OPERATING ROVS IN STRONG CURRENTS

Strong currents can present unique challenges when operating ROVs. Not all underwater vehicles are designed for high-current environments and so selecting the correct equipment and procedures can become key factors in mission success.

By understanding local factors and employing suitable piloting techniques, underwater robotic systems can perform effectively, even in these demanding situations.

VideoRay has compiled a number of determinants that should be considered when operating in such high-energy environments.

TETHER

Strong prevailing currents – typically anything exceeding two knots – can be enough to make navigation and stability difficult. In these conditions, managing the tether (that provides power and control to the vehicle) can sometimes be particularly critical.

"The tether can act like a drogue sail in the water, increasing total drag and making manoeuvrability problematic," said Brad Clause, Global Account Manager at VideoRay. "By deploying only the minimum necessary length of tether, therefore, we can reduce this effect, allowing the ROV to move more freely.

"Another strategy we often use involves attaching small clump weights to the tether, using carabiners. This stabilises the vehicle by reducing surface and midwater drag.

Distributing the weight ensures that the tether hangs straight in the water column, preventing unnecessary strain on the vehicle. Adjusting weight increments carefully allows operators to maintain balance and control without impeding manoeuvrability.

"At all times, clear and continuous communication between team members is vital. The pilot and tether handler must coordinate their actions to ensure precise adjustments during tether deployment. Regular updates – typically every five minutes – allow for real-time adjustments based on the ROV's positioning and external conditions.

"Monitoring tether twists and torque is another factor that can impact manoeuvrability," said Clause. "Excessive twisting can confer strain on the system, making control more difficult. Awareness of tether rotation enables the user to better understand vehicle movement and make necessary corrections."

VESSEL DEPLOYMENT

When being launched from a vessel, it is essential to prevent the line from becoming entangled in propellers, rudders or other obstacles. Rough seas further increase the risk of entanglement.

"In some cases, live boating (deploying the robot from an unanchored vessel) may be a preferred option," said Clause. "In currents exceeding three knots, the boat should be turned to face upstream while the robot is deployed downstream. Pilots can then use the current to their advantage by manoeuvring *with* it rather than *against* or *across* it.

Live boating, however, introduces additional risks as the vessel movement can be unpredictable."

When operating from shore, natural current breaks such as ship hulls, bridge footers, underwater structures and even debris, can provide shelter from strong currents. A thorough understanding of the local environment, therefore, is useful before deployment.

SHORE

Factors such as water depth, current strength, visibility and potential obstacles all impact mission success. Even in familiar locations, conditions can change quickly and unexpected hazards may arise. Conducting pre-mission assessments, including sonar scans, particularly simultaneous localisation and mapping (SLAM), is useful in allowing operators to map the environment in real time, improving navigation and reducing risks associated with unknown obstacles.

When navigating to a target, taking a diagonal approach and "crabbing" across the current

CHOOSING THE RIGHT TETHER

One important factor is to select the appropriate tether type as different tethers offer varying levels of strength, buoyancy, and power transmission.

Choosing the right tether depends on the specific mission parameters, including depth, current strength, and distance.

"Thinner tethers reduce drag but may have lower power capacity. Neutral buoyancy tethers, conversely, are slightly buoyant in saltwater and provide a balance between handling and performance.

Negative buoyancy tethers, which sink, offer increased power transmission over longer distances but can weigh down the robot it too much is deployed.

can sometimes be more effective than attempting a direct path. Starting upstream and moving downstream with a short tether can provide better control of the ROV's movement.

ROV THRUSTERS

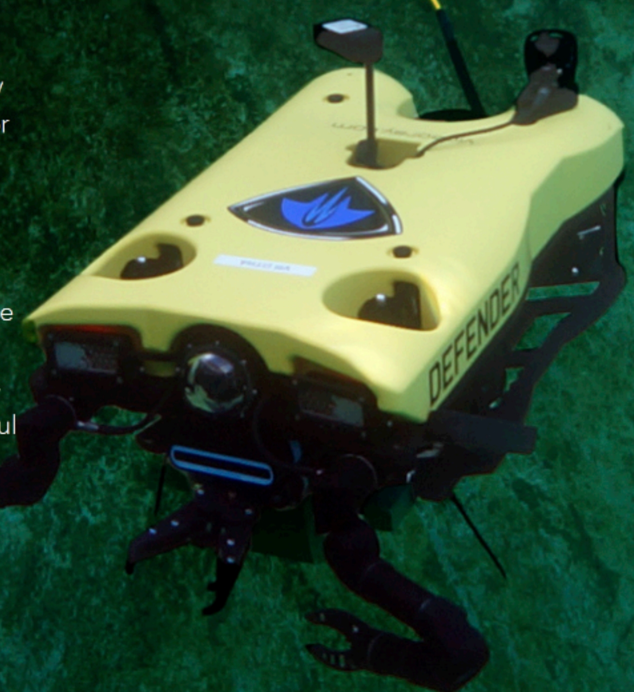
A robot operating in strong currents must have sufficient power to counteract water movement. As a general rule, a system should have approximately twice the thrust of its mass to maintain stability and manoeuvre effectively.

“Lateral thrust capabilities, combined with an auto-heading feature, improves responsiveness and allows the robot to maintain direction more effectively," explained Brandon Turner, VideoRay Global Account Manager.

"Auto-heading technology also enhances operational control by maintaining a consistent heading without requiring constant manual adjustments.

“When engaged, the system automatically applies horizontal thrust to compensate for changes in direction, ensuring stability in fluctuating conditions.”

Good mission planning is another critical aspect. While real-time adaptations may be necessary, having a detailed plan – including one or more backup strategies – always improves the chances of a successful outcome.



TIDES

"Understanding tidal patterns can be particularly beneficial," said Turner. Slack tides (occurring when the tide is neither rising nor falling) provide the best window for operations due to the reduced current.

The minimised resistance can improve manoeuvrability.

"Awareness of spring and neap tides is invaluable." he said. “Spring tides, occurring during full and new moons, result in stronger currents due to increased gravitational pull. In contrast, neap tides, occurring a week later, produce weaker currents.

"Factoring these tidal cycles into planning can significantly extend the operational window, allowing more time for mission execution. Importantly, however, tidal conditions can vary based on location, and tide tables even from nearby ports may not be entirely accurate. "