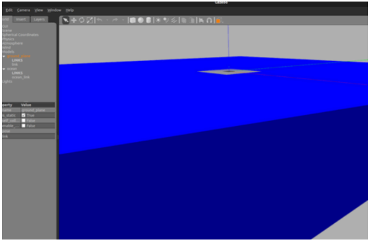


Image : Gazebo Simulations of water

Configuration of Raspberry Pi

Objectives:

- Raspberry Pi as access point using DHCP server
- Testing communication range
- “Ping/Pong” code

Steps:

- Install/Update
- Configure hostapd
- Setup the dhcp server
- Configure Netplan
- Reboot and test

Next Steps and Goals

1. Gazebo Simulation

2. Testing Communication

- Test the maximum distance of communication between two Raspberry Pis.

3. Enhancing SEAL Robots

- Step-by-step assembly of the surface robot.
- Replace Ardupilot with ROS alternatives.

Conclusion

Strategic Move towards ROS:

- **Purpose:** Overcome challenges of integrating multiple systems
- **Current Progress:**
  - Developing virtual simulator in Gazebo for surface robot testing.
  - Configured Raspberry Pi for wireless communication.

Thank you for listening

Sources

DESIGN AND DEVELOPMENT OF THE YELLOWFIN UUV by Georgia Institute of Technology

AN OVERVIEW OF AUTONOMOUS UNDERWATER VEHICLE SYSTEMS AND SENSORS AT GEORGIA TECH

An implementation of ROS on the Yellowfin autonomous underwater vehicle by Georgia Institute of Technology

Modularis research paper by University of Florida Research team

Github : Maritime-Robotics-Student-Society/sailing-robot

Hybrid Underwater Robot System Based on ROS | Semantic Scholar