2024 International SeaPerch Challenge

Presentation Abstracts

Optional abstracts submitted by teams invited to present at this year's event are included below.

Academic Magnet High School, AMHS H2Go (532) | North Charleston, South Carolina, USA

Session 14 - Sat 1:30 PM

Our ROV is unique in many ways from others in the competition. Our frame was 3D printed in one piece to increase the sturdiness and to make it more simple, and the frame was designed to be slightly hollow to increase the ROV's buoyancy. The horizontal motors are placed on the back left and right corners, while the vertical motor is at the front to allow the driver to control the pitch of the robot. The horizontal motors have motor covers with fins to stabilize the ROV, and the general "v-wing" shape was also meant to aid in stabilization. The simplistic design of the claw proved most effective in retrieving objects. Its shallow dip allows the object to be stabilized while the ROV is in motion. All of these features make our ROV unique from the rest of the competition

Academic Magnet High School, AMHS Krakens (533) | North Charleston, South Carolina, USA

Session 18 - Sat 2:30 PM

The Technical Design Report for Team Kraken discusses and details the process of creating, testing, designing, and optimizing the Kraken Remotely Operated Vehicle (ROV) as well as its unique elements. A cone-shaped 3D printed custom motor casings allows the Kraken ROV to move through the water with enhanced speed and agility. 3D Printed joints allow for angular precision and are tailored to fit the tubing tightly, along with an innovative epoxy seal on the ends of the PEX to prevent leaking. Mmsh netting assists the ROV in achieving neutral buoyancy by increasing the surface area, allowing for a higher buoyant force to act on the robot while keeping drag low and improving lift. The 3D printed hook is relatively straight with a raised tip at the end. A curved piece protrudes from the base and over half of the hook to ensure hooked objects stay on better.

Bonneville School, The Mighty Coquis (726) | San Juan, Puerto Rico, USA

Session 1 - Fri 2:00 PM

The Mighty Coquis' ROV includes several fascinating components that allow the prototype to operate and be effective in a variety of circumstances. If a nation experiences a global emergency or an existential catastrophe, it may explore the waters for missions for which the ROV can provide solutions. It not only aids in the search for answers, but also gives insight into how the ROV perceives the world and adjusts to its surroundings. Speed, control, and mechanics are critical components of an ROV's ability to innovate in the real world. On the other hand, it may be used for operations such as military extractions from various places under the waters in search of unique items or to study the status of the oceans. The ROV may be useful for persons who operate in areas where animals reside, such as fish, whales, seals, and other ocean wildlife. This tool may assist in determining the status of the creatures and their survival requirements based on the environment in which they dwell, such as the quality of the water, density, or even depth. To summarize, the ROV is more than just a competitive model; the globe must develop and grow toward better outcomes and solutions for real-life circumstances.

Burns Sci-tech Charter School, Bunsen Burnsers (515) | Oak Hill, Florida, USA

Session 13 - Sat 1:30 PM

Plastic pollution is one of the biggest pollutants in our world today. Almost everything we use as a society at one point or another comes in contact with plastic. As plastic degrades it only becomes more difficult to clean up and reuse. Microplastics can be found everywhere from the food we eat, the air we breathe, and even in our own blood. One of the biggest microplastic pollutants is Polyethylene Terephthalate (PET). To find a solution to this problem, we designed a experiment around collecting PET through the use of ferrofluid and magnets on our ROV. Ferrofluid's non-polar properties attract the microplastics and the magnetic properties allow it to easily be collected by the ROV. Plastic pollution affects us locally, as our school is located close to the Indian River Lagoon. This ecosystem is fragile and diverse, and using our ROV to collect microplastics allows for easy removal. Due to their small size, it is almost impossible to filter microplastics from water, and this technology allows us to make a difference in our environment.

Cape Henlopen High School, JABE (116) | Lewes, Deleware, USA

Session 10 - Sat 10:30 AM

Our presentation analyzes the challenge and obstacle courses and their impact on the team's engineering design approach. Experimental results in the report demonstrate how detailed testing informed the final design decision. The report also covers Team JABE's reflections on their SeaPerch journey and future plans for the ROV design and team members. The JABE ROV is distinctive in the SeaPerch community due to the following unique design features: 1. Pinpoint Buoyancy Design: Team JABE utilizes custom 3D-printed sealed air capsules, which employ Archimedes' principle. These capsules provide neutral buoyancy to the ROV, allowing it to float effortlessly in the water. Additionally, the air capsules help to evenly distribute weight throughout the ROV, which improves its balance and stability. 2. Optimized Frame: The frame crafted from lighter CPVC for maximum thrust-to-mass ratio provides peak ROV speed. 3. Innovative Parts: The ROV uses a front-mount hook made from two coat hangers that is optimized for grabbing and transporting various materials in the mission course. The hook is carefully angled to easily hook and release the temperature sensor and gas collector while still being able to pick up and hold any and all rock samples. 4. Pitched Motor: The ROV is equipped with a front-angled up/down motor, enabling the operator to adjust the pitch of the ROV as required. This pitch control feature enhances maneuverability and allows the robot to attain higher speeds while navigating vertically through the water column.

Carl Wunsche Sr. H.S, Wunsche Phoenix Fire (703) | Spring, Texas, USA

Session 11 - Sat 10:30 AM

Phoenix Fire Tech stands at the forefront of 21st-century innovation through its participation in SeaPerch. Seamlessly integrating cutting-edge technology with hands-on learning, SeaPerch equips our team with the skills and knowledge needed for success in STEM fields. By engaging with remote-controlled vehicles and underwater imaging systems, our members are prepared for careers reliant on robotics and automation. Through designing, building, and operating underwater vehicles, we develop practical skills in problem-solving, teamwork, and critical thinking, essential for navigating the challenges of the modern era. SeaPerch's interdisciplinary approach mirrors our commitment to embracing diverse perspectives and addressing multifaceted challenges head-on. By cultivating essential 21st-century skills such as creativity, collaboration, communication, and adaptability, SeaPerch empowers our team to become innovative problem solvers and future leaders in STEM. Moreover, SeaPerch projects simulate real-world applications in marine exploration, archaeology, and environmental monitoring, providing us with invaluable experience in tackling global challenges. As Phoenix Fire Tech embraces SeaPerch, we bridge the gap between theory and practice, connecting classroom learning with real-world situations. With SeaPerch, we are not just learning; we are leading the way towards a brighter future.

Carrollton School of the Sacred Heart, Sustainable Cyclones (543) | Miami, Florida, USA

Session 4 - Fri 3:00 PM

Our ROV is unique because of its shape, innovative materials, and groundbreaking hook design. The ROV has an original shape not based on any of those provided by SeaPerch. The design of the ROV is a 20cm by 17cm square with a triangular hull that is 9cm tall and 10cm long under the top frame. These small dimensions allow for the ROV to perform quicker and sharper movements when completing desired tasks and reaching optimal hydrodynamics during both the obstacle course and the mission course. Next, our team decided to use ¼" CPVC to build our frame. This is not the standard size or material that teams are provided with when purchasing a kit from SeaPerch. This will minimize the weight of the ROV even further than designing a small frame and will lead to an increased performance. The last important feature of our design is our retractable hook. The hook is a metal wire wrapped around the frame loosely enough to allow it a small range of motion. A rubber band runs across the front of the frame so that it can stretch down to hold the hook up and out of the way during the obstacle course. When the hook is needed, the rubber band can be stretched again to release the hook so that it sits in its deployed position. These aspects together make our ROV a unique example of hard work and innovation.

Centro Residencial Oportunidades Educativas de Villalba, Aurora (025) | Villalba, Puerto Rico, USA

Session 11 - Sat 10:30 AM

The original SeaPerch design we started with underwent a drastic change with a different, and innovative design. For the KOI ROV's first design, we had a very lightweight and small design which made our work difficult, so we decided to make some modifications to the ROV. The KOI ROV final design is more hydrodynamic and distinctive. This ROV has a very eye-catching color which we consider a more effective way to see it underwater. Additionally, our ROV's design was created in a simple yet different manner. Basically, the ROV engineer decided to join four tubes cut diagonally at the front of the ROV with the purpose of "breaking the water", thus reducing water drag, making it faster and much easier to handle. Our ROV is a unique design where we went beyond the design provided by SeaPerch.

Centro Residencial Oportunidades Educativas de Villalba, Watatsumi (026) | Villalba, Puerto Rico, USA

Session 12 - Sat 10:30 AM

Remotely Operated Vehicles (ROVs) play a crucial role in a variety of real-world situations, serving as essential tools for underwater exploration. They enable the investigation of ocean depths and the discovery of unknown marine ecosystems. The effects of climate change have had serious repercussions on the structure, composition, and behavior of coastlines in southern Puerto Rico, leading to an acceleration in coastal erosion process. This erosion has significantly impacted the quality of marine life. We conducted research using an ROV to study the erosion of María Langa Cay. Given the cay's severe erosion pattern, we hypothesized that over time, the coast would experience further erosion, potentially damaging the stability of the marine ecosystem. Six stations around the cay were identified and used to measure the width of its shoreline. An ROV was deployed to record data on seafloor topography, marine vegetation, and sediment presence. By comparing the collected data on shoreline width and marine environmental conditions, we identified patterns of coastal erosion in the study area. This interdisciplinary approach, combining engineering and marine conservation, proved to be an effective strategy for addressing the challenges associated with coastal erosion and climate change. Looking ahead, our objective is to continue measuring and analyzing other coastlines over an extended period. This effort will enable us to create a database containing patterns of coastal erosion and changes in the seafloor of each coastal area under study. In summary, ROVs are vital for marine biologists to study underwater life without disturbing its habitat.

Clements High School, Oceanus Titans (702) | Sugar Land, Texas, USA

Session 3 - Fri 2:00 PM

We have made connections to multiple real-world scenarios using our ROV, our most notable being our research in marine flora and fauna, our experience communicating our design to professionals in the field, and our underwater inspection of apparatuses like ships and boats. For starters, our Real World Innovation Project, headed by Jennifer Duma, allowed us to view different bacteria, fungi, and protists in a nearby lake. The research gave everyone experience in capturing aquatic wildlife with the ROV attachments, handling it so it can be transported to the Clements High School lab, and finally observed through the microscope at the lab. In addition to this riveting research, we learned how to communicate and voice our ideas eloquently to professionals in the US Navy. They gave their praise and critiques to our design. They tested us over preliminary questions about aquatic robotics in general, with questions like “What is buoyancy?”. Because these questions were randomly picked, we had to practice thinking on our feet and answer their questions to the best of our ability, similar to a job interview. Finally, our expertise on how to tweak the design to drive as smoothly as possible gives us experience in the underwater inspection of boats and ships. Similar to how we used the hook to move the rungs on the ladder obstacle course, we can replace the hook with a possible wiper, to clean fungus off the boat, reduce rusting between metal plates and screws, and clean windows to increase visibility.

Clinton High School, DANDRUFF (409) | Clinton, Michigan, USA

Session 6 - Fri 3:00 PM

Hello, we are Team Dandruff. Our SeaPerch is unique because it adopts a lightweight, quick design and combines it with a solid, sturdy design. This SeaPerchh has evolved from essentially a cube-shaped hunk of PVC into the capable, multi-purpose vehicle that we know today. We accomplished this by utilizing programs such as Autodesk Fusion to digitally create motor shrouds and more efficient hooks. We entered this SeaPerch season with one year of experience under our belts, and this proved to be a huge advantage for us because we knew what the layout of the competition was going to be like, and what was expected of us when it came to things like our technical design report. Coming into the season our main goal was to qualify for Internationals, and our goal wouldn’t have been reached without the unbreakable teamwork and camaraderie that we have within our team. We are extremely grateful for the opportunity to participate and are optimistic for the future.

Clinton High School, Ocean Perch (408) | Clinton, Michigan, USA

Session 8 - Sat 9:30 AM

Our team’s ROV is unique from others in the competition for various reasons. One reason why it’s unique is because of our fully 3D-printed frame. We chose a 3D-printed frame because of the lighter weight and all of the choices for design you can have for your ROV. Another reason why our ROV is unique is because we have counter-rotating propellers that keep the torque the same on each motor so the ROV moves evenly forward or backward. Our third reason why our ROV is unique compared to others is because of our ROV’s custom controller. Even though it’s not technically a part of the ROV completely, we have built a custom controller to have an easier time controlling the thrust on the motors so they don’t run full speed at all times. This makes it easier for us to drive through the Mission Course and could also help us with the Obstacle Course because it would be easier to control compared to 100% or nothing on the regular controller.

Experimental School of Beihang University, Blue SeaPerch (022) | Beijing, China

Session 9 - Sat 9:30 AM

Our SeaPerch is unique and distinguished by its adaptability. It can not only complete complex tasks, but also has strong stability and can work in an underwater environment for a long time. This underwater robot stands out in the entire competition with its low cost and excellent performance.

Ideaventions Academy, Manatee (312) | Reston, Virginia, USA

Session 15 - Sat 1:30 PM

Our Remotely Operated Vehicle (ROV) is different from others because of its simplistic design. Originally we had made it very complicated and gave it many bells and whistles. We thought that these would help our design, but instead only hurt it. The net we had was too small to be practical and added too much extra weight. The servo was taking too long to implement, and it ended up rusting because it wasn't actually waterproof. After we realized this, we changed to having only one modification: a bar across the top for stability and for adding a hook. This made our ROV stand out because it is small, compact, and doesn't rely on complications. Instead, our strength is our teamwork and skill.

Ideaventions Academy, The Whale (314) | Reston, Virginia, USA

Session 18 - Sat 2:30 PM

Our Remotely Operated Vehicle (ROV) is named "The Whale." As the name suggests, it was made to resemble a whale by having an angled segment at its front, which makes it more hydrodynamic and maneuverable. The hook also simulates a claw arm which could be used in current underwater submersibles to be able to collect samples. For example, in the competition we had to move simulated rocks and collect samples with simulated sensors. To do this we used the hook. We also added mesh on the bottom of The Whale to allow it to be able to catch things if we weren't able to use the hook -- a backup measure which engineers often implement in actual machines.

IEEE Suez RegionE, RE.Marine3 (032) | Suez, Egypt

Session 10 - Sat 10:30 AM

Our team, RE.Marine3, has undertaken a project aimed at bridging real-world applications with our SeaPerch initiative to contribute to resolving environmental challenges. Our initial focus was on identifying local environmental issues that our Remotely Operated Vehicle (ROV) could potentially address. Egypt's strategic position includes the Suez Canal, a vital conduit in global commerce. Unfortunately, the canal grapples with a notable challenge: the accumulation of ship waste and oil spills, posing threats to marine ecosystems. In response, we conceived a pioneering solution—a robot designed to plunge into considerable depths beneath the water's surface, meticulously collecting accumulated debris both on the water's surface and seabed. This innovative robot boasts absorbent capabilities through the integration of specialized cellulose sponges, adept at selectively absorbing oils while leaving water unaffected. Following collection, the robot efficiently deposits the gathered waste and oils in designated disposal sites, ensuring responsible waste management practices. To enhance operational oversight and responsiveness, the robot remains tethered to a central control center, facilitating immediate notifications in case of operational anomalies. Furthermore, leveraging satellite connectivity, the robot aids in pinpointing and mapping areas afflicted by pollution and oil spills, enabling targeted intervention strategies. Through these integrated efforts, we aim to contribute meaningfully to environmental preservation and sustainability, aligning technological innovation with ecological stewardship on a global scale.

Lacey Township High School, Diplodocus Divers (207) | Lanoka Harbor, New Jersey, USA

Session 2 - Fri 2:00 PM

The "Claw" is a unique design function. We used additive manufacturing, our past SeaPerch experience, and our new-found knowledge from another year of advanced High School classes to create our 2024 design.

Lake Castle Slidell Private School, Heat Risers (507) | Slidell, Louisiana, USA

Session 6 - Fri 3:00 PM

The team employed the Engineering Design Process (EDP) to optimize decision-making throughout the ROV's design phase. A notable challenge encountered during assembly was ensuring stability. For instance, while affixing the motor rack to the ROV's base, it was observed that the propeller blades overlapped and interfered with each other due to the initial rack design. This necessitated a redesign of the rack, which in turn required recalibrating the center of gravity for the new configuration. One proposed design involved positioning the rack above the ROV base; however, this resulted in the top motor protruding above the waterline. After extensive trials to achieve equilibrium, it was determined that situating the rack beneath the ROV base allowed for adequate spacing of the motors without any part extending above the waterline. Another obstacle emerged during the construction of the ROV's base concerning our choice of sealant. The base design involved precisely cutting Polyvinyl Chloride (PVC) pipes to form a pentagonal structure. Despite initially using a sealant to bond the PVC segments, the joints failed. This prompted the search for a stronger adhesive solution, resulting in the selection of epoxy resin for its superior strength and lightweight properties.

Lake Castle Slidell Private School, Hydro Warriors (538) | Slidell, Louisiana, USA

Session 11 - Sat 10:30 AM

The team encountered problems that were slowing down the ROV (Remotely Operated Vehicle), a significant one being the up motor, which often froze or was too slow for what the team desired. The team had to switch out the motor on the ROV and test the motor many times before it functioned in the manner essential for the team's success. It was a challenge that required constant patience and perseverance to overcome, but the team worked long and hard to build an ROV that accomplished their goals. The team wanted to make their ROV unique yet practical, which is exactly what they did. The ROV is practical because it is light, has a hook to pick up the "rocks'on the mission course and can easily move in all directions thanks to well-placed motors. One unique feature of our ROV is its shape, a pentagonal frame, which improves the ROV's hydrodynamics. It is also small, which makes the obstacle and mission courses easier to maneuver and quicker to complete.

Los Fresnos High School, Falcons (707) | Los Fresnos, Texas, USA

Session 5 - Fri 3:00 PM

What makes our ROV unique compared to other designs is that of its nimble frame. We ensured that our ROV had both a hydrodynamic structure that allowed for it to swiftly navigate through the water, and a sturdy base to avoid flipping. With this, our ROV is considered lighter than that of the base design as we cut off unnecessary parts that would only weigh us down. In regard to the nose of the ROV, it is contractible so that we can adjust it according to the tasks of the course. Additionally, the wiring of the ROV was tightened down to the PVC using zip-ties to not only maintain a clean and appealing look, but also to avoid having wires get tangled with one another or possibly our motors. Lastly, we ensured that our ROV would maintain a positive buoyancy so that it can have a better time resurfacing and picking up objects with that assistance. With all these factors in mind, our ROV has shown effective results as compared to other designs, and we expect it to perform considerably well for this competition.

Manchester Township Middle School, Manchester Shorebot Lobsters (206) | Manchester, New Jersey, USA

Session 9 - Sat 9:30 AM

Our team made connections from our challenge to the real world by researching hydrothermal vents. Our challenge was creating an ROV that could explore hydrothermal vents in the ocean. To better prepare ourselves, we researched vents near the Galapagos Islands. We focused on aspects like temperature, depth, features, and what is needed on an ROV to explore the vents properly. Being able to connect our ROV and challenge to a real-world problem helped us better understand what we needed to do to excel in our competition.

Margaret Brent Elementary School, S.C.U.D (313) | Stafford, Virginia, USA

Session 7 - Sat 9:30 AM

Our team's ROV has a unique name because it is an acronym that stands for Self Contained Underwater Device. In fact, the Merriam Webster's Collegiate Dictionary defines scud as "the action of scudding: RUSH to move swiftly as if driven forward." A Scud is also a marine animal that looks like a shrimp and the female carries a bright orange egg sac, which became our team color. The ROV has four 24" concave bent insulation support rods resembling scud legs. There are orange painted forks where we bent the tines upwards to snag the objectives. There are four corks on the bow of the ROV for added floatation. Two additional plastic light hooks on either side of the forks gives us a bow full of grappling hooks. We have added port and starboard lights for navigation, dark black plasti dip on the motor thrusters for additional waterproofing and bright orange painted foam board gives us buoyancy. Reflective motor cradles made from aluminum keep the motors stable. Additional foam inside of the ROV ensures stability. The bobbers on the CAT cable provide the distance traveled and bright orange 0.95" plastic filament line attached to the CAT cable increases rigidness and prevents hindrance underwater. A Kort nozzle has been fitted around our vertical motor for increased marine propulsion and maneuverability during diving and surfacing of our ROV.

Mayport Coastal Sciences Middle School, Mayport Stingrays (728) | Atlantic Beach, Florida, USA

Session 12 - Sat 10:30 AM

The team will first discuss each team membe'rs roles and how they contributed to the team's success. They will then discuss their ROV's many features that make it extremely unique: 3D printed frame that provides versatility to quickly adjust buoyancy and an adjustable fin to compensate for any motor imbalance. Servo controlled gripper that enables the team to grab the temperature connector and position it at a 45-degree angle to easily place in the connector port. Improved motor waterproofing to reduce motor weight, size, and improve reliability. Improved cable sheathing with added cable buoyancy that eliminates cable kinking. A collapsible hook that innovatively and quickly transitions for the mission course or reduces the ROV's height for the obstacle course. Power Switching Controller (PSC) - the team's biggest innovation to date - will demonstrate how the team rewired a standard SeaPerch controller to add a DC step down converter and switch to provide the driver with the ability to have full power and RPMs or switch to six volts and reduce the RPMs for the more difficult mission course tasks. Additionally, the team will discuss what they learned as they tested a 4th motor for a booster motor on their initial open class design. Lastly, the team will describe their biggest challenges and most important lessons learned before opening it up to participants questions.

Mayport Coastal Sciences Middle School, The Strawfish Pirates (520) | Atlantic Beach, Florida, USA

Session 11 - Sat 10:30 AM

The presentation will cover each team member's specific role on the team. They will talk about what they do, their contribution to the team and how they work together to create a successful team. The Strawfish Pirates will detail what is so special about their underwater ROV. The team utilized 3-D printing technology to create their frame. With this innovation, they had the ability to create an unparalleled design that is lightweight, compact and versatile. Their Servo gripper is essential to the success of completing tasks, specifically, transporting the Temperature Sensor Connector and placing it to the 45-degree connector. Their Power Reducing Controller quickly reduces motor RPMs to slow the motor movements and enable the driver to easily complete the mission tasks. Lastly, the team will discuss their lessons learned and how they helped them succeed.

Mayport Middle School, Team Anglerfish (519) | Atlantic Beach, Florida, USA

Session 8 - Sat 9:30 AM

The presentation will cover each member's roles and how they help the team succeed. The team will then discuss their ROV's many unique features. Adaptable frame design: The team opted for a hollow Polyvinyl Chloride (PVC) pipe frame able to have buoyancy easily added or removed. It also allows motors to be quickly moved in position for adapting to each course's challenges. Ultralight design: The frame weighs very little to reduce buoyancy needed decreasing hydrodynamic drag. Adjustable buoyancy: Team Anglerfish uses plastic bottles with 3D printed caps that have screw on buoyancy for easy addition and removal. Variable Speed Controller: The controller for the ROV was improved with the addition of a switch which activates resistors to slow down the motors for a slow-motion effect. Innovative parts: All parts of the ROV are specifically designed to fold, rotate, or collapse to easier navigate the obstacle course. Lastly, the team intends to discuss their lessons learned and thank their many supporters.

Mixed: Grovetown School, Riverlands School, Springlands School, Correspondence School, BumbleBots (020) | Blenheim, Marlborough, New Zealand

Session 15 - Sat 1:30 PM

The 2023 New Zealand Aquabots Challenge theme included issues facing New Zealand and its underwater environment. One that is close to our team, because we live in Marlborough, is the loss of kelp forest in the Marlborough Sounds. Malborough has one fifth of New Zealand's coastline and is a rich marine ecosystem, partly dependent on kelp, New Zealand's version of a coral reef. In the Sounds, the loss of kelp is mainly due to the explosion of urchins, called kina in New Zealand, plus changes to water temperature and turbidity. Our team decided to use its ROV to find kina and kina barrens and to monitor kelp. The team attached a Go-Pro 12.0 and a Eyoyo camera with a cable to a surface screen to their utility-ROV, and after adjusting for buoyancy and center of gravity were able to capture high quality video footage of kelp forest and kina barrens. The main challenges were managing the tether and camera cable in sea conditions, the ROV didn't have enough power to be stable in currents and tides over 2 knots and we couldn't test the ROV deeper than 3m. Our next step is to build a prototype of a kina culling attachment that we can add to our ROV. As a team, we have decided that we would like to raise awareness of the kina barrens in the Marlborough Sounds by engaging with our local community. We are really proud that young children like us can make a real-world difference.

Mt. Ararat High School Science Club, Mt. Ararat Serpents (100) | Topsham, Maine, USA

Session 3 - Fri 2:00 PM

This ROV's design has several unique features to perform its tasks. The ROV is made out of PEX pipes rather than PVC pipes to increase the customizability of the ROV. The PEX pipe was heated and bent to create a curved frame to increase the speed and maneuverability of the ROV. The rear connector of the ROV is custom made through articulately cutting and shaping elbow connectors to create a unique three way intersection between the PEX piping. Sheathing on the ethernet cable helps keep the cable untwisted and free-flowing to assist the ROV's maneuverability. Other unique design features include custom made 3-D printed thruster mounts. Especially unique is the ROV's poker tool, made with a 3-D printer as well. The poker tool ends in a Y-shaped prong, making it more useful in picking up and returning the tools, rocks and taking the gas sample from the hydrothermal vent. Finally, the ROV has a special 3-D printed hoop to allow a large object into one side of the ROV's frame and out another side of the frame.

Noor Language School, Sovereigns (033) | Cairo, Egypt

Session 4 - Fri 3:00 PM

This Technical Design Report outlines the Engineering Design Process (EDP) employed by the team to construct a Remotely Operated Vehicle (ROV) and highlights its successful design features. ROVs are underwater robots controlled remotely from the surface via a tether to serve multiple purposes like deep-sea exploration, underwater inspections, and search and rescue missions. The SeaPerch International Competition includes an Obstacle Course testing maneuverability and a Mission Course simulating deep-sea exploration tasks around an underwater lab area. Our specific ROV offers several advantages. Its compact size allows for increased maneuverability and speed, while a hook attachment enables the transport of objects underwater. Balance is key in designing the Sovereigns' ROV, considering thrusters, buoyancy, and a sturdy frame to examine the challenging courses that influenced the team's Engineering Design approach. Adding pool noodles helped to evenly distribute weight throughout the ROV, which improved its balance and stability in the water. The frame is hollow to provide maximum thrust to mass ratio for peak ROV speed. Its perfect streamlined design allows it to break through the water easily as the surface area exposed to water is relatively small.

Parkview School, G.T.K (Good Tasting Kelp) (913) | El Monte, California, USA

Session 14 - Sat 1:30 PM

Our ROV is set apart from other models because our ROV's frame is flat and has several unique 3D printed modifications. Also, the ROV uses water bottles for buoyancy and that is because it is reliable and gives more control of how much buoyant force is wanted on one side. The bottles are great for the mission course and obstacle courses as we can change the buoyancy to the amount that we feel is best for that course. The ROV also has 3D printed caps on the front bottle and the motors to increase the hydrodynamics and to reduce drag. Another 3D printed item is the Q tip hook that is on the front of the ROV. The hook also has a key mechanic that allows the hook to be pushed through the PVC pipe to twist and lock into place. This mechanic also allows the hook to go all the way through the PVC pipe for times like the mission course. The ROV also has a flat frame that was made with a pointed tip to decrease drag and make the frame more hydrodynamic. We believe that our ROV has modifications that are not present in the other team's ROVs. The hydrodynamic caps have been done by other teams, but our Kort nozzle and Q tip hook with its keyhole design are things that separate us from the rest.

Rehobeth High School, Rehobeth High School NJROTC (536) | Dothan, Alabama, USA

Session 9 - Sat 9:30 AM

We have learned that shark attacks in America are a much bigger problem than most readily available statistics let on. We also understand that, in general, shark attacks are unintentional encounters for the shark. We believe our ROV concept can build on recent research and ultimately pave the way for a solution that preserves human life, as well as the coastal area tourist income that Florida depends on, while remaining conscientious of the need to also preserve local sea life. Our concept centers on using ROVs, positioned on the seaward side of the surf zone, to project naturally occurring oceanographic sounds both seaward and towards the surf zone as a deterrent for sharks to move into surfing and swimming areas well-known for shark bites. Since shark attacks commonly occur in the surf zone, we believe a mobile platform is necessary to ensure optimum positioning based on tidal variations. Since previous studies have shown that collection sources have been contacted by sharks in the past, we also feel it is prudent to avoid bringing human collectors into the immediate study area. We believe this concept, if proven effective, can later be used to assist in identifying the optimum placement of long-term implements in each area of interest. This is important to not only minimize costs on what could be a very expensive project, but also to ensure minimum disturbance of the aquatic environment.

Rice Robotics, PBJ (110) | Rochester, New York, USA

Session 13 - Sat 1:30 PM

The Green Crab is one of the most invasive species in New England. They have very few predators, are very aggressive when they hunt and eat their prey, and they damage the environment because they tear up the seagrass. They also over compete with the local wildlife in the area for food and habitats. It has been recorded that the Green Crab will also eat juvenile King Crabs as well as young salmon. Green Crabs also destroy eelgrass habitats that larval fish use to hide from predators. The first thing Team PB&J would do to our ROV is add a basket, net or trap. Doing that gives us the ability to drop capture and count Green Crabs safely. To be able to control the ROV we would have to increase the tether by quite a bit. We would also have to add a GoPro so we could see what we're doing when the ROV is submerged. Our presentation will demonstrate the need for counting and catching Green Crab in order to help the seacoast ecosystem. We would work in tandem with Nature Groupie as well as NOAA to research the population and help to collect data for fisherman hoping to use this abundant resource for food as well as helping the overpopulation that is affecting the seacoast region's natural resources.

Shadow Creek High School, Liopleurodons (713) | Pearland, Texas, USA

Session 1 - Fri 2:00 PM

In our 2024 SeaPerch mission, optimizing speed and maneuverability was our main goal. Through a collaborative effort, we extensively utilized 3D printing to enhance the design of our ROV, named Lio. Our approach involved designing and 3D printing components such as float and motor caps as well as lightweight connectors to address key challenges. The application of the Engineering Design Process (EDP) guided our iterative design process, allowing us to identify and overcome design flaws systematically. By addressing issues related to hydrodynamics, weight, and design, we achieved significant improvements in Lio's performance. The utilization of 3D printing not only provided practical solutions but also cultivated valuable skills applicable beyond the SeaPerch competition. Reflection on our design journey underscores the importance of the EDP steps in fostering innovation and continual improvement. Future endeavors will focus on further refining Lio's design and leveraging new design innovations for enhanced performance. As the Liopleurodons, our mission extends beyond SeaPerch. We aim to impart our knowledge of SeaPperch and engineering to the younger generations, igniting their passion for STEM and contributing positively to the world. We are confident that Lio exemplifies the pinnacle of ROV design, achieved through the Engineering Design Process and collaborative team effort.

Sonoran Science Academy - East, Golden Eagles (705) | Tucson, Arizona, USA

Session 2 - Fri 2:00 PM

What makes your ROV unique from others in the competition? Our SeaPerch ROV, The White Eagle, stands out in the competition with its unique design and capabilities. Representing Sonoran Science Academy - East from Tucson, Arizona, this is our team's inaugural year in the SeaPerch program. What sets our ROV apart is its resemblance to our school mascot, the eagle, reflected in its white color and streamlined design. Beyond aesthetics, The White Eagle boasts attachments capable of accomplishing most missions, showcasing its versatility and adaptability in various underwater tasks. Notably, our up-down thrusters are strategically positioned on top of the hook for stability when carrying or lifting objects, enhancing its functionality during competition challenges. Additionally, our team's approach emphasizes innovation and effectiveness, departing from conventional PVC designs to explore alternative materials and construction techniques. Leveraging the Engineering Design Process, we prioritized key elements such as sleekness, agility, and ease of reconfiguration, resulting in an ROV optimized for maneuverability and speed underwater. With a team comprised of enthusiastic and committed members, including younger students eager to learn and contribute, our biggest takeaway this season is embracing the learning experience and starting fresh. As we embark on our SeaPerch journey, The White Eagle symbolizes our dedication to excellence and innovation in underwater robotics, poised to make a mark in the 2024 SeaPerch competition.

STEMA Center Development and Training Center, SeaDivers (028) | Dubai, United Arab Emirates

Session 7 - Sat 9:30 AM

We, as a team of students, are excited to announce our community service project using the SeaDivers' ROV in partnership with non-profit organizations and community centers in Dubai. Our project aims to offer free pool cleaning services and swimming lessons to benefit the community. We will begin by testing the mechanical design of our ROV to ensure its effectiveness in pool cleaning and assisting with swimming activities. Once our testing is complete, we plan to offer our services to organizations in need, providing them with a valuable resource for maintaining clean and safe pool environments. Through this project, we hope to make a positive impact in our community by utilizing our robotics skills to benefit others. We are committed to serving our community and look forward to the opportunity to contribute in a meaningful way.

The Aerospace City School of RDFZ, HangHang (024) | Beijing, China

Session 3 - Fri 2:00 PM

The theme of World Environment Day on 5 June 2023 is Beat Plastic Pollution. About 8 million tons of large plastics and 15,000 tons of primary microplastics enter the ocean every year. Microplastics are a new type of environmental pollutant, which refers to plastic particles with a particle size of less than 5mm. Microplastics have spread into the human food chain. There are a considerable number of microplastics in both the ocean and inland waters, so our ROV was equipped with a camera and pumping sampling devices to observe the distribution of large plastics in different sections of the rivers in the upper, middle and lower reaches of the river near the living basin through the cameras, and at the same time carry out pumping sampling, which is handed over to the Chinese Academy of Environmental Sciences for water analysis to analyze the types, concentrations, and sources of microplastics. At the same time, students went to Tianjin, Qinhuangdao, Dalian to conduct water sampling and analysis. We will also publicize the results in schools, communities, streets, so that people can realize the crisis of plastic pollution, reduce the consumption and use of plastic products, and consciously live a green and low-carbon life.

The Piney Woods School, Archimedes (522) | Piney Woods, Mississippi, USA

Session 16 - Sat 2:30 PM

Our ROV may have a basic utility vehicle appearance, but its reliable control and smooth agility during obstacle navigation stem from a strategic combination of design elements. The placement of foams and the retractable hook work together to ensure optimal performance. The foams optimize buoyancy and stability, allowing the ROV to maintain a steady course. The retractable hook provides a reliable anchor point, enhancing control and adaptability. Embracing simplicity eliminates potential points of failure and enhances ease of use and maintenance. Our streamlined design emphasizes reliability and efficient maneuvering through obstacles. In conclusion, the strategic placement of foams and the integration of a retractable hook enable our ROV to excel in obstacle navigation, showcasing the effectiveness of simplicity in achieving exceptional results.

U.S Naval Sea Cadet Corps, Yellowjackets (923) | Rancho Cucamonga, California, USA

Session 1 - Fri 2:00 PM

Innovative enhancements have transformed the POV's performance underwater. By switching to 3D-printed parts, we achieved an impressive 86% reduction in mass, leading to improved speed and maneuverability. The incorporation of hooks underneath the ROV not only enabled efficient ball pickup and door opening but also enhanced its overall functionality. Utilizing bright-colored filaments enhanced underwater visibility, crucial for effective guidance in murky conditions. Additionally, enhancing the control cable's flexibility and waterproofing the motors further optimized maneuverability, control, and longevity in aquatic environments. These modifications collectively set our SeaPerch apart with enhanced capabilities and efficiency.

U.S. Naval Sea Cadet Corps, Team Seals (919) | Walnut, California, USA

Session 6 - Fri 3:00 PM

Our plan for our design was to build two ROVs, Prototype A and Prototype B. Prototype A's purpose was to help establish a baseline and ROV performance data. Prototype B was the final design. The first iteration of Prototype B had 20% less length and width than Prototype A. These special modifications led to Prototype B being faster and more agile in the water. Prototype B has four unique design elements: Hook - Aluminum hook placed at center of gravity to help balance the ROV when picking up items. Floatie Placement - Floaties were placed inside the ROV pipes to reduce drag. Size reduction - Our ROV had a 20% reduced length and width pipe measurements off the stock utility ROV. The reduced surface area helped reduce drag. Liquid insulated motors - Reduced the cross section of the motor and ultimately reduces drag. The main things that we learned were mostly relating to Issac Newton's laws of physics, such as inertia and mass. We also learned about EDP framework and developed engineering skills that helped us throughout our ROV design, build, testing and validation of our design. For example, we drew designs, soldered, waterproofed motors, ran ROV tests, captured and analyzed test results. However, the most important things we learned are teamwork, team member roles and responsibilities, and that communication between the linesman and the driver is the key to success. We look forward to improving our engineering and design skills next year.

Union Grove High School, SpeedPerch (416) | Union Grove, Wisconsin, USA

Session 17 - Sat 2:30 PM

Our unique ROV is a modified utility ROV with a shrunken frame, forward-mounted motors, Kort nozzles, and a stripped CAT-5 wire. The combination of these elements resulted in an extremely fast and maneuverable vehicle. Forward-mounted motors give greater leverage when turning, Kort nozzles offer protection/speed, and the stripped CAT-5 wire results in greater acceleration and reduces overall drag. The most unique part of the ROV are the Kort nozzles. This ring-like structure around our propellers acts like an underwater wing, accelerating water through the propeller. This is not the only benefit of the Kort nozzles. They also reduce the potential for cavitation, and reduce the amount of turbulence experienced by the propeller. By placing the motors on the front of the ROV, the ROV gains greater maneuverability because motors are closer to the center of gravity of the vehicle. This reduces the amount of distance needed to travel for the ROV to turn.

Union Grove High School, The Wave Sharks (415) | Union Grove, Wisconsin, USA

Session 16 - Sat 2:30 PM

Our ROV's frame is pretty much just a box. Although it is not necessarily the most dynamic, our main goal was for it to be extremely maneuverable and drive quickly. We had to switch up our motor placement and experiment with it. There were quite a few larger ROVs at the competition, but we tried to make ours pretty compact so that it was lighter and easier to get through the obstacle course. We had access to multiple 3-D printers that allowed us to experiment with different designs for the hook and motor housings. Our hook has two prongs but we made it with curved notches in which the rope is able to sit while it carries the different objects to wherever they need to go. We had to change our motor housing design a few times in order to retain as much power output from the motors as possible. We moved our ROV's up/down motor closer to the hook in order to make it easier to pick up heavier objects. Our ROV was made by testing and redesigning accordingly from our results.

Unity Junior High School, Phoenix (405) | Cicero, Illinois, USA

Session 7 - Sat 9:30 AM

Our ROV was designed to navigate hydrothermal vents. Our goal was to make it faster by making it lighter, smaller, and hydrodynamic. We designed four different ROV prototypes to experiment with size, shape, and PVC type, and used knowledge gained to build our final ROV. The first iteration, Picasso, was a shoe-shape design with space on top so buoyancy material didn't interfere with the up/down propeller. Second iteration, Berty, was a mini utility ROV because utility frames are stable and move consistently. Third ROV, Kevin, was a trapezoid base with top handle, aerodynamic from both the front and top, to go forward and upward faster and through hoops smoothly. Our fourth ROV, Stuart, was an experimental lightweight design built by bending PVC instead of using connectors. We used ¼ inch PVC pipe due to it being 3.4g less per inch. We made one set of waterproof motors to attach to each frame for quick testing, so we printed 3D motor holders. Final ROV, Bob, is small and lightweight because we used ¼ inch PVC pipe. Its balanced, hydrodynamic utility design has good places for a hook, motors, strain relief, and buoyancy. Strain relief prevents damage to the tether if pulled, and a thin, straight pegboard hook with a curved tip and rubber grip picks up props. We weighed each ROV's mass, collected data on forward driving speeds, and concluded that Bob had the fastest velocity and second-lightest weight. Future improvements might include different buoyancy or new shape.

Unity Junior High School, Poseidon (406) | Cicero, Illinois, USA

Session 9 - Sat 9:30 AM

Our ROV is designed to imitate actions an ROV would take on hydrothermal vent exploration expeditions. It will traverse an obstacle course consisting of a series of hoops in different orientations. It will also complete a mission course that includes collecting and transporting various objects. We built several ROV prototypes with the goal of completing these tasks quickly. Our first design, Trident, had six motors to grant it more speed and to tilt it. Its cube-shaped frame was taller to fit parallel motor positions with 3D printed motor holders. We tried several variants of connecting the motors to circuit boards and decided on two control boxes glued together. Bottom toggle switches control the vertical motors while top toggle switches control the horizontal motors. The tether was changed to two four-conductor security cables to wire the parallel motors, and an aerospace terminal block allowed us to repair wires if necessary. Testing for speed led us to our final design, Leviathan, which has three motors and is designed to be smaller and weigh less. It is a utility frame with a simple hook to collect and transport materials. The hook is thin to grab the ropeless ball and is in front to carry objects easier. Strain relief in the back of the ROV protects the wires from tearing apart from the motors. We concluded Leviathan was fast, more stable, and easier to control compared to Trident. Our past experiences contributed to improvements of the modified ROV.

Unity Reed High School, Sea Lions (303) | Manassas, Virginia, USA

Session 11 - Sat 10:30 AM

Since this was our first year, this season was very eventful and gave us many different challenges, many of which we were able to solve through collaborative effort. The main issue that we ran into was that our ROV had many weight imbalances between the main body and the buoys, causing the ROV to be very front heavy and difficult to maneuver at times. Our strong point, the classroom challenge, was a great success. We were able present our work interactively with the judges which helped us score enough points to qualify for Internationals. We think that we can provide a positive and passionate message to future STEM students about the SeaPerch program. It is an innovative approach to STEM learning that we want so many more people to know about.

US Naval Sea Cadets, The Otters (924) | Pomona, California, USA

Session 15 - Sat 1:30 PM

Our SeaPerch design is unique because of its simplicity. It is engineered and constructed of PVC pipe and fittings. Our final iteration incorporates specific features which enhances speed for the obstacle course and maneuverability for the mission course objectives. To increase speed, we reduced the overall size, optimizing Newton's Laws of Motion. Using vibrant colored 3D printed parts enhanced the vehicle's visibility. Being easier to see the vehicle helped us maneuver and complete the mission course.

West Mesa High School, WMHS 2-4 (715) | Albuquerque, New Mexico, USA

Session 6 - Fri 3:00 PM

The team Cobalt ROV brings several unique design choices to the table at the 2024 International SeaPerch Challenge. To start us off, our chassis was designed and cut out of ⅛ inch acrylic sheets, a unique choice that provided a sleek profile and a lightweight material. Composing the ROV of this material was a challenge that became well worth it in the end, because of the properties of the chassis. Using our school's Epilog CNC laser cutter, our team could easily implement design choices into the chassis that would overall benefit our progress. Another interesting decision to improve our ROV's maneuverability and stability was our choice of medical syringes for buoyancy. Other common buoyancy methods that are most likely present in this competition include pool noodles, packing material, insulation material, and other foam materials. Our team believes that these methods are somewhat prehistoric and messy. Our use of medical syringes not only provides a more hydrodynamic profile, but an extremely adjustable source of buoyancy which we could tune into perfection through testing. Our final design choice that makes our ROV unique is our hook. Our hook features a "bird beak" design that we believe brings something new to the table. This design can easily grab and hold onto all of the necessary objects, some of which are extremely difficult to complete.

West Mesa High School, WMHS 3-2 (714) | Albuquerque, New Mexico, USA

Session 4 - Fri 3:00 PM

Our initial design was functional enabling us to win the 2024 Regional Southwest SeaPerch Challenge in the Stock Category. We wanted a good center of balance while having vertical thrust in the center assisting with lifting objects, yet small enough to be fast and maneuverable. It was heavy and slow in picking up the mission course objects due to the structure being made of Polyvinyl Chloride (PVC). When we were informed we would be selected to participate in the 2024 International SeaPerch Challenge we knew we needed to make significant engineering changes due to the sheer nature of competition. Changes included reducing weight by utilizing Chlorinated Polyvinyl Chloride (CPVC) pipe and fittings, reducing the SeaPerch's drag profile while keeping the same functional design just smaller and compact. Utilizing CPVC vs PVC we reduced weight dramatically by 220 grams. We reduced our drag profile by running the motor wires within the structure and then inserting foam backing inside the top of the structure while molding construction insulation on the outside of the structure for buoyancy and balance. Our SeaPerch was then painted, further reducing drag. To prevent a single point failure and quickly change out motors, we utilized quick disconnects and 3-D printed shroud covers. To prevent the fouling of our propellers, our tool was cut from acrylic plastic utilizing a laser cutter from our STEM lab. We hope to be competitive and give other teams competition!

Zeta Phi Beta Sorority Incorporated - Sigma Kappa Zeta (SKZ) Archonette Youth Group, SKZ Archonette Youth Group (009) | Brooklyn, New York, USA

Session 8 - Sat 9:30 AM

The key component of the exercise was to get the ROV to go through the obstacle course with flexibility and accuracy. As a beginner team, we chose the design that was simplified and provided each group member with a task that best matched their learning style. We also quickly learned that collaboration and great communication skills would be very important in our group dynamics. As we navigated the rigor and technical skills needed to complete the ROV, remotely operated vehicle or an aquatic robot as it is also called, we used our problem solving skills to think through difficult spots. The SeaPerch competition key points allowed us to use our inquiry-based critical thinking skills while making real world connections and engineering challenges in the field of robotics. As documented in our observations, task overview, design approach , experimental results, reflection/next steps, acknowledgements, and references, our journey to a workable ROV was engaging and insightful. Our paper will highlight the highs and lows as well as the bumps and bruises that were felt as we navigated and explored while using our imagination and creativity with our ROV.