The emerging role of autonomy in modern combat swimmer propulsion systems

How judicious use of autonomous controls can improve the human-machine interface

Underwater Intervention
February, 2018

GREENSEA

The Realm of the Combat Diver

The Realm of the Combat Diver

Tasks:

Infiltration & Exfiltration for:

- Amphibious Assaults
- High Value Target Operations
- Clandestine Surveying
- Special reconnaissance

Subtasks:

- Warfighting specific tasks
- Swimming
- Vehicle Piloting
- Navigating

Quintessential AI Conversation

Minsky

“We're going to make machines intelligent.

We are going to make them conscious!”

Engelbart

“You're going to do all that for the machines?

What are you going to do for the people?”

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More Machines = More tasking

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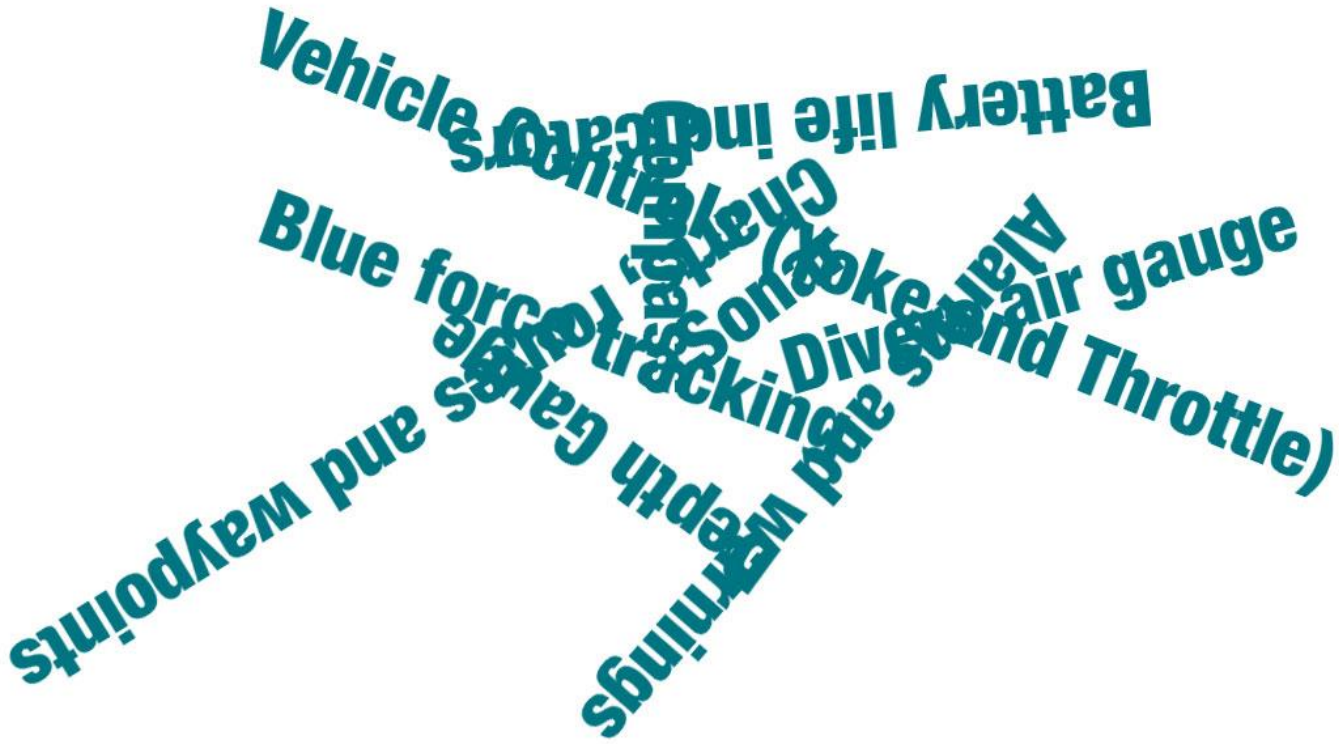


STIDD and Greensea Partnership

STIDD – EXPERTS IN DIVER PROPULSION

- Producing military submersibles since1998
- Most widely used two-man underwater mobility platform in the world
- Extensive customer-base: United States Marine Corps, Special Operations Command, Coast Guard, and Coalition Forces.
- STIDD continues to offer SOF and Marine units the latest technology to counter today's increasingly asymmetric and unpredictable maritime threat environment.

GREENSEA – EXPERTS IN NAVIGATION & AUTOMATION

- Founded in 2006
- Patent-pending OPENSEA technology -- the first commercial operating platform for the marine industry
- Leading provider of commercially available navigation, control, and automation products for marine with over 700 systems in the field
- Spanning the marine industry – unmanned, manned, surface, and subsea

Mission & Strategy

Greensea improves the relationship between man and machine to make the work they do together more productive.

MAN AND MACHINE ENGAGEMENT

OPENSEA OPERATING PLATFORM

MANNED - UNMANNED - SURFACE - SUBSEA

NAVIGATION

CONTROL

USER INTERFACE

Vehicle Types Utilizing Greensea

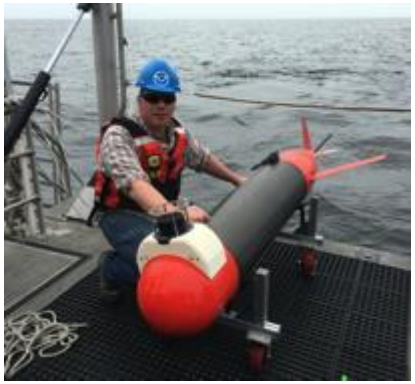
Inspection-Class ROVs

Work-Class ROVs

Diver Propulsion Sys

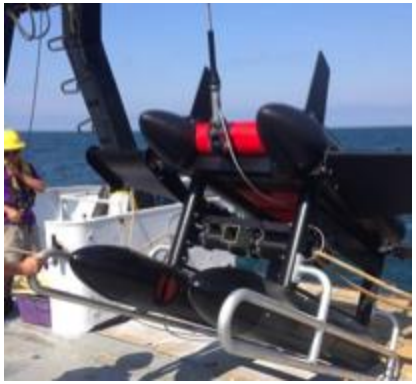
Vessels

Gliders



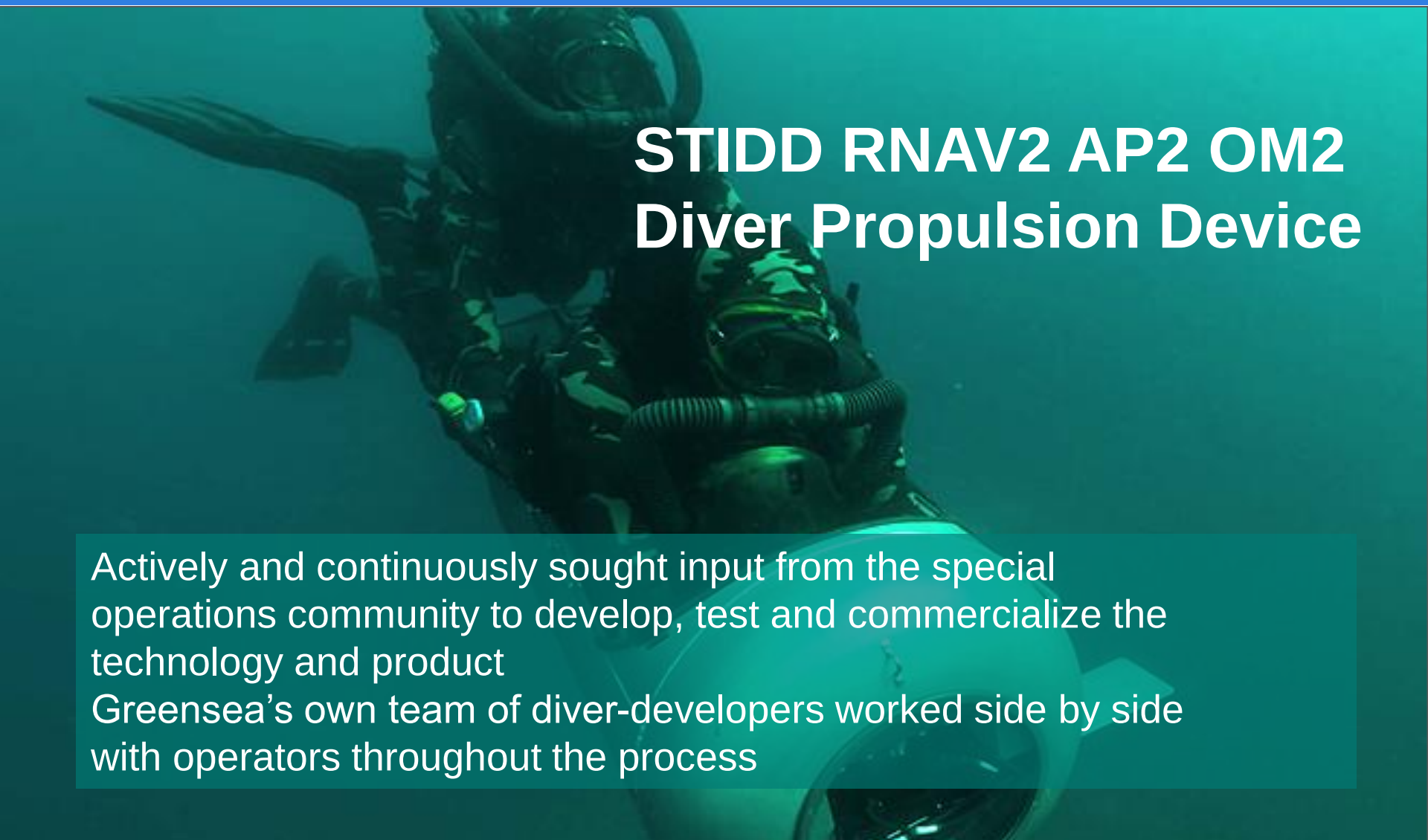
USVs

Towfish



Submarines

Special Operations Community Engagement



STIDD RNAV2 AP2 OM2
Diver Propulsion Device

Actively and continuously sought input from the special operations community to develop, test and commercialize the technology and product

Greensea's own team of diver-developers worked side by side with operators throughout the process

Let Combat Divers be Combat Divers

What are you going to do for the people?

Combine manual operation
with electronic fly-by-wire

Add autopilots

Add route-following

Allow optional manning

Add remote communications to automation

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STIDD RNAV2 AP2 OM2 Diver Propulsion Device
Powered by Greensea

O P E N S E A
Operating Platform

RNAV2 Diver Navigation System
- Inertial navigation system (INS)
- Sonar interface
- Mission planning
- Mission execution

Diver Propulsion Device (DPD) with AP2 & OM2
- Autopilots
- Automation
- Optionally Manned Capability
- Through-water, through-air, over the horizon communication and control

STIDD RNAV2 Interface
w/ Fully-Integrated Navigation & Control

Simplify Vehicle Piloting

Add fly-by wire capability through:

Auto-heading control

Auto-depth control

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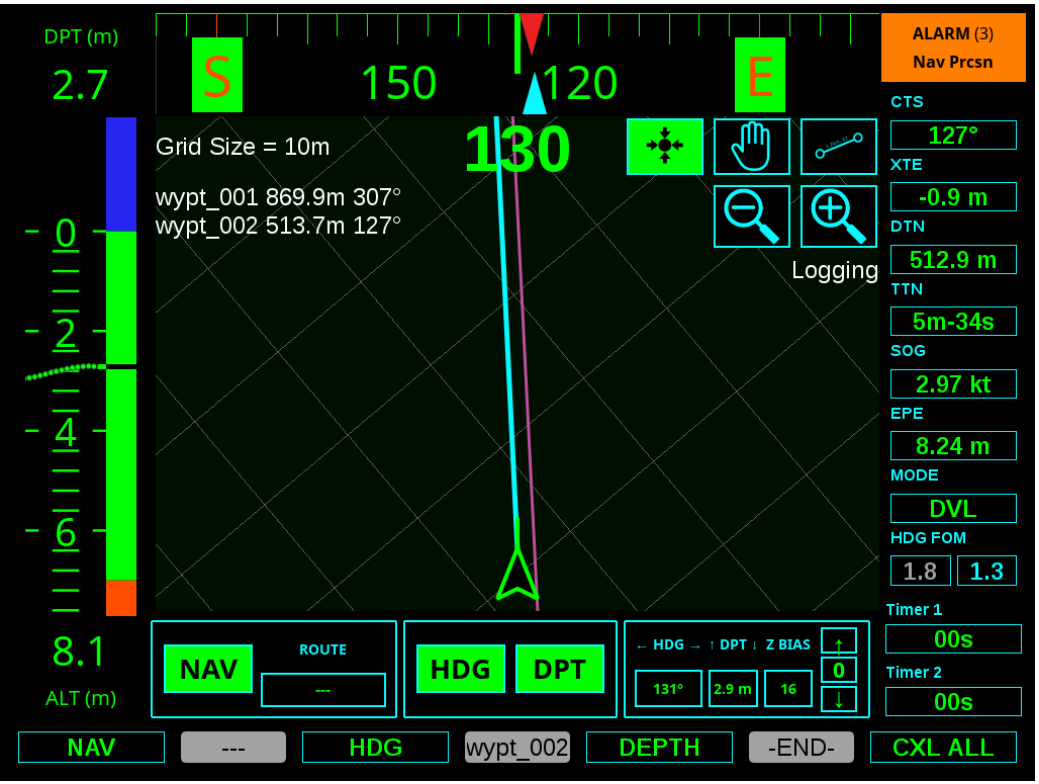
Simplify Vehicle Piloting



Steering is shifted to simple thumb movements

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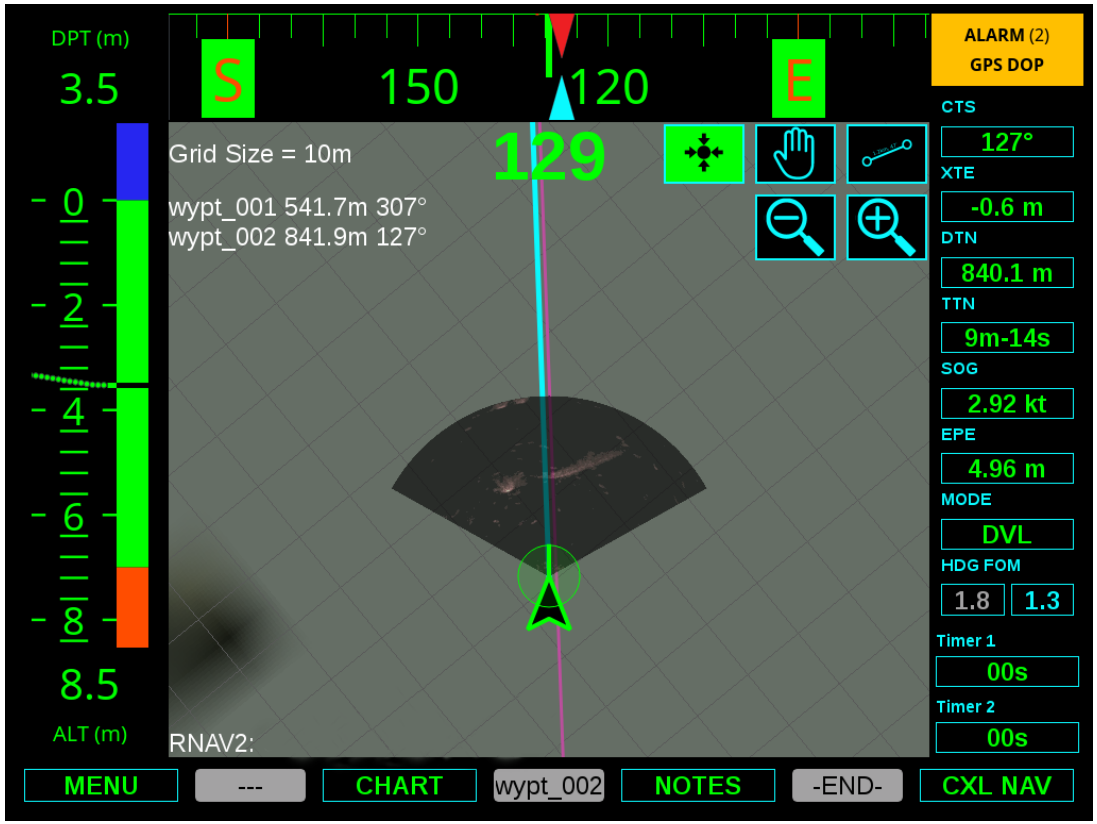
Simplify Navigating



Autopilot:
Waypoint and route following
Less steering, more situational awareness

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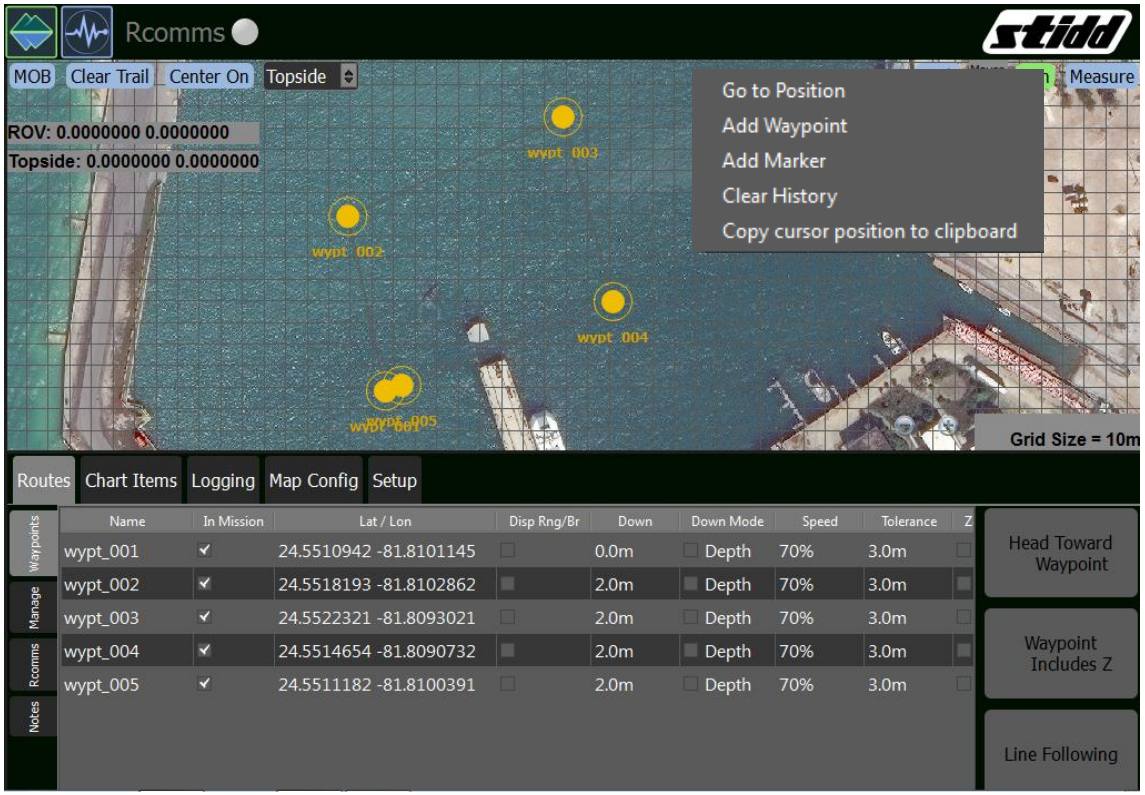
Simplify Planning & Task Execution



Use offline planning software to pre-load routes, search patterns, notes

Embed task functions within software (loiter, sonar relative, virtual anchor)

“Man overboard” button to capture all data and screenshot at a given instance

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Optional Manning

Turn the DPD into an AUV, making the diver an interested passenger with ability to assume control

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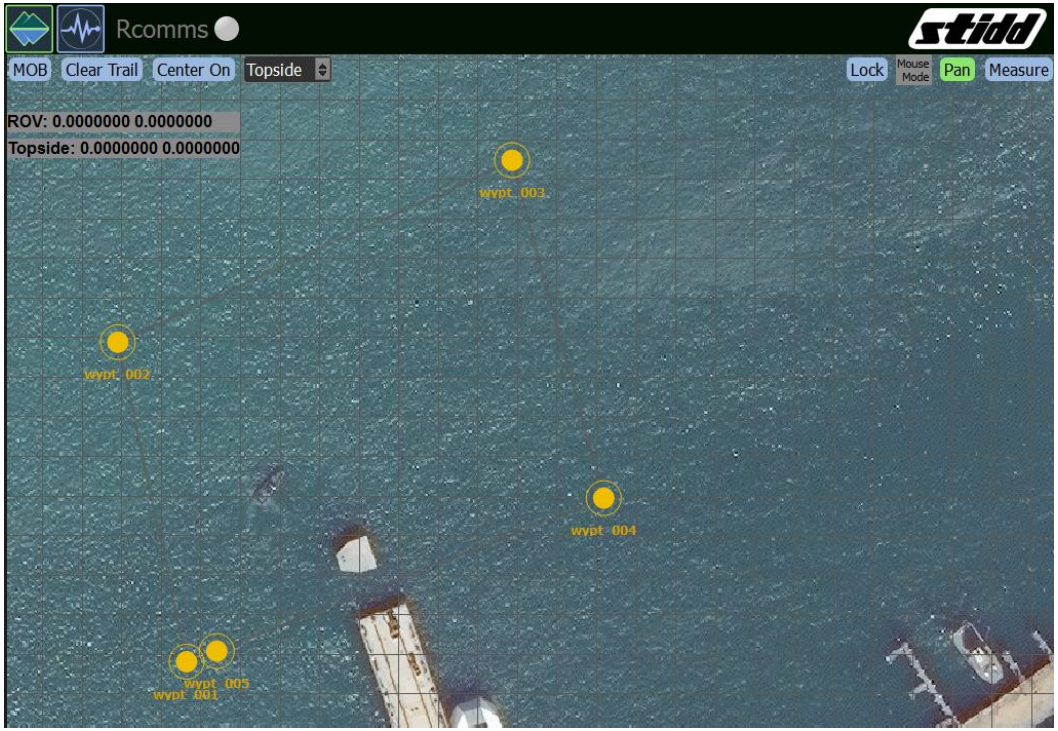
Functions provided by remote autonomy



Send waypoints and routes remotely

Assign tasks to waypoints, send remotely

Vehicle can “sneak and peek” to receive updated tasking

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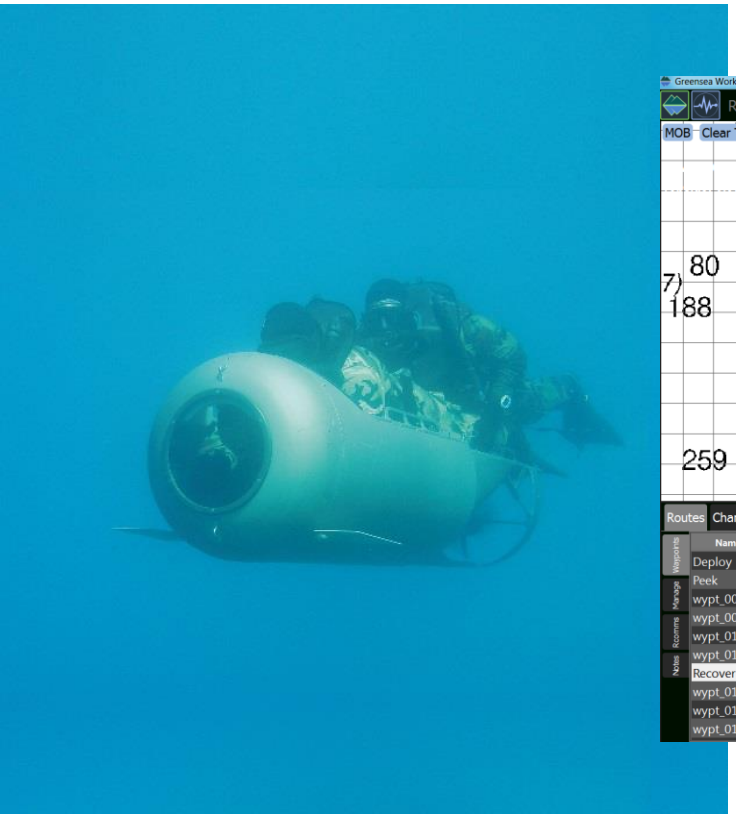
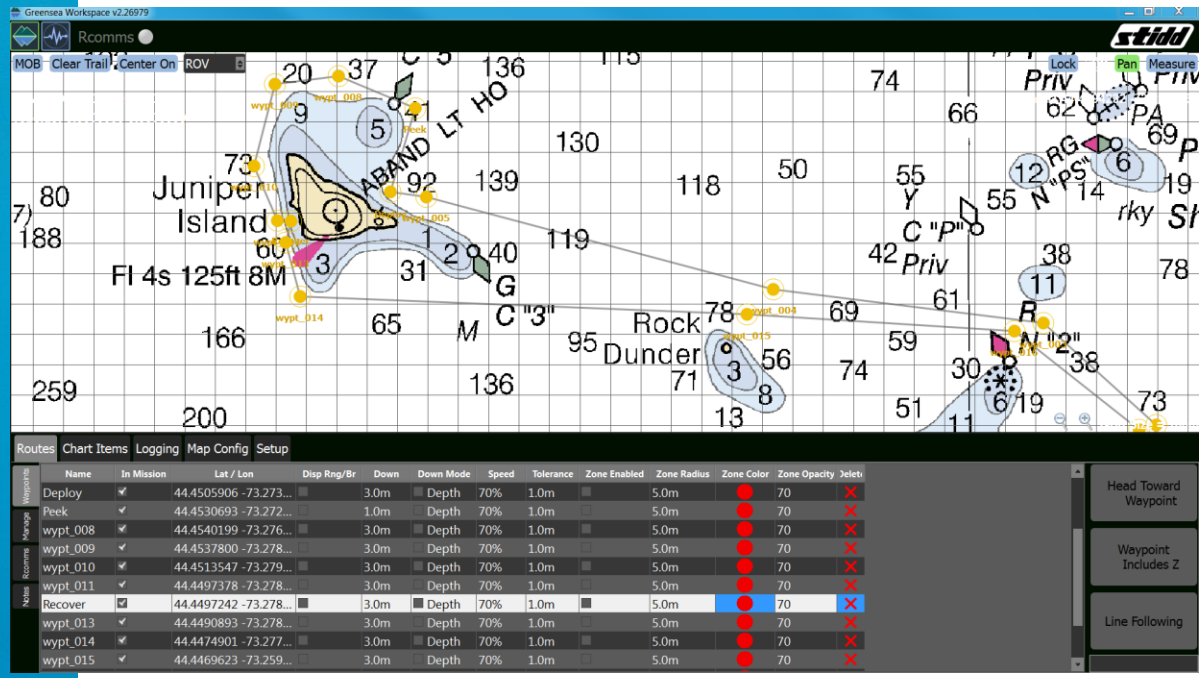
Potential Operational Scenarios

DPD returns to home base after delivering divers





Name	In Mission	Lat / Lon	Disp Rng/Br	Down	Down Mode	Speed	Tolerance	Zone Enabled	Zone Radius	Zone Color	Zone Opacity
Deploy	✓	44.4505906 -73.273...		3.0m	Depth	70%	1.0m		5.0m		70
Peek	✓	44.4530693 -73.272...		1.0m	Depth	70%	1.0m		5.0m		70
wypt_008	✓	44.4540199 -73.276...		3.0m	Depth	70%	1.0m		5.0m		70
wypt_009	✓	44.4537800 -73.278...		3.0m	Depth	70%	1.0m		5.0m		70
wypt_010	✓	44.4513547 -73.279...		3.0m	Depth	70%	1.0m		5.0m		70
wypt_011	✓	44.4497378 -73.278...		3.0m	Depth	70%	1.0m		5.0m		70
Recover	✓	44.4497242 -73.278...		3.0m	Depth	70%	1.0m		5.0m		70
wypt_013	✓	44.4490893 -73.278...		3.0m	Depth	70%	1.0m		5.0m		70
wypt_014	✓	44.4474901 -73.277...		3.0m	Depth	70%	1.0m		5.0m		70
wypt_015	✓	44.4469623 -73.259...		3.0m	Depth	70%	1.0m		5.0m		70

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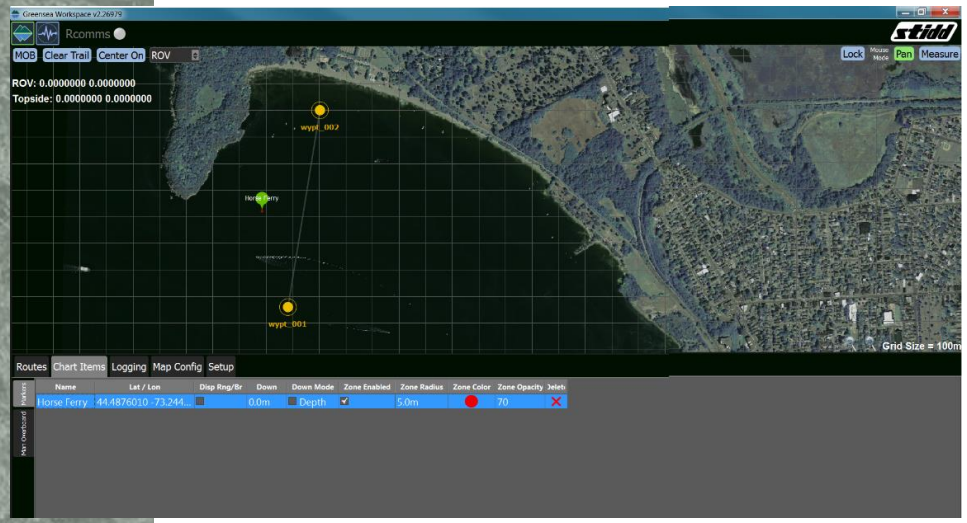
Potential Operational Scenarios

Unmanned DPD delivers materials



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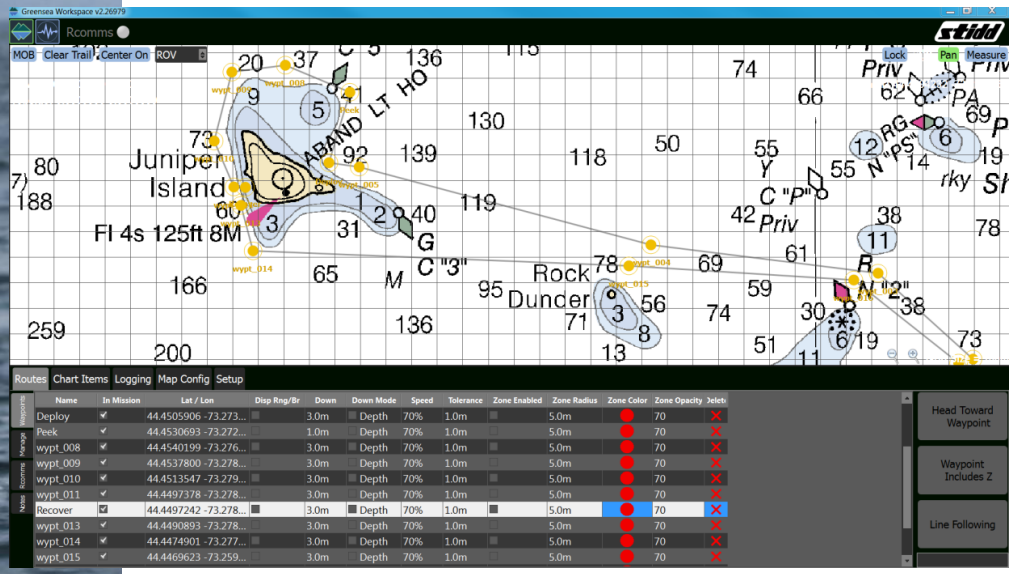
Potential Operational Scenarios

Unmanned DPD receives FRAGORD and transits to secondary exfiltration point

Potential Operational Scenarios

Unmanned DPD conducts sonar survey of area, returns to home base, and picks up divers for infiltration using info gained from survey



Autonomy and the Combat Diver

Technology for Man and Machine

The implementation of autonomous and supervised autonomous functions does not eliminate the need for the Combat Diver.

By developing and improving the diver's relationship with the technology, the diver and the vehicle can meet their full potential and open paths to more efficient operations.

-The diver has more bandwidth available for the combat related tasks.

-The diver and tactical commander can more efficiently implement contingency plans.

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Acknowledgements

Thank you to STIDD Systems, Inc. our manufacturing partner for RNAV2 AP2 OM2.

www.stiddmil.com

Need a good
STIDD photo here

Thank you to all the divers who have evaluated the RNAV2 AP2 OM2 product and provided valuable, honest feedback.

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