

INTERNATIONAL Ocean Systems

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ROVs/AUVs/USVs

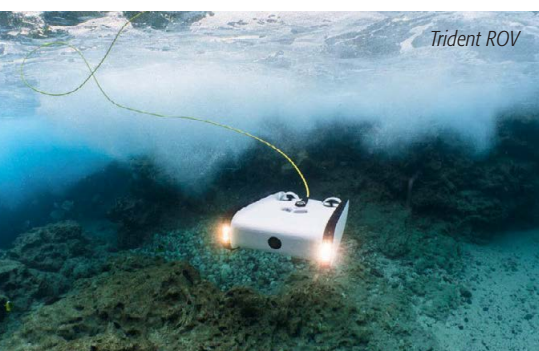
The top 10 educational

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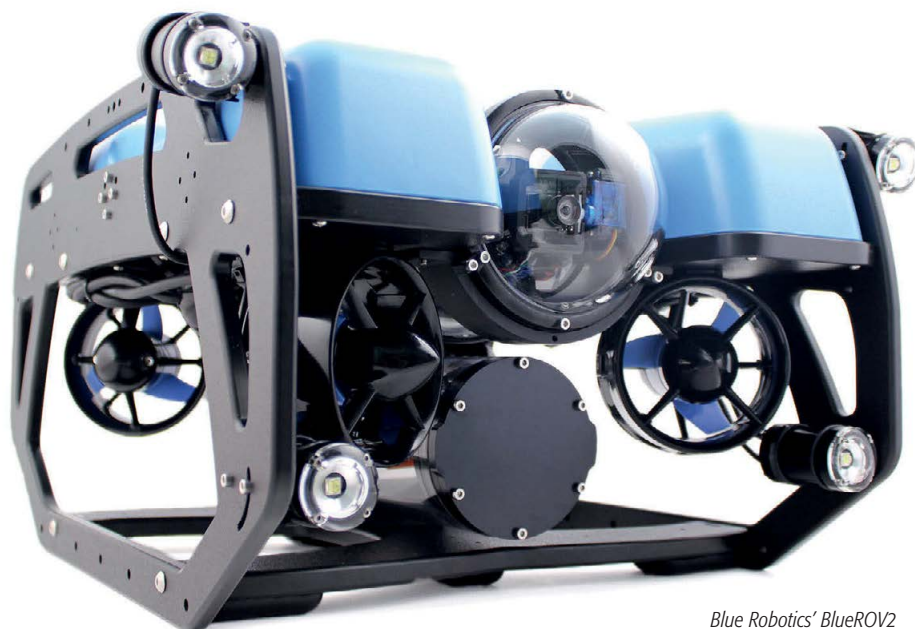
ROV systems can help to inspire the marine scientists of the future, but which ones are best for educational use? Marc Deglinnocenti returns with his annual countdown of top picks

Once again it is time to review the top 10 educational remotely operated vehicles for the coming year. If they are good for observation, marine geology, marine archaeology, marine biology, underwater maintenance and other endeavours, then they are probably going to be good for educational purposes too. That means that they will be excellent for teaching both children and adults about our shared marine environment. That environment lies beneath 71% of Earth's surface, which is water. It is worth taking a look under that surface to learn more about it. Here comes the countdown of some of the best ROVs – for a very broad range of budgets – to do that with in 2021.

● Starting off with the less expensive ROVs for those of us that don't have big budgets, there are still plenty of choices. For US\$2150 (£1648) you can buy a great little portable, advanced ROV called the Trident from Sofar Ocean Technologies of San Francisco, California, USA. The Trident is one of the fastest ROVs on the market –



Trident ROV



Blue Robotics' BlueROV2

it has a top speed of two metres per second – and has a depth rating of 100 metres (328 feet) with a three-hour dive time. The price includes a user-friendly game-inspired controller with a built-in video screen and a hard carrying case. You get 100 metres of tether on a reel with a Wi-Fi interface too. Options include a smart mooring buoy system that can also bring a Wi-Fi connection via the internet right into your classroom for viewing real-time dives. The underside payload area has preinstalled hardware for attaching Wi-Fi connected add-ons. This slim ROV is great for the price.

● Seadrone of Mountain View, within California's Silicon Valley, offers up its Seadrone Enforcer ROV, which is actually built in Mexico. It also has a three-hour dive time like the Trident, but it has a deeper dive capability at 150 metres (492 feet). This UFO lookalike ROV with gripper arm comes fully assembled and costs just under US\$30,000 (£23170). Along with the usual tether reel and extra batteries offered, there are a few more options available. An ultrasonic probe can be fitted to measure the thickness of underwater

steel plates. Also available is a cathodic potential (CP) probe that can measure the electrical current within the water. The sonar options are the 35-degree field of view Tritech (UK) Micron or the 60-degree Oculus multibeam sonar by Blueprint Subsea, also of the UK. Additional surprisingly sophisticated options include a Doppler velocity log (DVL) for highly accurate water current speed readings and an ultra-short baseline (USBL) underwater acoustic positioning system. A USBL system consists of a transceiver mounted under a vessel, and a transponder on the ROV. Inexpensive add-ons are a laser scale and a small sphere buoy for shallow water visual tracking. The external depth, internal pressure, internal humidity, internal temperature and internal leak sensors are all standard equipment and included.

● Another relatively inexpensive ROV is Blue Robotics' (USA) BlueROV2. The BlueROV2 is a kit that you put together yourself. That has pros and cons. The cons are that it takes time and knowledge to put it together. There are a couple of companies out there that will sell you a fully assembled BlueROV2, but you'll be

ROVs for 2021

paying a premium for that service. The pros are that you can learn about electromechanical engineering while building it, and there are online forums to help you along the way. If it breaks down in the field, you won't be panicking. You can probably diagnose it and repair it yourself, because you're the one that built it! Another advantage of going with Blue Robotics is that you can start off cheap at US\$2989 USD (£2277) by using your own game controller. Starting with lower specifications such as lower depth ratings and shorter tether lengths you can then later increase its capabilities as additional funds become available. So, you start off with a 100-metre depth rating and then change out the 100-metre rated housing to a 400-metre one. You can go from six thrusters to eight with the Heavy conversion kit for better stability and control. You can add an equipment skid, a gripper, two sonars, and other options. You can go from two lights to four lights, and then even to an underwater GPS tracking system. These specification increases allow

you to get into the ROV exploration world with a limited budget yet won't tie you down forever with a limited ROV. There are some ROVs that are already pre-built with high specs though.

- Deep Trekker is a Canadian ROV company which delivers a great line of preassembled ROVs with great specifications at reasonable prices. It has been on the top 10 list in past years due to its great line of ROVs, but this year the company has outdone itself with its new Revolution ROV. For US\$29,999 (£22,854) you get a remarkable ROV package that includes in the ROV with a 305-metre (1001 feet) depth rating with six magnetically coupled thrusters, a 300-metre (1000 feet) tether on a reel, an integrated super bright screen controller with Deep Trekker's BRIDGE operating software included, a standard sensor package that reads the water temperature, battery levels, the depth and heading, four LED lights, a laser scaler, a microphone, a hard case with wheels, spare batteries and lights, a battery charger and a tool kit, and

*The Revolution ROV
from Deep Trekker*



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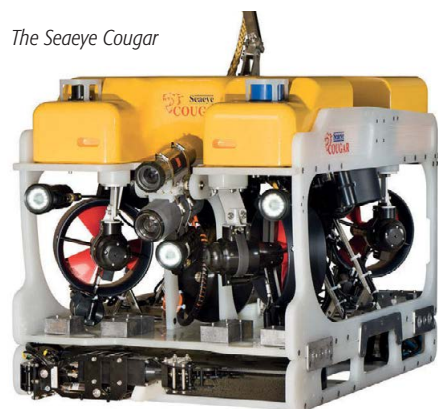
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a patent pending rotating 260-degree field of view high-definition camera with its own LED light, and a two-function grabber arm which is almost always an optional piece of equipment with other ROV companies. Wow, that's a lot for the money. Options include a sonar, a positioning system, and a DVL sensor that can measure current speed but is also useful for station keeping within those currents. Since the gripper arm was included in the package, go ahead and spend the extra US\$1249 (£952) for the six-piece quick change various gripper attachments option.

● Swedish firm Saab may make excellent automobiles and jet fighters, but it also makes an excellent line of ROVs through its UK operation, Saab Seaeye. Last year the company's Falcon-DR ROV made the number one spot on the list. That was primarily due to its price being comparable to other 300-metre rated ROVs, but it actually had a 1000-metre depth rating. This year Saab Seaeye has made the list once again with its Cougar-XT. This ROV, with its six high-voltage (500 volts DC) thrusters, has a maximum depth rating of 2000 metres (6562 feet). That requires a ship or shore power of 380 to 480 volts AC 3 phase to operate it due to those deep depths and its high-power thrusters. This is truly a university grade educational ROV that can handle demonstrations for even the most advanced marine biology courses. It can even make some new scientific discoveries of its own with that depth rating. It has quick-change tool skids for various mission requirements as well. This 409-kilogram (902-pound) ROV only needs a small hoist or ship davit to deploy and recover it. The options available are all

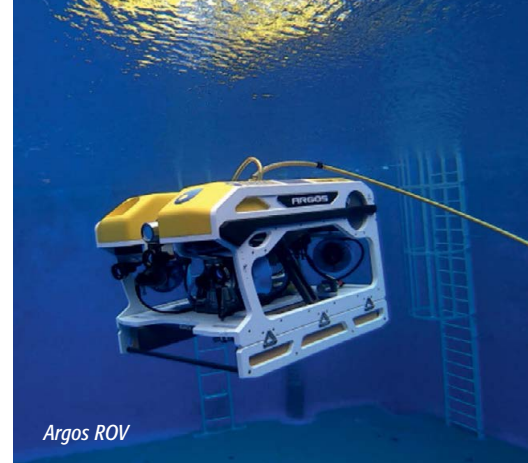


The Seaeye Cougar

cutting edge technological equipment such as a tool skid, a cutter capable of cutting 38-millimetre diameter steel wire rope, a heavy duty manipulator arm skid, an acoustic position tracking system, a laser scale, a multibeam sonar for excellent benthic surveying, a scanning sonar, a depth sensor and altimeter gauge, a CP probe for measuring electrical currents within the water, an ultrasonic metal thickness gauge, and a camera boom arm for collecting video data in hard to reach spaces as well as various high-definition camera options. Some other options are available as well.

● The Perseo ROV is an Italian made observation ROV with a standard 600-metre (1968 feet) depth rating. It comes with a colour and a black and white camera as standard, but it can be equipped with up to three cameras. Up to four 4K lumen LED lights can be installed on this tough yet smart ROV. It has a built-in inertial measurement unit that knows its heading and depth through various sensors as standard with an above the bottom altitude reading as an option. All of these readings are overlaid on the video screen along with pitch and roll readings and a date and time stamp. An optional CP probe for detecting electrical currents in the water can also be read on the screen. This ROV has excellent stability and control due to its two vertical and four vectored thrusters, which have magnetically coupled propellers for watertight integrity at high-pressure depths. The external power source for the Perseo is a more available 220-240 VAC, 50/60Hz for continuous dive times. A separate equipment skid can hold a multifunction manipulator arm along with other options. It can lift 25 kilograms as standard with optional buoyancy additions to lift even more weight. That's impressive, but so is our next ROV.

● France-based Forsea Robotics makes a state-of-the-art ROV called the Argos. This autonomous tracking ROV comes with a maximum depth of 500 metres (1640 feet), 1000 metres (3280 feet) or 2000 metres (6561 feet). It comes with six thrusters and a 320 VDC power supply for



Argos ROV

unlimited dive times. The optional equipment skid mounts underneath the ROV and can hold a myriad of equipment such as an electric five-function manipulator arm. Other equipment may include various class 1 to class 4 torque tools and cleaning tools. The Argos may not have vectored thrust, but you can adjust the thrusters prior to a dive to suit specific dive situations. Forsea Robotics proudly advertises its Argos Flooded Member Detection (FMD) tool for determining if a tank or other object has been flooded with water even through marine growth. Pipe and cable trackers are also available for the Argos. The Argos has a visual localisation system called V-LOC that is used for monitoring structure movement and ROV positioning, heading, and attitude. The smart Argos ROV can also be modified to communicate with an unmanned surface vehicle to then be operated remotely with a handheld touch screen controller. So, there's a lot more to this globally supported French ROV than meets the eye. Meanwhile, there's another globally supported smart ROV made on the other side of the Atlantic Ocean.

● VideoRay is an American ROV company with more than 20 years of experience. Its most sophisticated ROV is the Defender, and it boasts a 1000-metre (3280 feet) depth rating. I like the fact that it does not need a very high voltage to operate it at those depths either. A more common 110 or 220 VAC will run it for unlimited dive times, however you do have the option to power it on 400 VDC. Seven powerful thrusters and a sleek hydrodynamic body shape allow the Defender to speed up to an impressive four knots underwater. The list of standard and optional equipment that this ROV comes with is equally

impressive. Sonar options are the BlueView (USA) M900-130 Series, Tritech imaging, Tritech scanning or the Blueprint Oculus. Positioning options are the Blueprint Seatrac USBL and the Tritech MicronNav USBL. An ultrasonic thickness gauge and CP probe are just some great sensor options, along with a Nortek (Norway) DVL. It even has a radiation detection sensor option. The manipulator arm options vary from a simple rotating gripper to highly sophisticated dual robotic arms. More options for the Defender include a cavitation cleaner, a net cleaner, a heavy lifter thruster frame, hull crawler, laser scale, the Viper mine disposal unit, a water quality monitoring instrument that can measure water temperature, conductivity, salinity, dissolved oxygen, pH, turbidity, and depth, also training classes, and a standard included maintenance kit, two waterproof hard cases, Ethernet connections, and a two-year warranty. Is it any wonder why the Defender ROV made it so high on the list?

● The runner-up ROV is one that Sub-Atlantic of Aberdeen, UK, touts as both a work-class and an observation-class ROV. It is no wonder that the Comanche ROV, being an all-around purpose electric ROV, would make it to number two on the list for educational and scientific use. The Comanche ROV has 2000-, 3000- or 6000-metre depth options. It has an internal diagnostic system that can locate faults before your dive, and an internal dynamic stabilisation system that can help you control it. Standard internal electronics also includes a USBL navigation system. A multifunctional manipulator arm along with sonars and sensors are available as options. An offered auxiliary hydraulic



package can power a myriad of underwater tools for your mission needs too. Multiple gigabyte Ethernet options are available along with the hardware and software for underwater surveying, and surface weather monitoring. This midsize ROV can carry an impressive payload of 218 to 285 kilograms depending upon the buoyancy configuration. This ROV is transportable by air to any spot on the globe.

● My top rated ROV for 2021 is the world's most sophisticated production work rated ROV, the Schilling UHD III, from London, UK-headquartered TechnipFMC. The 250 hp ROV is rated to 3000 metres (9842 feet), with an optional 4000-metre (13123 feet) version. This herculean ROV has a payload capacity of 600 kilograms (1322 pounds). It even has a 150 hp power takeoff for operating heavy-duty tooling. All of this power is mustered via onboard hydraulic pumps. The vehicles also have strong Titan, Rigmaster and Schilling manipulator arms which also have their own hydraulic pumps with motors that can accept AC or DC currents. All of this awesome work power is tempered by the most sophisticated automatic station keeping

system available in an ROV. Of course various cameras and lights can be configured on the UHD III, but the impressive HD colour camera with zoom beats the rest. Just like VideoRay's Pro 5 ROV, this ROV also has a modular component design. Equipment can be changed right in the field in less than an hour to meet changing mission situations. That equipment change includes every type of sensor, sonar and collection device that you can think of. If you want a better performing ROV than this, then you'll have to build it yourself from scratch.

You don't have to build your own ROV in order to educate both youth and adults on various education levels though. There's an ROV available at every budget level. Whether it's a long marine science course or just a one-hour school assembly, there's really no excuse not to raise the student and teacher excitement level several notches with a real-time ROV dive. Whether it's a fresh water pond, a mountain lake, or the wild oceans and seas, let your students discover our underwater world with an ROV. Who knows, you might even make a few discoveries of your own.