

MATE ROV Competitions Bring Ocean Science and Technology to Students and Educators across the U.S. and Canada

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INTRODUCTION

The remotely operated vehicle (ROV) competitions organized by the Marine Advanced Technology Education (MATE) Center and the Marine Technology Society's (MTS) ROV Committee provide students and instructors with the opportunity to experience first-hand many of the scientific and technological challenges that ocean researchers, technicians, and engineers face every day. That's because each year the ROV competitions challenge teams across the U.S. and Canada with designing and building vehicles to accomplish tasks based on science, exploration, and industry missions taking place in the real world.

Funded by the National Science Foundation, the MATE Center is a national partnership of community colleges, high schools, universities, research institutions, marine industries, professional societies, and working professionals. MATE's mission is to improve marine science and technology education and, in this way, help to prepare the marine workforce. Working in partnership with the MTS ROV Committee, the MATE Center developed the student ROV competition program as a way to help accomplish its mission.

ABSTRACT

Despite our nation's increasing reliance on the ocean environment, students and educators are often unaware of ocean career opportunities and the knowledge and skills required to enter those careers (Sullivan et al., 2006; Sullivan, 2002). A consequence of this lack of awareness is a shortage of skilled individuals who can fill ocean workforce needs (MATE Forum, 1996; Zande & Sullivan, 2003). The Marine Advanced Technology Education (MATE) Center and the Marine Technology Society's (MTS) ROV Committee created the remotely operated vehicle (ROV) competition to address this issue and bring ocean science and technology to students and educators across the U.S. and Canada. Since 2001, the MATE Center and the ROV Committee have engaged thousands of students and educators from middle schools through universities in developing ROVs for tasks based on real workplace situations. In doing so, the program has promoted ocean issues and careers, connected students and educators with employers and working professionals, and helped students to develop valuable technical, problem solving, and teamwork skills.

From exploring shipwrecks to recovering scientific equipment and repairing damaged subsea telecommunications cable, the competition themes provide learning environments that help students develop technical, problem solving, and teamwork skills and see how those skills can be applied in the working world. Through the involvement of more than 60 working professionals and their organizations, the competitions also showcase career opportunities, connect students and their instructors with technical expertise in the form of industry mentors, and provide access to facilities, equipment, building materials, and, most importantly, employers.

Background

Our nation's interest in and dependence on the ocean environment—for energy, food, telecommunications, transportation, and exploration—is increasing (USCOP, 2004). It is estimated that twenty percent of our nation's economy is based on ocean activities, and that one in six jobs is ocean-related (Gore, 1998). These figures will undoubtedly continue to rise, especially as more and more of the U.S. population moves to the coast and is increasingly affected by ocean-

related events such as Hurricane Katrina, which devastated Gulf Coast communities.

Yet students and instructors are often unaware of the wealth of ocean-related careers that exist and the knowledge and skills needed to work in them, which translates into a lack of available educational programs and training opportunities (Sullivan et al., 2006; Sullivan, 2002). In particular, educational programs that focus on the engineering and technology that support ocean activities are scarce, especially at the middle and high school level where students are just beginning to think about their career paths.

Many electronics, machining, and other "shop" programs have been and continue to be phased out at schools and colleges because of funding cuts and a shortage of technical expertise to support them. This is especially alarming when our reliance on technology for national security, transportation and commerce, energy and exploration activities, telecommunications, recreation and tourism, fisheries and aquaculture, search and rescue, environmental assessment and regulation, and research has never been greater (USCOP, 2004).

The lack of hands-on technical education programs leads to a shortage of qualified individuals to support the ocean industry (Zande & Sullivan, 2003; USCOP, 2004). As Bruce Gilman, former president and CEO of Sonsub, Inc., one of the largest contractors for the oil and gas industry, states, “Sonsub and other marine contractors have an increasing requirement for skilled people with training in marine technology. Filling this need is a serious problem for companies such as ours.” Jerry Streeter, current president of MTS, underscored this statement during his 2005 “State of the Society” address. According to Streeter, the majority of technical professionals currently working in the offshore industry are over the age of 50 (Streeter, 2005). Qualified individuals will be needed to replace those professionals as they retire—which represents both an opportunity and a challenge for today’s educational system.

Bridging the Gap between Education and the Workplace

The MATE Center and the MTS ROV Committee created the ROV competition program as a way to help meet this challenge, increase awareness of ocean occupations, and infuse relevant technical skills and information into mainstream education. The program was also designed to promote the understand-

ing and development of the skills and abilities needed to support ocean activities, and to help bridge the gap between the educational system and the marine workplace.

Since 2001, the MATE Center and the ROV Committee have partnered with industry, education, professional society, government, and public aquarium organizations to engage more than 2,000 students and instructors from middle schools, high schools, home schools, colleges, and universities in developing ROVs for mission tasks that simulate the working environment. Designing and building a vehicle to successfully complete a competition mission involves a practical, working knowledge of math, physics, electronics, hydraulics, and engineering. It also requires budgeting, setting deadlines, documenting procedures and results, project management, communication, teamwork, critical thinking, continual problem solving, and producing deliverables on time—just like the real world.

From the Depths of the Oceans to the Far Reaches of Outer Space

Each year the competition focuses on a new theme in order to expose students and instructors to a different aspect of the ocean workplace and the scientific and technological advancements that are taking place.

From shipwrecks to sanctuaries and the offshore industry, the competition theme raises awareness of the vast range of ocean work, while also highlighting the careers, organizations, and technologies that support ocean activities.

In 2005, the competition focused on the similarities between ocean and space environments and how technologies designed for ocean work can also be used for missions in space—and vice versa. The MATE Center partnered with the NASA Johnson Space Center’s Neutral Buoyancy Laboratory (NBL) to create a scenario where teams designed and built ROVs to collect information about the ocean believed to exist on Europa and to tackle “Olympic” tasks that ranged from installing a new instrument module on the Hubble space telescope to capping a decommissioned oil well. The international competition was hosted by the NBL, where the underwater missions were staged in the facilities’ 6.2-million gallon pool, which has full-sized mock-ups of the International Space Station and space shuttle secured to the bottom.

In addition to building the mission tasks and report and poster requirements around the theme, the competition events include presentations and activities that further complement the theme and enrich the entire competition experience. For example, prior to the 2005 competition kick-off, students and educators had the opportunity to watch as astronauts went through a training exercise in the same pool where they would carry out their mission tasks. In addition, the NASA Extreme Environment Mission Operations (NEEMO) Project arranged for participants to take part in a live-link with aquanauts highlighting NOAA’s *Aquarius* underwater habitat, which, for NEEMO, serves as a very wet analog to flying in space.

Regional ROV Competition Network

In addition to the annual international competition, the MATE Center and its partners have created a network of regional competitions across the U.S. and Canada. From Hawaii to Newfoundland, the regional ROV competition network is helping to accommodate the ever-growing interest in the competi-

The Polar Submersibles ROV Team gets wet during a practice session in Fairbanks, Alaska.



tion program, allowing more and more students and educators to take part in exciting educational experiences.

Currently 13 competitions make up the regional network. The following is a list of the existing and planned regional events and the organizations that coordinate, support, and host them:

- The Southern California ROV Fly-Off is organized by the Birch Aquarium at Scripps Institution of Oceanography (SIO), with support from SIO, the MTS-San Diego section, and the University of California San Diego's Jacobs School of Engineering.
- The Texas Regional ROV Contest is organized by Alvin Community College (ACC) with support from the MTS-Houston section and the Flower Garden Banks National Marine Sanctuary.
- The New England Regional ROV Contest is organized by the University of Rhode Island's (URI) Department of Ocean Engineering and supported by the MTS-New England section, URI's Robotics Education and Research Institute, and Stellwagen Banks National Marine Sanctuary.
- The Monterey Bay Regional Contest is organized by the MATE Center, with support from Monterey Peninsula College's (MPC) Technology Preparation Program, the MPC Foundation, Monterey Bay Aquarium Research Institute (MBARI), the MTS-Monterey section, and the Monterey Bay National Marine Sanctuary.
- The Hawaii Underwater Robot Challenge (HURC) is organized by the University of Hawaii (UH) Manoa and Waipahu High School and supported by the UH's Seafloor Mapping Lab and the MTS- and IEEE-Hawaii sections.
- The Florida Regional ROV Contest is organized by Hillsborough Community College with support from the college, the MTS-Florida section, and Busch Garden's Adventure Island amusement park.
- The Great Lakes Regional ROV Contest is organized by Thunder Bay National Marine Sanctuary & Underwater Preserve and supported by the National Oceanic and Atmospheric Administration's (NOAA) Great Lakes Environmental Research Lab and Lake Superior State University.
- **NEW in 2006!!!** The Big Island Regional ROV Contest (BIRR) is being organized by Kealekahe High School and the Hawaii Island Economic Development Board's Women in Technology Program (WIT) and supported by WIT and the MTS-Hawaii section.
- **NEW in 2006!!!** The Northern California Regional ROV Contest is being organized by Arcata High School with support from Eureka High School, McKinleyville High School, and Humboldt State University.
- **NEW in 2006!!!** The Puget Sound Regional ROV Contest is being organized and supported by the MTS- and Institute of Electrical and Electronics Engineers (IEEE) Oceanic Engineering Society-Puget Sound sections, the Naval Undersea Museum, and the Youth Maritime Training Association.

- **NEW in 2006!!!** The Mid-Atlantic Regional ROV Contest is being organized and supported by the *Monitor* National Marine Sanctuary and Nauticus, the National Maritime Center.
- **NEW in 2006!!!** The Southeast Regional ROV Contest is being organized and supported by Gray's Reef National Marine Sanctuary and the Georgia Aquarium.
- **NEW in 2006!!!** Memorial University of Newfoundland is organizing a regional contest for middle and high schools in the St. John's region.

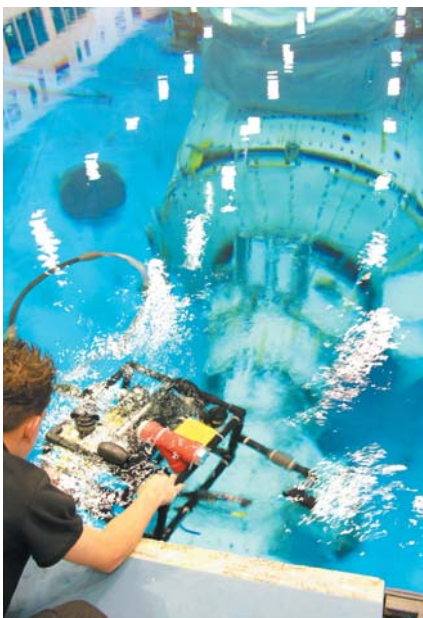
Working with organizations like MTS and NOAA's National Marine Sanctuary Program, the MATE Center will continue to facilitate collaborations and build the organizational infrastructures that will expand the regional network, providing even more students and educators with the opportunity to take part in these hands-on learning experiences.

The Power of Partnerships

In addition to those organizations involved with the regional competitions, MATE's partners include organizations that each year contribute funds that directly benefit the competing teams by providing them with travel and housing stipends as well as meals, awards, and prizes. These organizations include NOAA's Office of Ocean Exploration, which provides funds as well as technical expertise in support of the competition program. Major players in the offshore industry, such as Oceaneering International, Stolt Offshore, and Perry Slingsby Systems, also contribute funds. In addition to MTS, IEEE Oceanic Engineering Society provides financial support.

Organizations also support the competition by providing hardware, supplies, and access to workshop facilities and by supporting the involvement of the professionals that work for them. Currently more than 60 scientists, engineers, and technicians are involved as competition judges and team mentors. For example, each year engineers and ROV pilots from the Monterey Bay Aquarium Research Institute (MBARI) serve as judges at both the international competition and the Monterey Bay Re-

South Broward High School (Florida) launches its ROV above the International Space Station during MATE's 2005 international ROV competition.



gional ROV Contest. Several of the engineers also volunteer their time and technical expertise as mentors to local teams.

In 2005, NOAA's West Coast & Polar Regions Undersea Research Center provided an Alaskan high school team with access to facilities, equipment, and mentors. The Center also provided the team with funds to support travel to the international competition. Engineers from Perry Slingsby Systems, the world's leading manufacturer of commercial ROVs, have guided Florida high school students since 2004. Perry has also provided access to its test tank and workshop facilities.

Each year during the international competition, VideoRay LLC provides an ROV and a technician to film the students' vehicles completing their missions and broadcasts those images topside, much to the delight of both teams and spectators. VideoRay has also created a "MATE ROV Competition Store" that is available to competition teams only. This on-line store offers discounts on cameras and tethers, among other items. Sound Ocean Systems, Inc. (SOSI) provides lengths of umbilical cable to competing teams *at no cost* provided the teams cover shipping expenses. Other organizations, such as Stolt Offshore and Phoenix International, donate hardware or funds to be awarded as competition prizes.

Through the support that MATE's partners provide, the competitions are increasing awareness of career opportunities and infusing expertise (through access to industry mentors, equipment, and facilities) into educational programs where it is desperately needed. What better way for students to learn about ocean occupations than by working side-by-side with individuals currently in the workplace. And what better way to help educators deliver hands-on, real world learning experiences than by complementing and building upon what they are teaching in the classroom and providing access to materials and facilities often unavailable to educational programs.

What's in Store for 2006: Ocean Observing Systems

Teaming up with the National Office for Integrated and Sustained Ocean Observations, or Ocean.US, and the Ocean Research Interactive Observatory Networks (ORION) Program, the 2006 competition is highlighting the new and dynamic world of sustained ocean observing systems and the careers, organizations, and technologies allied with observing platforms.

Teams will face a mission scenario that challenges them to develop ROVs for tasks

associated with the operational aspects of deploying, operating, and maintaining ocean observatories. For example, students are being tasked with developing vehicles that can deploy and network instruments for power and communications, and recover equipment for maintenance and repair. In addition, teams are exploring the practical applications as well as the research questions enabled by observing systems, which will help them to see the practical impact that these systems have on society and the economy.

In addition to providing background information and resources for developing the mission scenario, working with Ocean.US and the ORION Program is allowing the MATE Center to provide teams with opportunities that further complement the theme and support them in the design and building process. For example, MATE and Ocean.US are working to connect the 11 regional associations (RAs) that make up the Integrated Ocean Observing System (IOOS) network with existing teams and regional competitions. The goal is to engage the organizations and working professionals involved in the RAs as team mentors and competition judges, and to encourage them to provide access to facilities, parts and supplies, and possibly funds and training opportunities for individual teams and instructors.

The NBL is planning to host the international competition again this year, helping to highlight NASA's role in IOOS. The event is tentatively scheduled to take place in June 2006.

Conclusion

Each year, the MATE Center and the MTS ROV Committee's competition program brings ocean science and technology to thousands of students and educators across the U.S. and Canada. As teams design and build their vehicles, they see how the skills they have developed can be applied to real-world ocean issues.

Through the power of partnerships, the program facilitates interactions between students and industry mentors where students take charge of their learning and build upon their knowledge and skills. In addition, students' talents are showcased to employers, who benefit by having access to individuals who

2005 competitor Miami Dade College (Florida) shows off the "right stuff" at the NASA Johnson Space Center's Neutral Buoyancy Lab.



come to them not only with relevant skills, but also with an interest and enthusiasm for the field of ocean science and technology.

In this way, the MATE Center, the MTS ROV Committee, and partners across the U.S. and Canada are working to bridge the gap between education and the workplace, and helping to develop the future scientific, technological, and engineering workforce that can continue to support the exploration, study, and utilization of our ocean resources.

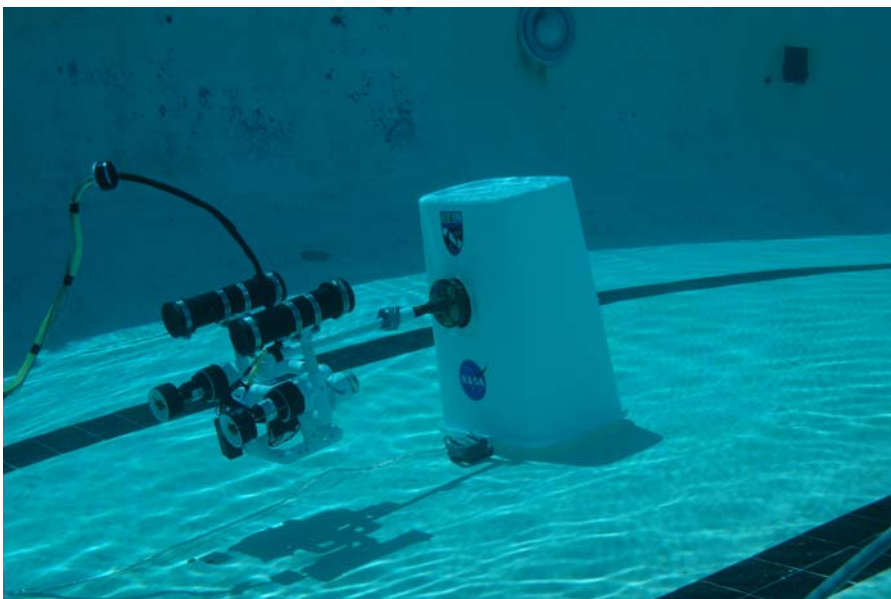
For more information about the competition program, visit http://www.marinetech.org/rov_competition/index.php. To become involved, contact the MATE Center's Jill Zande at (831) 646-3082 or jzande@marinetech.org.

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Gunderson High School's (California) ROV successfully installs an instrument package on a simulated Hubble space telescope during the 2005 Monterey Bay Regional Contest.



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