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ROVS for marine research

Abstract

ROVs, or Remote Operated Vehicles, come in a wide variety of sizes and shapes, and are all designed for a specific application in the underwater environment. Finding an ROV that is best suited for the industry and projects that is required, is often a very difficult and misleading exercise for most clients. Many ROVs are mass produced using cheaper components that arena suitable for continued commercial use. These ROVs often seem cheaper initially, however continually repairing damaged components, or collecting inferior data, soon outweighs the initial costs of the commercial grade machine. Also the lack of customization with off the shelf ROVs, limit their later use in a project specific environment.

"Due to electrical components becoming increasingly miniaturized and affordable, the observation class ROV is now capable of excelling in underwater projects once only available for divers and work class machines."

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Introduction

One ROV manufacturer that designs and hand builds industrial grade observation class ROVs is Seam or Marine (Figure 1). Based on Vancouver Island, Canada, Seaman build their ROVs for each of their clients, offering a level of customization not usually available from other manufacturers.

Figure 1 The ROV is now capable of excelling in underwater projects once only available for divers and work class machines.

ROV Stability and design

One of the most overlooked aspects of an ROV, and one of the most important, is its inherent stability whilst being deployed at depth. The ability to collect smooth, stable footage from the ROV cameras is paramount for any underwater inspection, survey, or research. Much of the stability comes from the overall design and hydrodynamics of the ROV itself, while the size and composition of the float and ballast also play a crucial role. Syntactic foam is the material of choice for most commercial grade ROVs, which offers increased stability at a wide range of depths whilst remaining incredibly rugged. Having the float cover 100% of the ROV footprint also makes for a very stable platform.

Most industrial ROVs today have a minimum depth rating of 300m. This should cover any onshore marine research; however ROVs can usually be upgraded to 600m if the areas of concern, or even possible future projects may call for these sorts of depths to be explored (Figure 2).

Figure 2 This should cover any onshore marine research, however ROVs can usually be upgraded to 600m if the areas of concern, or even possible future projects may call for these sorts of depths to be explored.

Research methodology

Depending on the actual research methodology applied, the ROV should be able to adapt to each project and allow maximum flexibility to collect the data required. Quadrats and Transects are typically used to collect quantifiable data, which requires the ROV to be able to host additional cameras focused on the different research parameters, and underwater lasers to accurately measure distances and size. These cameras may either be built into the ROV itself, allowing live streaming of the video footage or the ROV should allow by design, the attachment of multiple third party cameras recording to their own local media storage.

Most third party "Action Cams" record in high definition and come with a water proof housing to around 40m depth. If deeper habitats need to be surveyed, custom designed housings can usually be found. Note that these deeper housings usually take up considerably more room on the ROV therefore the ROV needs to be able to accommodate the increased space, as well as have the required torque in its thrusters and stability to operate with the additional payload. The reason multiple cameras are required is that the primary ROV camera is usually focused on piloting the ROV safely, not collecting footage of the marine environment.

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If the environment needs to be sampled, the ability to easily and effectively collect these research samples needs to be paramount. Either with a dual function manipulator for collecting one off samples, or for more delicate sampling, having the ability to collect multiple items and store them within their own sample container without having to return to the surface, becomes necessary (Figure 3).

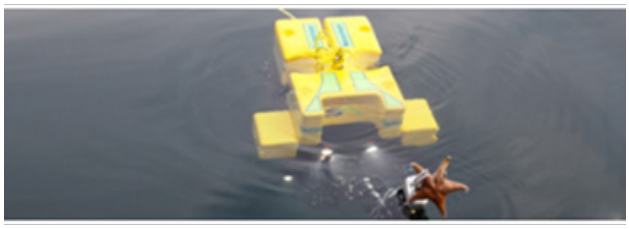

Figure 3 The ROV camera is usually focused on piloting the ROV safely, not collecting footage of the marine environment.

Camera and monitor

Even though the primary camera is used for piloting the ROV, collecting qualitative data on species composition and relative abundance can still be obtained. Therefore it is always recommended that a quality high definition camera be used. Quality HD cameras such as Sony provide the confidence in species identification, allow an extremely high level of information to be captured, operate well in low light conditions, and are able to zoom in to usually over 200 times both live and on replaying of the footage.

A large LCD monitor within the control panel of the ROV, allows for an increased in situational awareness, therefore the research personnel can accurately pilot the ROV to the required sites for data collection. Recording in HD also allows the captured footage to be played back on large, ultra HD LED screens, where even the smallest details can be seen and recorded (Figure 4).

Figure 4 Dual function manipulator for collecting one off samples having the ability to collect multiple items and store them within their own sample container without having to return to the surface, becomes necessary.

Open framework and modularity

Another extremely useful and cost saving design feature for marine research is to have an open framework for the ROV. This allows researchers to attach any number of additional probes, water quality meters, and custom designed equipment to the ROV without compromising the attached equipment or ROV itself.

Modular ROV accessories such as manipulators, sonar's, underwater positioning systems for habitat mapping, laser scaling, additional LED lighting, and additional cameras should also be "plug and play". This allows the ROV to be enhanced at any stage either at purchase, or after sales, without the costly need to send the entire system back for the upgrade (Figure 5). Having all systems modular is also beneficial if there is a system failure of any component. The ability to quickly swap out a failed thruster in a matter of minutes is crucial when being on site is costing thousands of dollars per day.

Figure 5 Modular ROV accessories such as manipulators, sonar's, underwater positioning systems for habitat mapping, laser scaling, additional LED lighting, and additional cameras should also be "plug and play".

Portability and ruggedness

As most research is conducted in remote areas, it is important that the ROV itself can be easily and safely transported either by air, road or sea to arrive at the project site undamaged (Figure 6). When all ROV components come standard stored or built into quality Pelican Cases, the chance of any damage occurring is greatly reduced. When the entire system is only 4-5 pelican cases in total, it becomes an incredibly portable piece of scientific equipment that is fundamental to any marine research.

Figure 6 It is important that the ROV itself can be easily and safely transported either by air, road or sea to arrive at the project site undamaged.

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Conclusion

For any ROVs that are going to be used in the field of Marine Research, either by Academics, Environmental Consultants, or even Documentary and Film Makers, we would recommend the following features and functionality –

a. High Definition (1080p) quality camera
b. Additional LED lighting
c. Large LCD monitor for live viewing
d. Underwater Lasers for accurate distance measurements
e. Modular ROV accessories ("plug and play")
f. High stability and Open frame design
g. Ability for multiple cameras, or significant "real estate" on the ROV to house third party HD cameras
h. Minimum 300m depth rated
i. Rugged Industrial design
j. Easily and safely portable to remote locations

This is a fairly brief introduction that will hopefully assist in the decision making process for any researchers looking at increasing their underwater capacity by purchasing an ROV.

If you have had any experience with the design or experimentation of ROVs in this field, we would love to hear from you on the project itself, how the ROV assisted, if there were any issues, and if the ROV was easily adapted to the project requirements.

Acknowledgments

None.

Conflicts of interest

None.