3D Printed Solutions

EMBRY-RIDDLE ROBOTX CHALLENGE SUBMARINE RISES TO THE CHALLENGE

"Some of the mounting geometries on the submarine are very difficult. We could not have designed a solution with subtractive technologies. 3D printing was the only technology that could provide a solution."

– Dr. Eric Coyle, Embry-Riddle Aeronautical University

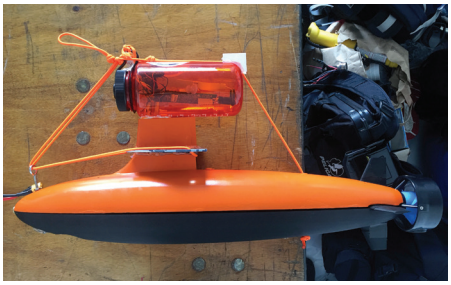
CASE STUDY

Schematic of RobotX Challenge submarine

THE CHALLENGE OF WANTING IT ALL

Students at Embry-Riddle Aeronatical University (ERAU), wanted the best of everything when it came to the submarine they entered in the Maritime RobotX Challenge, off Sand Island, Hawaii. Team Minion, with members from 11th grade students to Ph.D. candidates in software, electrical and mechanical engineering, wanted "more than a hull with okay shape and okay structure," said Chris Hockley, Ph.D. candidate. What they wanted was a streamlined and watertight vessel. And, of course, they wanted to win the international competition.

Team members were charged with securing sponsors to help fund travel and hardware for their challenge sub and boat. The 16-foot robotic boat or WAM-V, had to be transformed into an autonomous seagoing robot that used cameras, lasers and sonar. Team Minion had planned for the robot to deploy a submarine, but instead chose to deploy an autonomous seagoing robot that rode on the surface of the water with a submersible camera.



Deployable submarine with camera, encased in 3D printed material

Since their 2014 vessel entry, Team Minion employed a fundamental design shift, choosing to make their vessel an autonomous, reconfigurable sensor platform. “Because we needed the vessel to have communication with the surface at all times, it wasn’t possible to deploy a true submarine,” said Hockley. Instead, these autonomous systems feed on the information delivered to them, including weather conditions and traffic, which are communicated through sensor suites of cameras, RADAR and LIDAR.

These systems are encased in a hull or housing, which needs to withstand many perils during competition, including flooding or leakage and heat build-up within the closed housing. Seeking a competitive edge, the team considered many housing options. “But we weren’t willing to sacrifice function.”

Team Minion’s entry in the RobotX Challenge

3D Printing Gives Team Their Edge

3D printing has been used within the engineering department at the University for a number of years and team members quickly realized the additive process was the answer to its design challenges. “With 3D printing, we could design for function and manufacture any shape housing we wanted to,” said Hockley. Not only was the housing watertight but it was hydrodynamic and sleek-looking. “We had both the mostly highly-functioning deployable submarine and the best looking vessel in the competition,” said Hockley.

Time savings were another consideration for the team who was able to produce high precision, high quality parts in little time with a Fortus 900mc™ 3D Printer, using FDM Nylon 12™ material. The team began working on its entry in mid-August and had the submarine in hand in early October, ready to begin testing. “If we’d had to manufacture the parts, we couldn’t have met the timelines,” said Hockley. Instead of the expensive and time-consuming process of getting parts machined, “we took measurements in CAD and then printed them off to see how it all fit.”

A Winning Combination

ERAU placed 4th overall in the RobotX Challenge, also winning an award for ‘Most Autonomous System.’ “Some of the mounting geometries on the submarine are very difficult. We could not have designed a solution with subtractive technologies. 3D printing was the only technology that could provide a solution,” said Dr. Eric Coyle, faculty advisor to the team.

Solving real world problems, such as the challenges posed by autonomous systems, has a growing relevance as autonomous vehicles are starting to come to market. High quality testing, like that performed by teams in the RobotX Challenge, gives students the kind of experience that helps them land jobs after college. The iterative capabilities of 3D printing facilitate this and “companies are looking for graduates with additive manufacturing experience. In the R&D areas of industry, 3D printing is helping students gain the skills needed for employment,” said Coyle.

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