Multi-Robotic Ocean Exploration:

Enabling multi-robot collaboration by integrating the Sonardyne Mini Ranger 2 system with the Robotic Operating System

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https://www.sonardyne.com/marine-robotics/

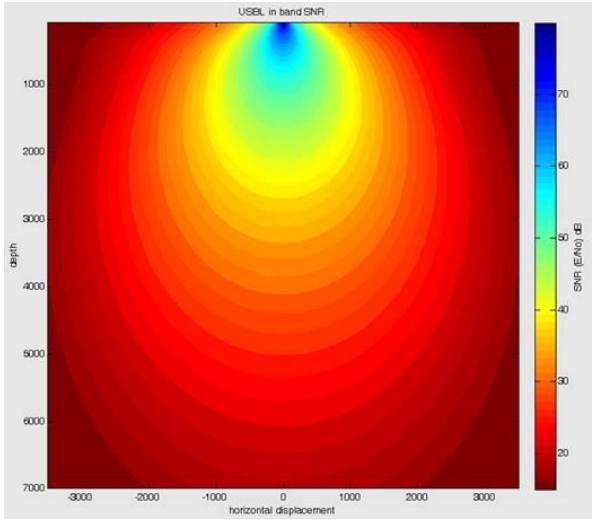
Enabling multi-robot collaboration by integrating the Sonardyne Mini Ranger 2 system with the Robotic Operating System

University of New Hampshire

Center for Coastal & Ocean Mapping Joint Hydrographic Center University of New Hampshire CCOM JHC

Sonardyne

Mini Ranger 2



- Ranger 2 software with robotics pack
- HPT 3000
  - MF (20–34 kHz)
  - <4,000m tracking (with ER option)
  - <15mm ranging precision
  - Positioning repeatability: <1.3% of slant range 1 Drms / 0.9% 1 Sigma (internal MRU) <0.2% of slant range 1 Drms / 0.14% 1 Sigma (external MRU)
  - Integrated MTi-30 Xsens MRU
  - Ethernet-based comms

Beacons for Positioning and Telemetry

- Simultaneous USBL navigation with two way SMS telemetry (AvTrak 6)
- High data rate (9kbps) acoustic modem
- <7000m depth operation
- Variant options include remote transducer, OEM and Nano

ROS Sonardyne drivers (Developed by the University of New Hampshire)

https://github.com/CCOMJHC/sonardyne_usbl

modem_node

The modem_node.py node provides topics for sending and receiving SMS messages using `sonardyne_msgs/SMS` messages and for sending and receiving raw modem commands using `std_msgs/String` messages.

Supports serial, TCP or UDP connections.

ranger_node

The ranger_node.py node subscribes to asynchronous position updates from the Ranger software and publishes them as `geographic_msgs/GeoPointStamped` messages. Uses XML base UDP remote control protocol.

ROS Message Definitions

https://github.com/CCOMJHC/sonardyne_msgs

Position.msg

```
Header header
string UID
float32 age
string category
string name
float64 latitude
float64 longitude
float32 depth
string history
```

SMS.msg

```
time receive_time
string address
string message
```

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During the 2022 NOAA Ocean Exploration Cooperative Institute Technology Integration Cruise (aka: OECI Tech Challenge), The surface robot DriX worked with the underwater robots Mesobot and NUI allowing Nautilus to freely map the seafloor nearby.

The Sonardyne ROS driver was a key component used with Project11 on DriX which provided situational awareness and command and control

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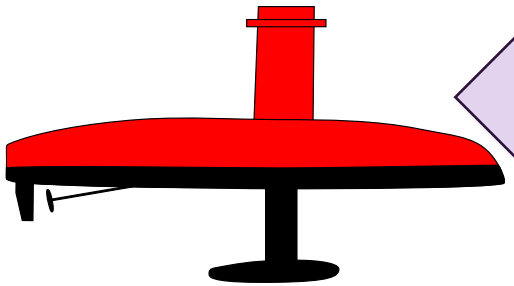
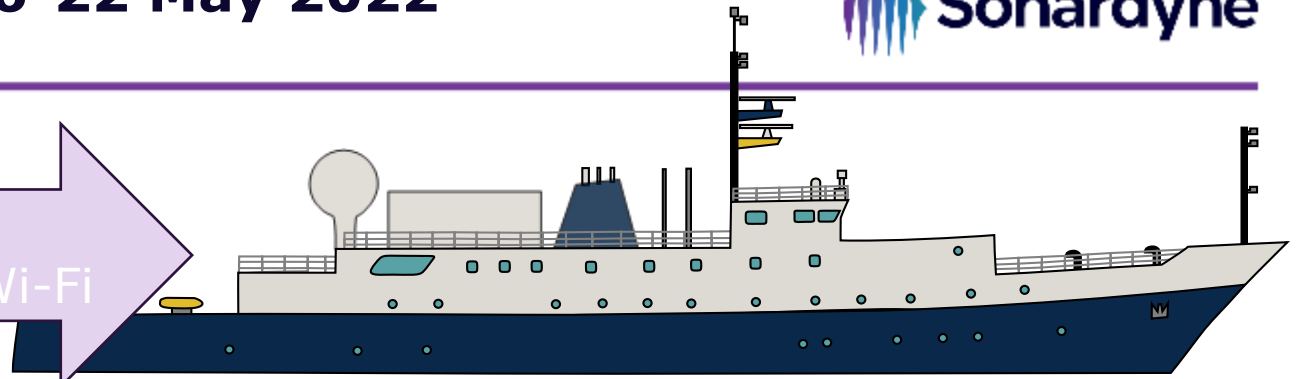
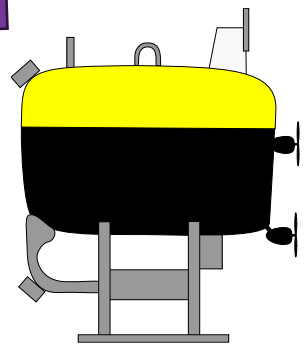


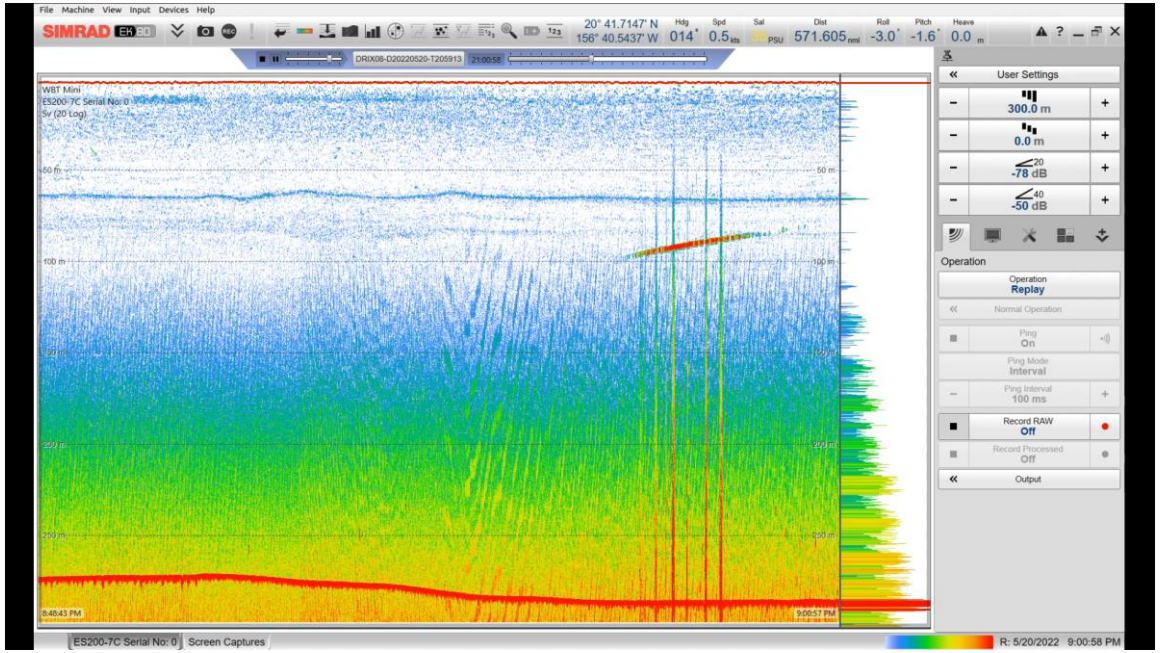
Starlink, Marine Broadband Radio or Wi-Fi



Sonardyne Mini Ranger 2 telemetry and communication

Watercolumn Sonar



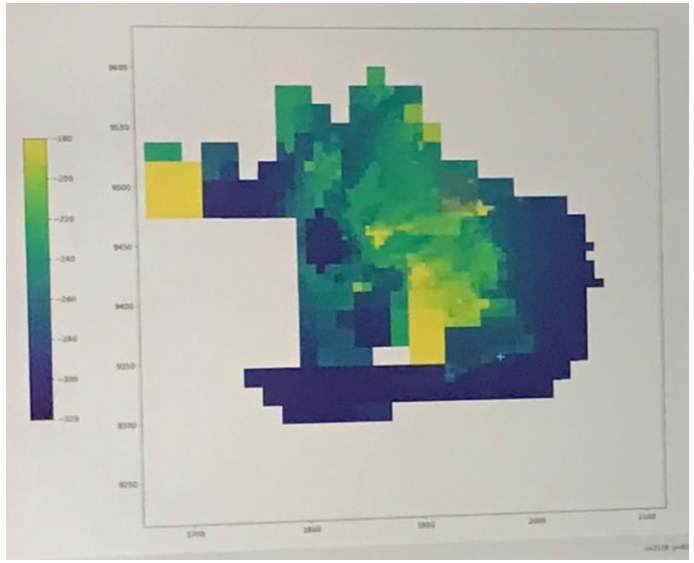


Layer confirmed using EK80, command sent to Mesobot to change depth, once confirmed that Mesobot was in the layer, command to sample for eDNA was sent:
“VERIFIED - DIRECTED SAMPLING”

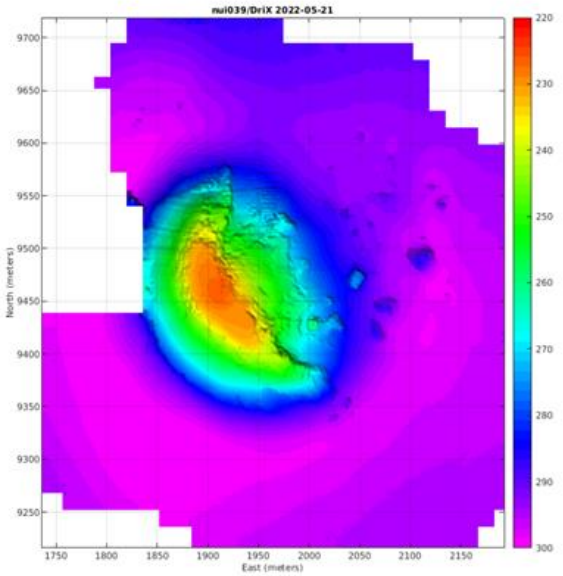
Near Real-time Data for Operational Decision Making!

- NUI “Co-Exploration”
- Both MBES mapping and camera data via DriX acoustic relay.

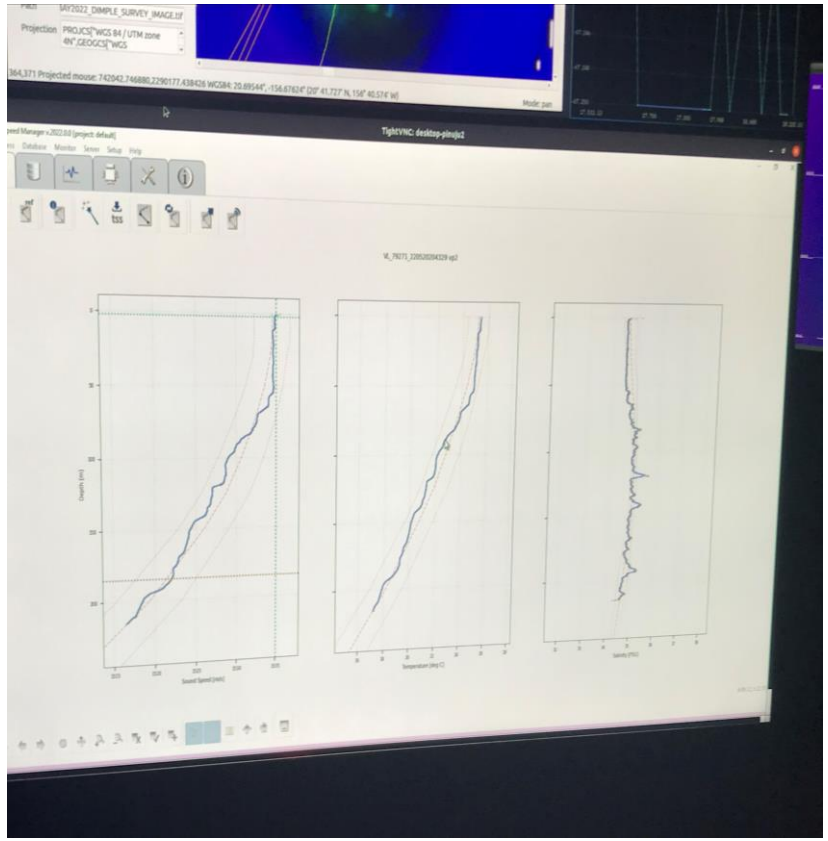
- Transmission of CTD measurements from Mesobot to ship via DriX for real-time input on water column properties



Realtime “CO-EX” Transmitted Data



Post Deployment Data



Conclusion… but not really, there's another slide and a video

The combination of the Sonardyne Mini Ranger 2 system with a ROS driver for integration with Project11 was a key building block allowing the rapid development of technologies for marine robot cooperation

University of New Hampshire

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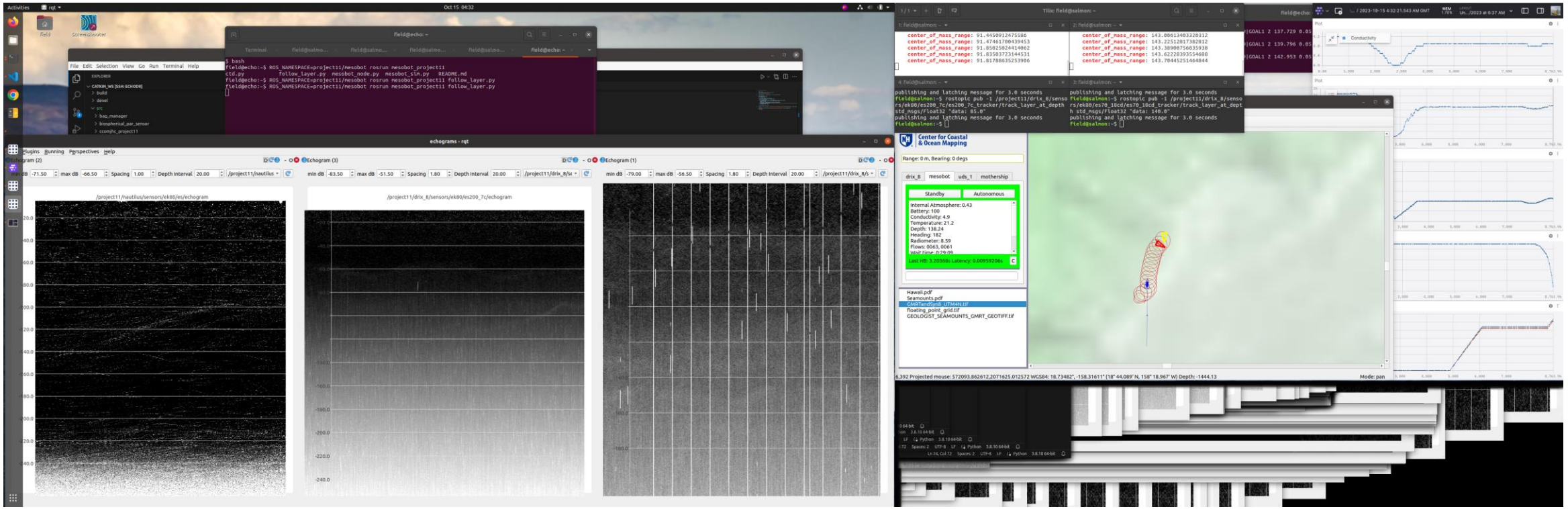
Breaking News! October 2023 Tech Challenge Cruise

Building on the success of the 2022 Tech Challenge cruise, Mesobot and DriX cooperation was improved.

- Verified Directed Sampling was refined using offset orbits
- Automatic layer tracking was implemented as well as layer following by Mesobot. The Sonardyne system using the ROS driver was a key component for making this happen.



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Thank you for your time today

Any Questions?

https://www.sonardyne.com/marine-robotics/

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