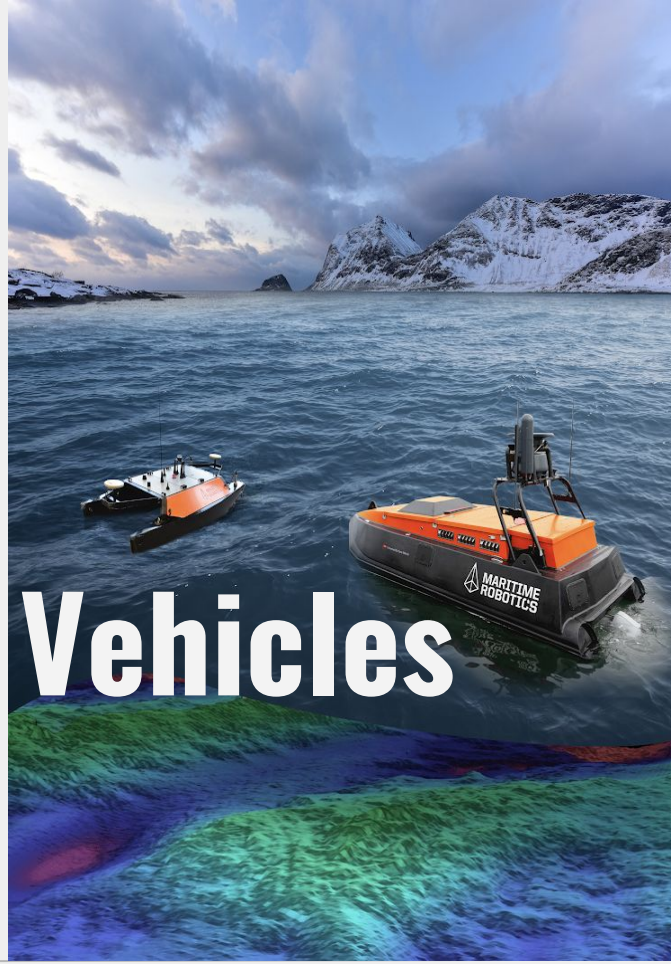
Autonomy for Unmanned Surface Vehicles



Innovation Expo 2018 -- Smart Shipping

Stephanie Kemna -- stephanie@maritimerobotics.com

MARITIME ROBOTICS

About Maritime Robotics

- Established in 2005
- Located in Trondheim, Asker and Eggemoen (Norway)
- Main markets: geophysical mapping, environmental monitoring and defence/security

UNMANNED SYSTEMS

COST EFFICIENT AND RISK-REDUCING
MARITIME DATA ACQUISITION

Moored Balloon System - The OceanEye

Unmanned Aerial System - The PX-31

Unmanned Surface Vehicles

Maritime Robotics - Unmanned Surface Vehicles

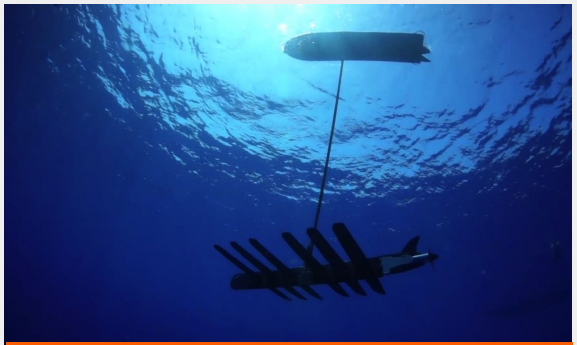
SHELTERED WATERS

OTTER

COASTAL/OPEN WATERS

MARINER

OPEN OCEAN



WAVE GLIDER
LIQUID ROBOTICS

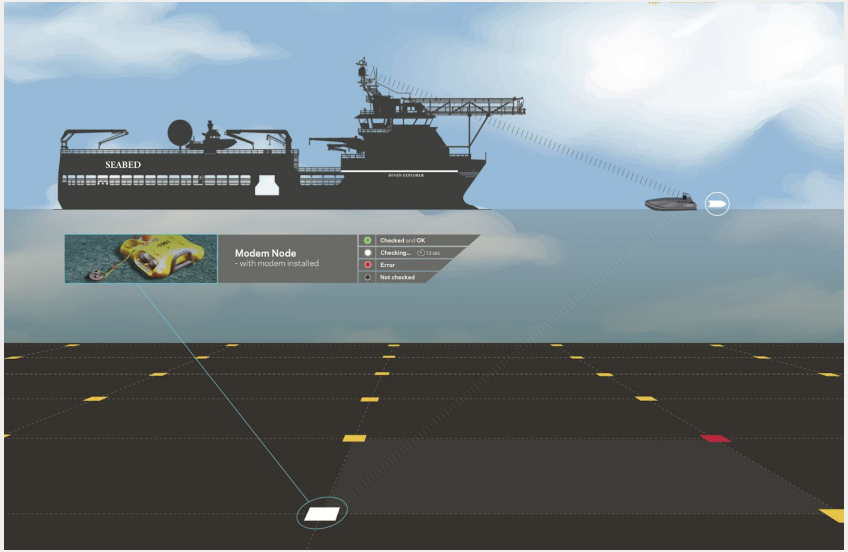
USV

Unmanned Surface System - The MARINER

- EO/IR cameras
- Radar, Lidar
- Bow thruster
- Waterjet
- Diesel engine (150hp)
- 1 700 kg

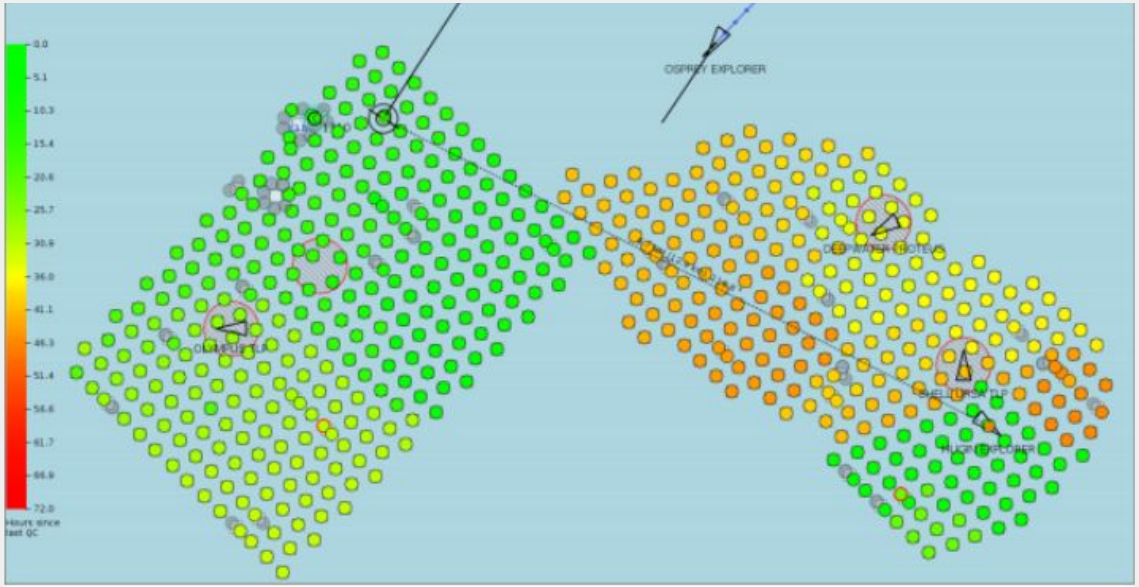
- 10nm typical radio range (VHF/UHF/C-band)
- Global range with SatCom/Mobile data
- 50 hours (5 kts)
- 35 kts max speed
- Echosounder, Sonar, Acoustic positioning
- METOC, CTD, ADCP

Use Case - Quality Control of Seabed Nodes



MARITIME ROBOTICS

Use Case - Quality Control of Seabed Nodes



USV

Unmanned Surface System - The OTTER Mk3

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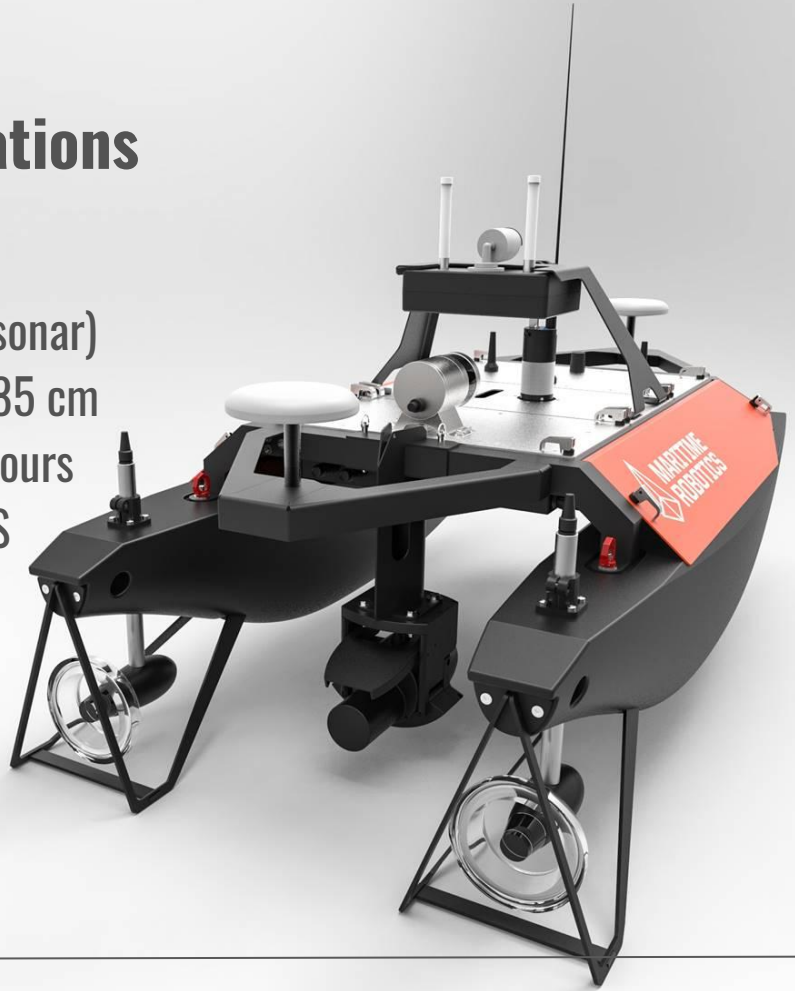
The OTTER - Specifications

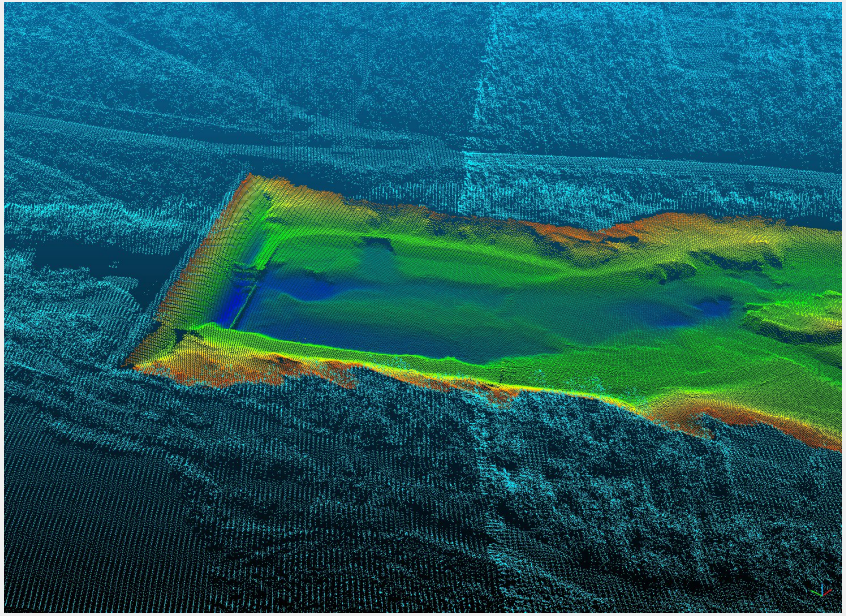
- 2 x electrical thrusters
- Max speed: 6.0 kn (4.5 w/sonar)
- Dimensions: 200 x 105 x 85 cm
- Endurance: 20+ NM / 10+hours @ 2 kn with Norbit iWBMS
- Flexible options:
  - AIS receiver,
  - integrated camera,
  - GSM modem and
  - pt-2-pt link
- Splits into pieces < 15 kg



The OTTER - Modes of Operation

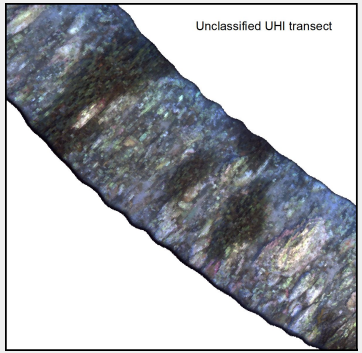
- Remote control (via app or laptop)
- Course and speed autopilot
- Waypoint tracking
- Station keeping
- Formation

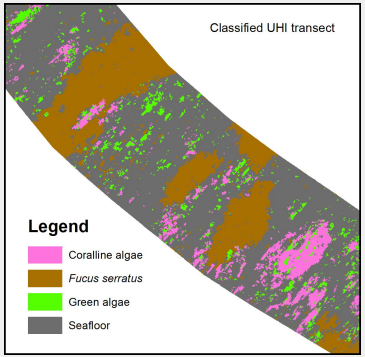
Use Case - Reservoir Mapping with Multibeam Echosounder



Norbit iWBMS, Aplanix AP20 and CPOS RTK

Use Case - Underwater Hyperspectral Imager Research on Algae Classification





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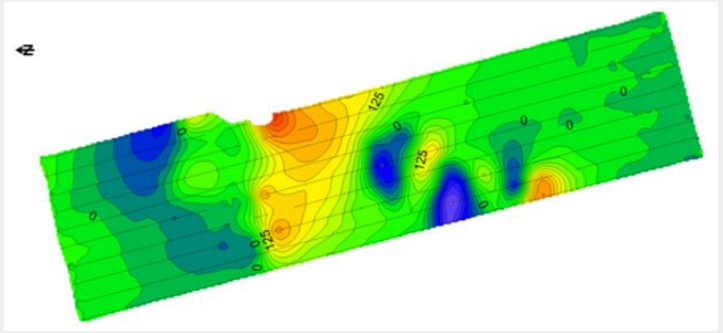
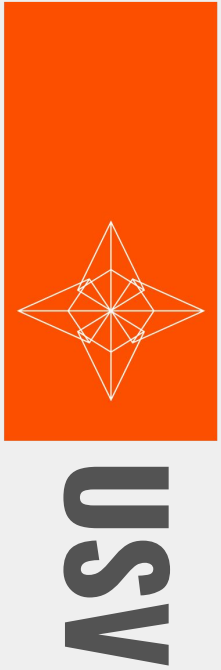
Use Case - Magnetometer and Sonar Searching for Missing Aircraft





Unmanned Surface System - Conversion System

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Unmanned by Maritime Robotics

Conversion System consists of an
diate **Communications System** and a
enabling Unmanned Surface operations

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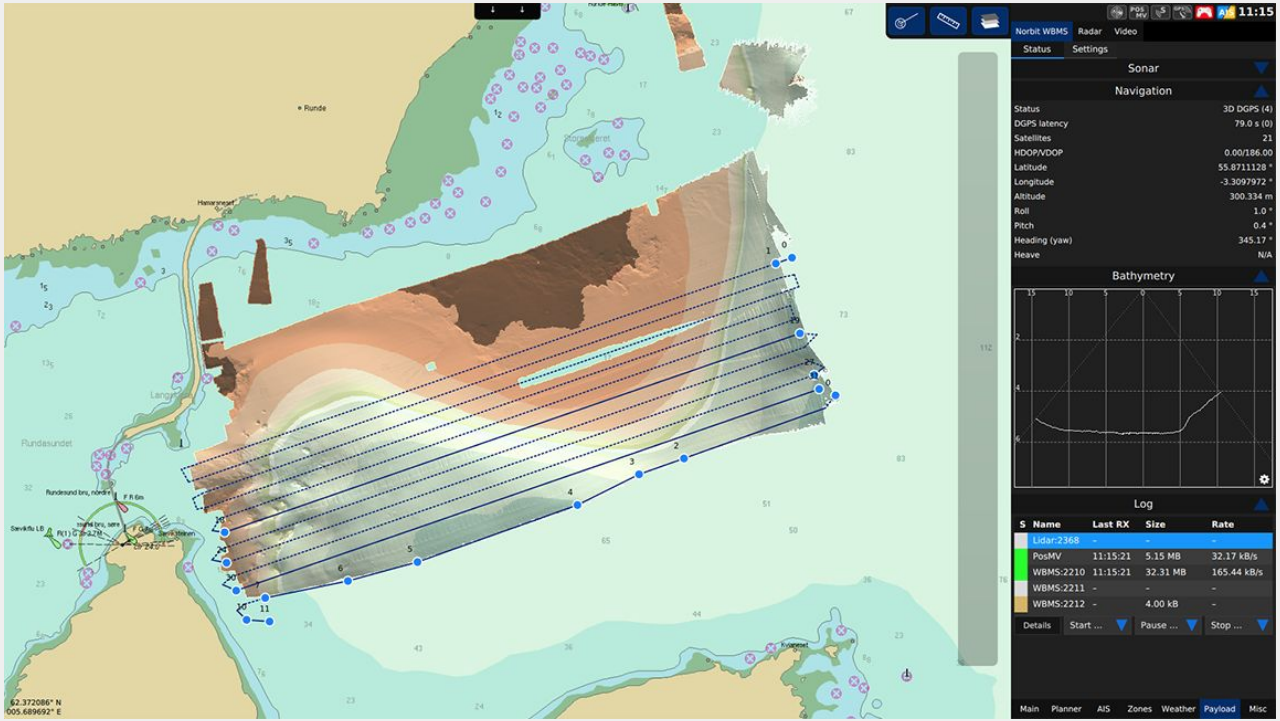
Conversions

Goldfish, 11m (36 ft), 65 kn

Viknes 830, 8.5m (28 ft), 20kn

Alumaster, 6m (20ft), 10kn

Vehicle Control Station



Touch tablet

PC

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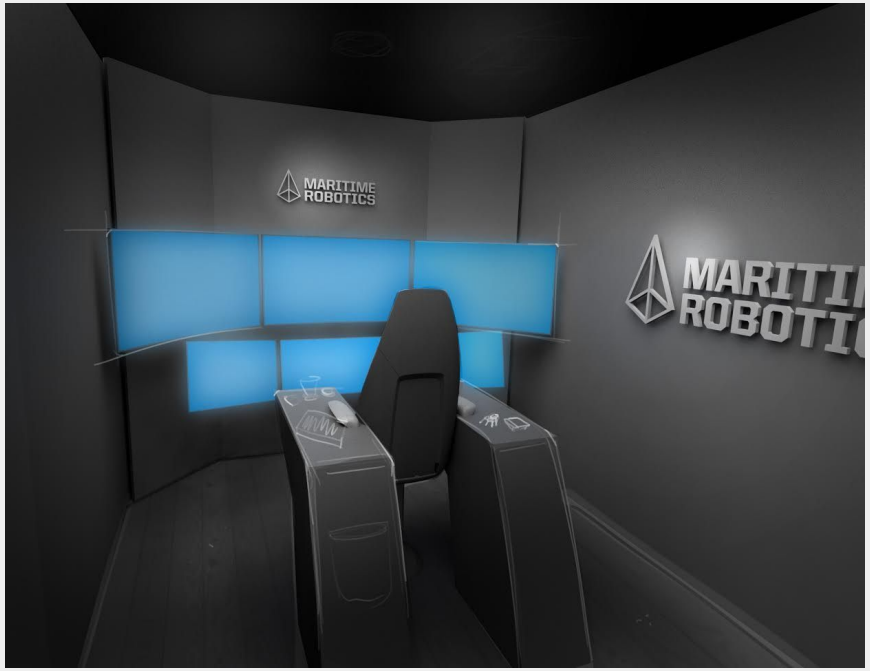
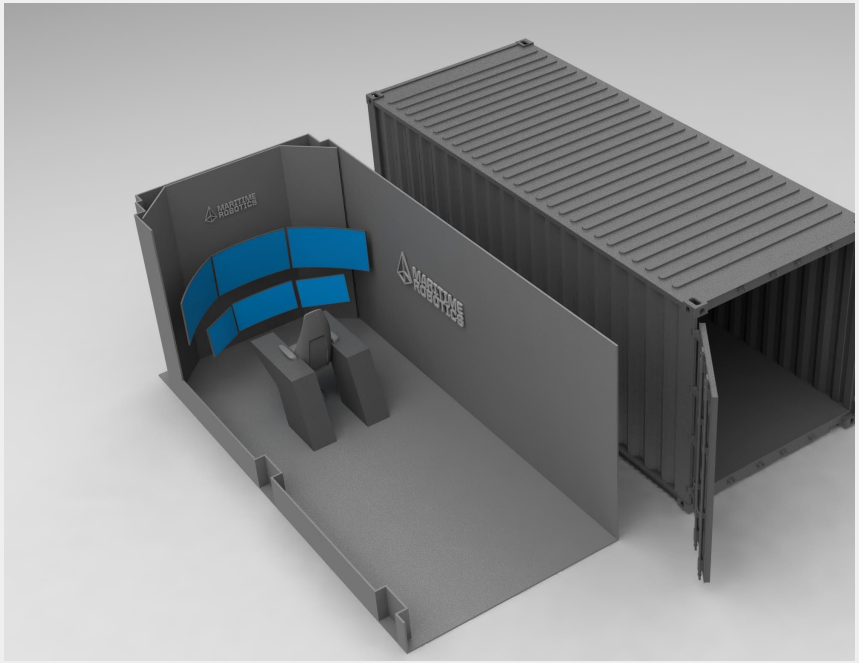
Vehicle Control Station



- Situational awareness
  - Sea chart
  - Radar overlay
  - 360 camera (daylight and IR)
- Ergonomic control chair setup
- VHF voice communication
- Quick deployment with pre-rigged monitors and input devices
- 10 or 20-ft shipping container

Vehicle Control Station



- Situational awareness
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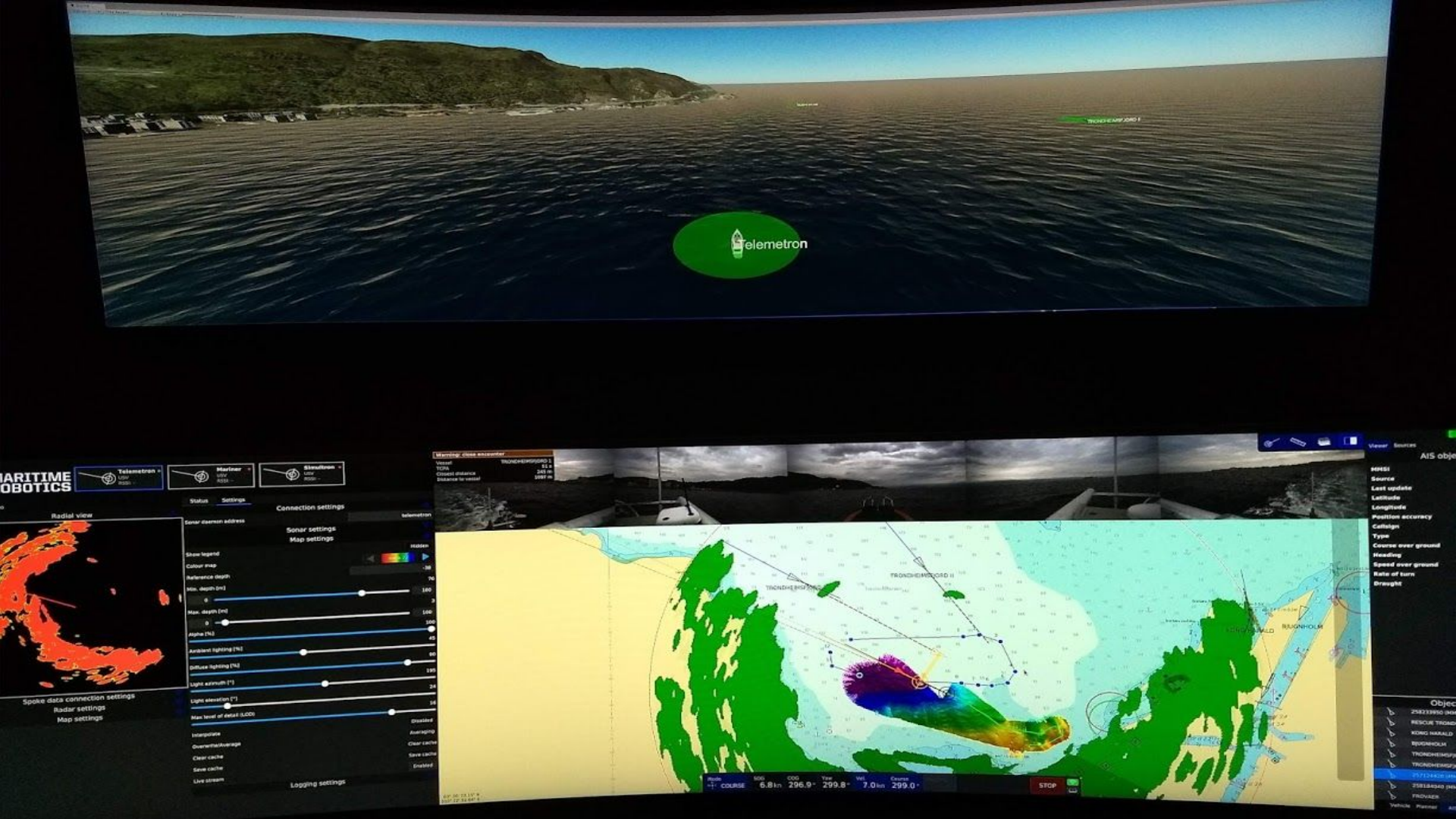
MARITIME
ROBOTICS


Telemetron
Telemetron
Mariner
Sinsitron
Radial view
Status
Settings
Connection settings
Sonar settings
Map settings
Spoke data connection settings
Radar settings
Map settings
Logging settings
Warning: close encounter
TRONDHEIMSFJORD II
BJUGNHOLM
COURSE
6.8 kn
296.9
299.8
7.0 kn
299.0
STOP
Viewer
Sources
MMSI
Source
Last update
Latitude
Longitude
Position accuracy
Callsign
Type
Course over ground
Heading
Speed over ground
Rate of turn
Draught
FROVAER

Why Use Unmanned Systems?

DULL

Mowing the lawn

DIRTY

Prop-washing oil slicks

DANGEROUS

Near-shore survey

MARITIME ROBOTICS

Why Use Unmanned Systems?

FUN

Mowing the lawn

GREEN

Prop-washing oil slicks

SAFE

Near-shore survey

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How much autonomy is desired?

Automatic

digital link

MARITIME ROBOTICS

Autonomous

The future?

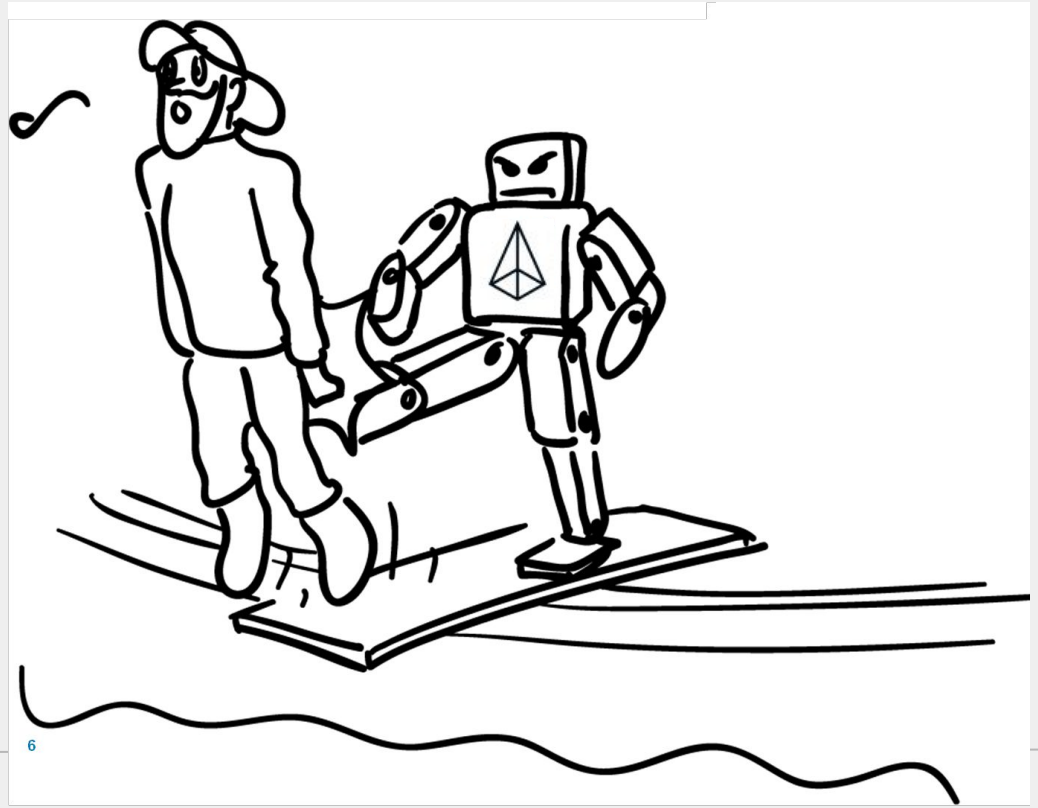

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TABLE 1: Levels of Automation

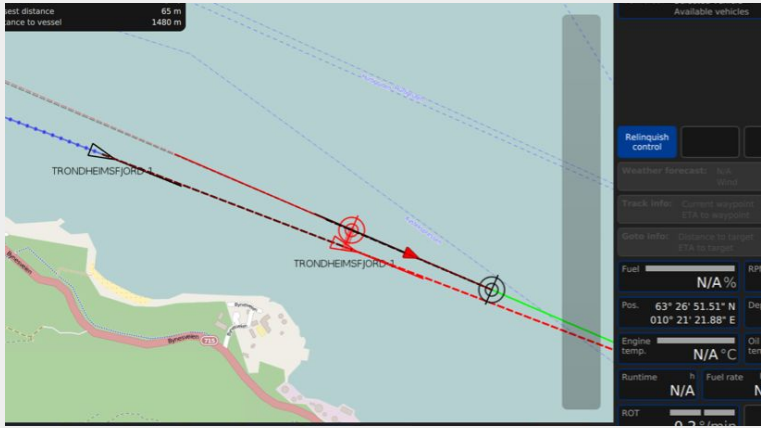
1. Human does it all
2. Computer offers alternatives
3. Computer narrows alternatives down to a few
4. Computer suggests a recommended alternative
5. Computer executes alternative if human approves
6. Computer executes alternative; human can veto
7. Computer executes alternative and informs human
8. Computer executes selected alternative and informs human only if asked
9. Computer executes selected alternative and informs human only if it decides to
10. Computer acts entirely autonomously

After Sheridan and Verplank (1978).

Increasing autonomy

Collision detection & avoidance

- Collision detection with alarm to operator (Sheridan&Verplank lvl 4)
  - AIS, RADAR, EO/IR cameras, lidar/proximity sensors



- Collision avoidance
  - COLREGS
  - Active R&D
  - Connected to regulations taking shape

Autosea

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COLLISION AVOIDANCE
system for USV
MARITIME ROBOTICS

Autonomous shipping

- Collision avoidance & COLREGS
- Sensor fusion
- Machine learning for collision detection
- Research partnerships
  - NTNU
  - H2020
  - Rakuten

Rakuten

Thank you for your attention!
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ROBOTICS

Questions?