Special Operations Forces Technology

Open Architecture Software for Combat Diver Applications

GREENSEA

DIVER FOCUSED
PRODUCT DEVELOPMENT

The special operations forces (SOF) combat diver performs incredibly complex tasks under hostile conditions. But those complex tasks are made up of simpler subtasks, like operating mobility systems and navigating, and we believe that if these subtasks can be automated, the diver will be able to focus on the higher-level objectives necessary for mission success and safety.

Greensea has partnered with STIDD Systems, Inc., creator of the world's most widely-used Diver Propulsion Device (DPD), to apply our navigation, control, and autonomy technology—the most advanced on the subsea market—to the challenge of simplifying these complex tasks. The result is the RNAV2, a compact navigation and mission management tool for combat swimming.

We understood that, without deep involvement from the operational community, it would be impossible make sure our system was easy to use and had capabilities relevant to divers in the field. Our team of engineers—many of whom are divers themselves, with regular testing responsibilities—has spent years getting to know combat divers and gathering feedback from the field, all with one objective: comprehensively meet the diver's needs so they can focus on executing successful and safe missions.

> "The diver has a lot going on—especially a combat diver on a STIDD DPD flying underwater at three or four knots. If you ask a combat swimmer 'what do you need to make this mission possible?' they are not going to mention a piece of high-tech equipment. They are going to tell you, 'I need to get to Point B, period.' That's our job—to get them there. We are building a 'get me where I want to go' system."
>
> **Ben Kinnaman, CEO, Greensea**

OPENSEA IS THE DIFFERENCE

The technology behind Greensea's ability to deliver the world's most advanced navigation and autonomy for complex robotic systems is OPENSEA®, our universal open architecture software framework for the marine industry. OPENSEA unlocks advanced robotic capabilities and enables truly novel and groundbreaking technologies by fully integrating data into one unified system. With over 800 systems in the field, and a decade of development behind it, OPENSEA is proven to be a robust system for special operations forces.

Modular Open Architecture: OPENSEA's modular design makes it possible to produce customized systems without extended lead times and development expense by leveraging a common platform.

Vehicle Agnostic: OPENSEA offers the same operating platform and user interface across a wide range of manned, unmanned, surface, and subsea vehicles. Operators train on one system, which minimizes cost, time, and risk.

Sensor Agnostic: OPENSEA provides sensor integration with payload control accessible through Greensea's unified interface, Workspace. Thousands of sensors, devices, and equipment are natively supported.

Ready to evolve: OPENSEA supports rapid prototyping of emerging technologies by utilizing a common library and fully distributed application suite.

PRECISION NAVIGATION

AUTONOMY & CONTROL

RECON-NAVIGATION SYSTEM (RNAV2) & ACCESSORIES

Navigation, positioning, mission planning

The RNAV2 integrates several internal sensors through an Inertial Navigation System (INS) for accurate subsea navigation, providing a visualization of position and attitude in an intuitive chart plotting display. Routes can be pre-planned on a mission planning computer or directly on the RNAV2, and can be modified on the fly.

Sonar

The S2 sonar accessory integrates an external multibeam sonar and provides a rich suite of tools for georeferencing sonar data on the navigation display, controlling the sonar, and locating targets within the sonar data.

Autopilots

The AP2 autopilot accessory removes the task load of actively driving through auto heading, auto depth, fly-by-wire, and preset route-following automation, freeing up operator bandwidth for higher-level mission objectives.

Hydrographic survey

The hydrographic survey accessory delivers a comprehensive map of the mission area for clandestine surveying or reconnaissance.

Subsea communications

The ACOMMS acoustic communication accessory enables operators to text, share data, and track team members and other submerged assets within a 2km radius. Divers can easily text a new mission objective to team members who can "click" to autonomously transit to the specified location.

Autonomy

The OM2 autonomy accessory enables full remote autonomous control of the DPD, turning it into an optionally manned system for INFIL/EXFIL and equipment delivery. An automated antenna mast enables passive communication with mission control.

WHAT DOES YOUR PROGRAM NEED FOR SUCCESS?

The RNAV2 suite of accessories are the direct result of input from SOF divers and program managers, and the suite continues to expand in response to the needs of teams worldwide. OPENSEA's modular software architecture made it possible to take each of the above advancements from idea to deliverable. When we work together, we can develop solutions to minimize risk and revolutionize combat diving operations, which is why we come to work every day. In the end we never lose sight of one simple truth: your success is our success.

Call us today to discuss how the RNAV2 and its suite of accessories can be modified or expanded to meet your program's needs.

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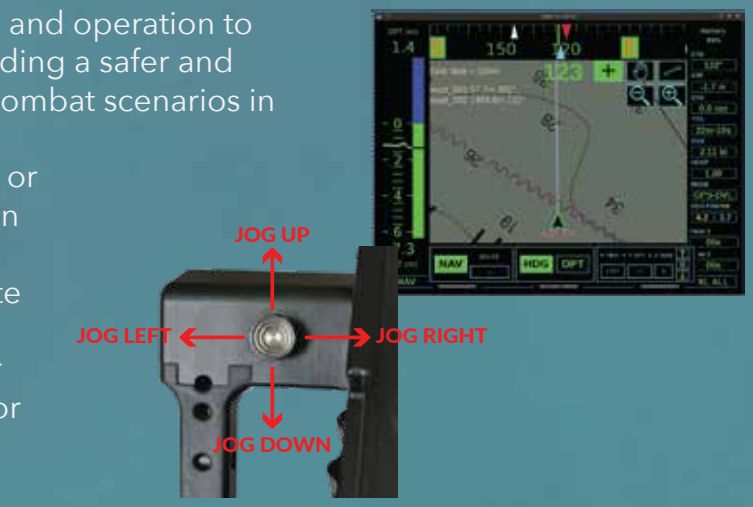
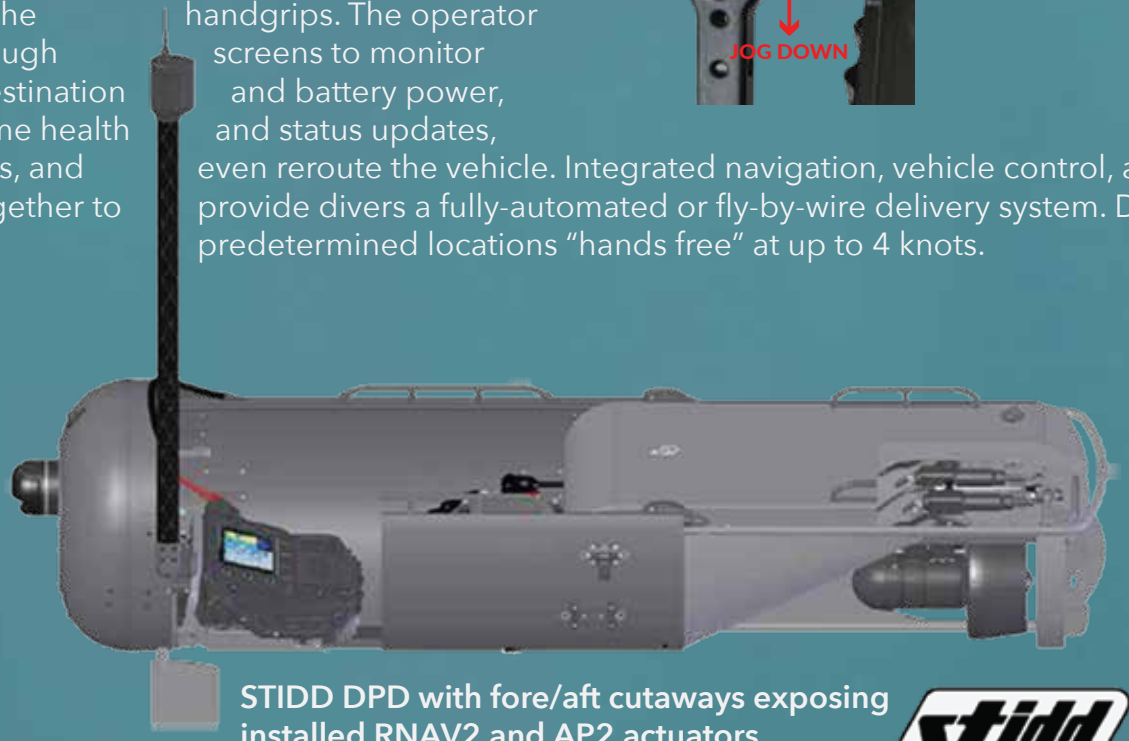
PROVEN DPD NEW CAPABILITIES

With the RNAV2, combat divers offload navigation and operation to the supervised autonomy of the STIDD DPD, providing a safer and more productive mobility system. Designed with combat scenarios in mind, the RNAV2 is simple and efficient to use.



Missions can be pre-planned either on the RNAV2 or conveniently on a mission planning laptop, and can be updated on the fly. Thumb knobs and finger triggers are used to control the vehicle and operate the mouse on the intuitive visual user interface, Workspace, so an operator's hands never have to leave the handgrips. The operator can swipe through screens to monitor progress to destination and battery power, receive real-time health and status updates, manage alarms, and even reroute the vehicle. Integrated navigation, vehicle control, and sonar work together to provide divers a fully-automated or fly-by-wire delivery system. Divers can transit to predetermined locations "hands free" at up to 4 knots.



STIDD DPD with fore/aft cutaways exposing installed RNAV2 and AP2 actuators

SITUATIONAL AWARENESS

NAVIGATION

A fiber optic gyroscope with multiple alignment methods and an integrated INS deliver unprecedented underwater navigation. With error less than 0.5% of distance travelled, the RNAV2 is the most accurate diver navigation system in the world.

VISUALIZATION

An intuitive heads-up chart plotting display shows georeferenced position data for a diver's own position and the positions of their teammates, facilitating cooperation and coordination. A "man overboard" button captures all data and a screenshot at any given moment.

TRACK AND AVOID

Integrated multibeam sonar allows divers to confidently transit in low-and zero-visibility environments. Using the sonar view on Workspace, divers identify and track targets, while obstacle avoidance software assists divers in avoiding obstructions.

COMMUNICATIONS SURFACE & SUBSEA

One of the biggest challenges in subsea operations is lack of communication. Without accurate, up-to-date information about changes to mission objectives and the location and status of teammates, divers are at an extreme disadvantage, especially in today's multi-agency, multi-asset operations. The RNAV2 enables an unprecedented degree of coordination and cooperation through groundbreaking communications technologies, minimizing risk and creating an environment for successful missions.

SURFACE

Using an an automated antenna mast, divers passively transmit and receive communications as they surface. The RNAV2 comms system instantly sends diver status to mission command and downloads any messages waiting for them. Over-the-horizon and line-of-sight communications are supported for any transport mechanism including cellular, Iridium, radio, and military-specific.

SUBSEA

With the ACOMMS subsea text messaging accessory, divers can send encrypted messages and share data and missions with subsea teammates anywhere within a 2 km radius. Divers can send waypoints and new missions to their team. Use pre-programmed or customized messages to communicate mission-critical status updates.

OPTIONALLY MANNED

The OM2 accessory enables the STIDD DPD to operate completely autonomously, creating an opportunity to envision new CONOPS. The DPD can transit unmanned to or from predetermined locations and autonomously home in on a target for INFIL/EXFIL and equipment delivery.

When OM2 is combined with ACOMMS, the DPD can be operated remotely by fellow divers or surface teams to support incapacitated team members or to free divers from the workload of piloting so they can focus on higher-level tasks.

INTEGRATORS & DEVELOPERS

OPENSEA is continuously maintained and updated based on feedback from hundreds of operators utilizing the technology across many different applications worldwide. Direct customer engagement allows us to constantly expand our technology. New sensors and components are continuously integrated and there is a rapidly expanding number of automated tasks driving operational efficiencies. Being a part of the OPENSEA community allows system integrators and developers to take advantage of the latest updates to OPENSEA, provide technology feedback, and develop their own technologies on the OPENSEA framework.

Software Development Kit
The OPENSEA SDK includes everything needed to configure or expand an OPENSEA system. Implement changes, develop new features, or innovate new technologies on an open, robust architecture.

Custom Configurations
OPENSEA is easily configured for new capabilities and new deployments without code modification. Use the same base software with different vehicle configurations for different missions.

System Expansion
The OPENSEA application suite is designed for flexibility and scalability. Utilize a comprehensive toolbox of distributed software components that can easily add capability to existing systems.

No other software solution offers the same operating platform and user interface across a wide range of vehicles: ROV, USV, AUV, workboats, and diver delivery systems. Operators learn one common interface that is applicable across all vehicle types. Plan a mission and deploy it using one or many assets.

EOD applications


Surface applications


Survey applications

RNAV2 - SPECIFICATIONS

Navigation accuracy: 0.5% dt CEP50 (DVL aiding and transit alignment)
Navigation resolution: 0.01m
Heading accuracy: 0.2deg RMS (DVL aiding and transit alignment)
Heading accuracy: 0.3deg RMS (magnetic)
Pitch and roll accuracy: 0.1deg RMS
Depth accuracy: 0.1% FS
Depth range: 100m
Rotational rate max: 470deg/sec
Acceleration max: 5g
Velocity accuracy: 0.5cm/s
Velocity range: +/- 10m/s
Altitude: 0.5m - 120m
GPS: Internal and External
Alignment: Magnetic, transit, transfer, external (automatic)

GREENSEA SERVICE & SUPPORT

"You can throw all the technology in the world at a problem and you still won't get a solution if you don't address the operator's relationship to it. When we hand over a system, our job isn't finished—it's just starting. If we don't give operators the training and support they need to use our technology, it doesn't matter how powerful or advanced our system is—it's not going to get the job done."

Ben Kinnaman, CEO, Greensea

TRAIN

Our relationship begins with a one-week foundational training program delivered onsite by qualified Greensea instructors for all operators and technicians working with the RNAV2. After this training, operators have a working knowledge of the system, and are conversant enough to begin a dialogue about how we can best support you moving forward.

SUPPORT

Our SOF Operator Support Program gives you access to bug fixes and major and minor feature upgrades as released. Your feature suggestions will be given priority consideration. And when the success of your mission is on the line, you'll have a 24/7 urgent support hotline and a dedicated program manager to ensure a direct line of contact for responsive service.

DOCUMENT

Reference a comprehensive Knowledge Base filled with over ten years of important information compiled by Greensea engineers, including "how to" instructions, troubleshooting help, and industry reference information in inertial navigation and autonomy. All information is easily searchable and content is continuously expanding.

CUSTOMIZE

We understand that staffing rotations, deployment schedules, and equipment availability impact your specific training needs, and we're happy to develop a customized training program to support your team, either in the classroom or in the field.

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

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View our capability statement: www.greensea.com/capability.pdf