4 Tips for Piloting Your Underwater Robot Into Confined Spaces

Depending on the mission, you may encounter confined spaces or cluttered areas when operating your underwater robotic system. Under such circumstances, you need to consider several things before proceeding:

Do you truly need to enter the confined space or area?

The best way to mitigate risks is to avoid them all together.

Do you have permission to enter the confined space or area?

For instance, some wrecks may be preserved sites and off-limits.

Are there plans for the space that you can use as a reference?

As with driving somewhere new, it is best to have a map.

What is your goal—general observation, mapping the space or area, detailed inspection, retrieval of an object?

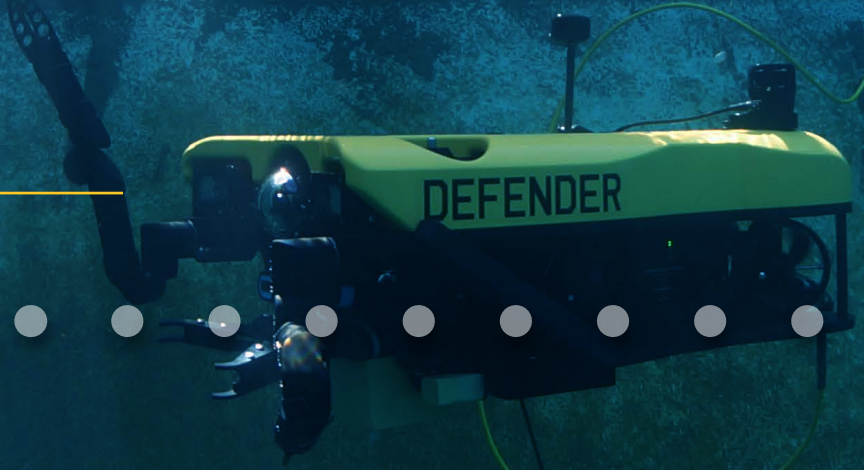
This may affect how you configure the system and how you operate within the space.

Keep in mind that even in open water, you can face challenges. Debris and protrusions can make it difficult to navigate. The tips and tricks in this eBook – while focused on confined spaces – can be utilized in other scenarios as well.

1

Practice, Practice, Practice

When working in a real-life situation, mistakes can damage your robot and the environment where you're working. However, practicing how to maneuver your submersible in confined conditions can help you better understand how the vehicle moves and prepare you for various scenarios in which your movements must be precise.

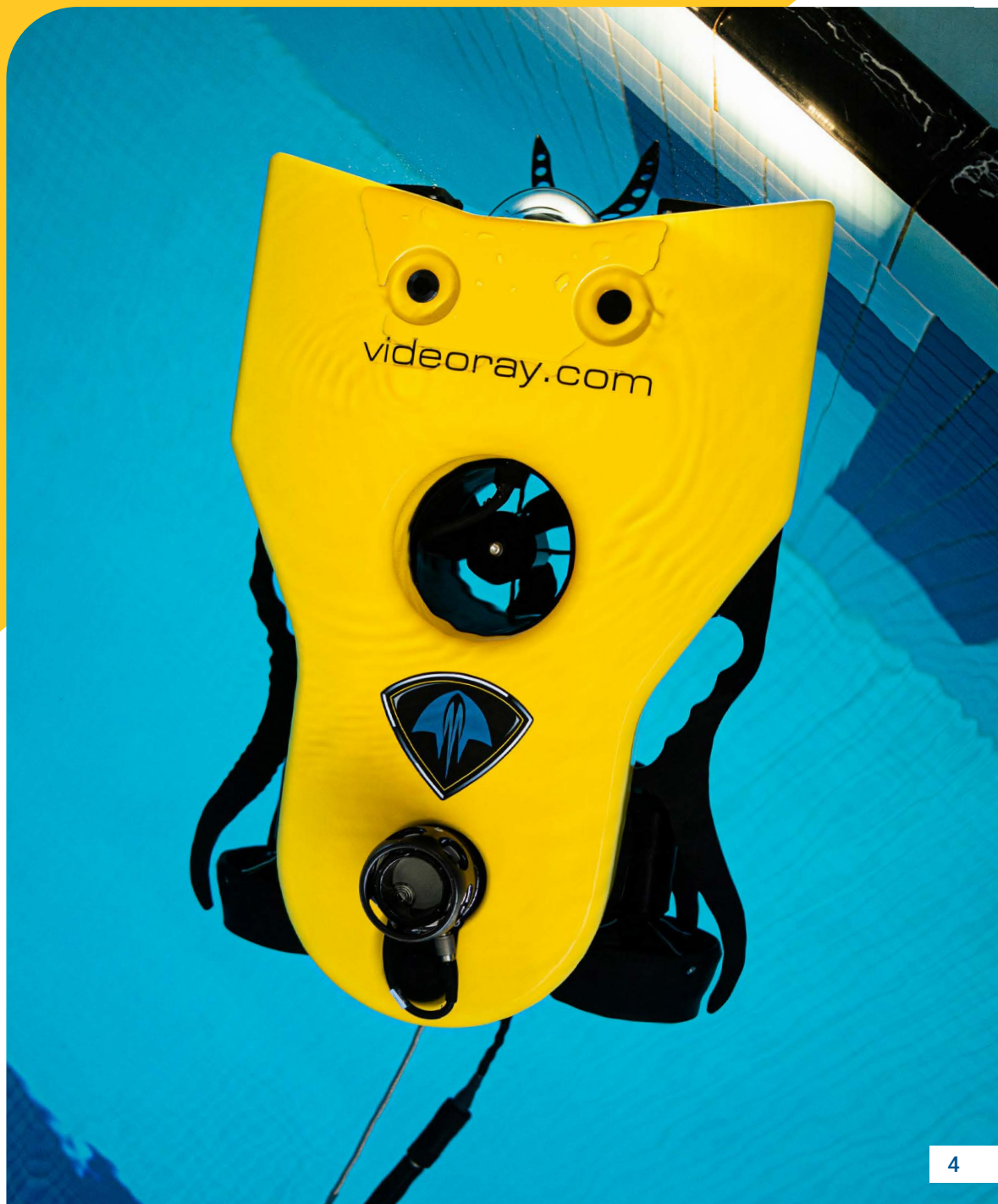


One way to practice for such encounters is to operate the robot in a swimming pool. Here are some practice tips to consider:

Direct the robot back and forth through a submerged hoop (use a hula hoop with a weight and a float) or a more elaborately shaped object like the opening you expect to penetrate. Practice going in forward, turning around to exit, and coming back out in reverse. You should be able to judge the size of the opening relative to the robot and be able to pass through without bumping it. Use an increasingly smaller size opening to hone your skills.

Submerge something that has protruding spars. Wrap your tether around one or more of the spars. Use your manipulator to remove your tether from the spar.

Practice following your tether—fly out, turn around, find your tether and follow it back as closely as possible.



2

Tether management is critical

Tether management can have a significant effect on the ability to pilot the system and achieve the objectives of the mission. That includes selecting the appropriate type of tether and managing the deployment and retrieval during operations.

As the name suggests, a neutral tether is neutral in freshwater and slightly buoyant in saltwater, but has thinner conductors. Neutral tethers are available in standard diameter and performance diameter (also called PPT), which is thinner. Thinner tethers have less drag, but also has smaller conductors and less power transmission capacity. Selecting the right tether is a balancing act between performance and handling characteristics.

When working in confined spaces, it's easy to get your tether snagged or tangled, so it's important to use an experienced tether handler for these jobs. Your handler will need to have expert knowledge of exactly how much slack the tether should have as the system maneuvers the space.

For example, when returning from the confined space, you want to minimize any loop of tether behind you to avoid getting it caught on something. At the same time, you don't want the tether handler to pull too hard on the robot. It's a good idea for the handler and pilot to practice together in the pool, if possible.

In addition, your team should always be on the lookout for tether snag locations (spars) or pinch points (V-shaped notches) to avoid. You should keep a plan in place for how you will handle a snagged tether that is difficult to free.

Pro tip! Communication is key between tether handler and pilot. In this video, the tether handler and pilot work together to remove their tether from a snag. The issue was overcome thanks to teamwork and communication. Neither could do the job on their own.

3

Plan ahead

Before you embark on your mission, think ahead about what you'll be doing. Have a plan for your entrance and exit, turn-around points and what you'll do in the event of a snag. This will help you stay on track each step of the way while also helping you remain calm if problems arise.

When planning how you'll enter the confined space, consider your penetration carefully. If the opening is smooth on one side but ripped open or jagged on the other, it will be better to approach from the smooth side to prevent damage to the tether.

As a pilot, you need to be able to estimate the size and shape of the entire area—do you have enough room to fit? Do you have enough room to turn around, or do you need to back out?

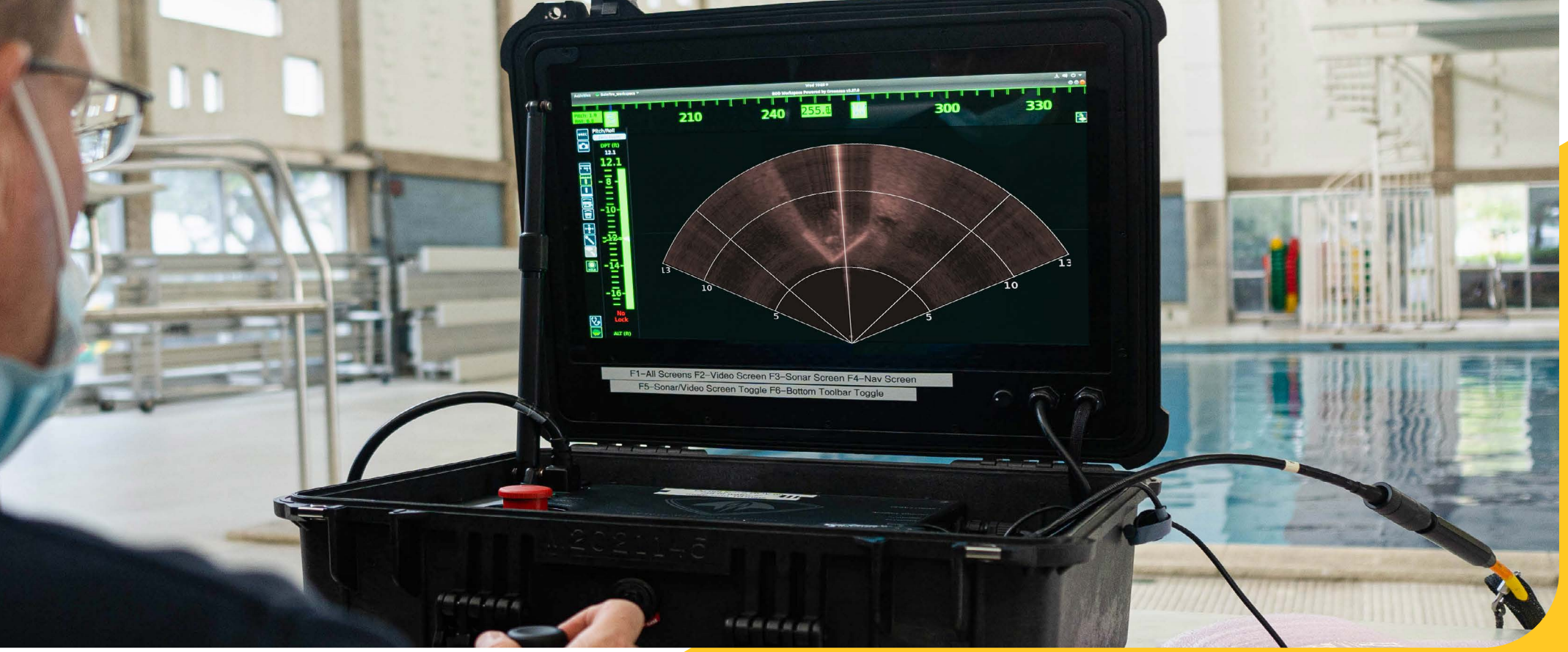
No one ever wants to encounter problems during a dive, but water can be unpredictable, especially in limited space. Think ahead and plan your response for worst-case scenarios.

If your tether becomes entangled will you attempt a recovery or just cut the tether? If you plan a recovery, you may need a second robot equipped with the appropriate manipulator jaw for that task. If you are not comfortable with your skills or the situation, be ready to abort and regroup for another attempt rather than risk entrapment and loss of expensive equipment.

4

Utilize helpful accessories

Certain accessories can make or break your underwater dive into confined spaces. For instance, you should install and use a manipulator to move objects or manage your tether. While a single access manipulator can be helpful to clear objects from your path, multifunctional, configurable manipulators can perform other tasks, like untangling your tether, with ease.



Sonar can be another helpful tool, particularly if you are not familiar with the space you intend to explore and do not have access to a map ahead of your dive. Some teams use sonar to perform a technique called SLAM (simultaneous localization and mapping). The SLAM method utilizes sonar to take images and sonar readings and stitch them together to create a mosaic-like map of the area you are working in. This can be advantageous for planning entry and exit routes as well as turn-around points for confined spaces.

You may also want to consider adding additional cameras or lights to your system during a dive into a confined area. Additional cameras add the ability to observe conditions in multiple directions without having to turn the robot. More lights would also be required if the existing lights do not illuminate in the direction of the extra camera(s).

VideoRay

Navigating a confined area is no easy task, but with the right team, training, planning and accessories you can successfully accomplish the mission.

At VideoRay, we want to be your partner in success. If you have a mission in mind that involves a confined space, we want to work with you. Our team of experts is here to offer insights on how to navigate a difficult mission and equip your underwater robotic system with the right tools for the job.

To learn more about how VideoRay can help you optimize your underwater missions with subsea robotic systems, visit **www.VideoRay.com** or call +1 (610) 458-3000