ODTÜ
METU

METU MECH NAUTRONICS

2025 Catalog

Who are we?

METU MECH Nautronics is an innovative student team founded by METU students in 2024, focused on autonomous driving and submarine technologies.

Composed of a dynamic team of 25 members, our group operates with an interdisciplinary approach, consisting of six distinct sub-teams. These sub-teams combine their knowledge and skills to create creative and unique solutions to technological challenges. As METU MECH Nautronics, our goal is to develop impactful projects at both academic and industrial levels, by integrating various engineering disciplines with our approach.

Our Team Structure

Mechanical

Design, Manufacturing, and Analysis

Responsible for the entire physical design of the vehicle, simulation of the designed parts, and their manufacturing.

Software

Responsible for designing, developing, and optimizing the relevant software for the task flow of the vehicle.

Electronics

Responsible for selecting the vehicle's electronic hardware, assembling it, and conducting tests.

Marketing and Finance

Manages sponsorships, media, and finances. Additionally, is responsible for designing and preparing the visual and physical elements required for team promotion.

Team Captain

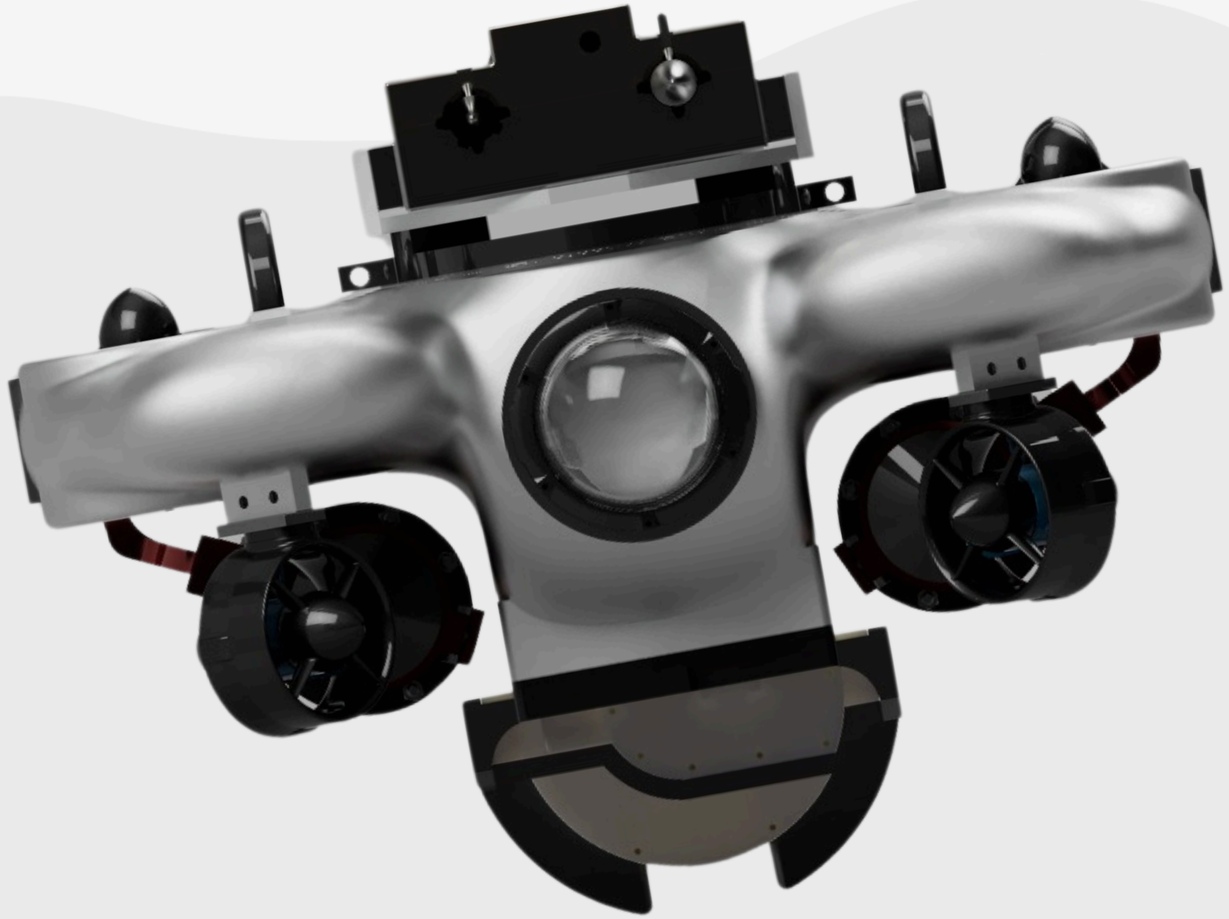
Enes Öztürk

Department of Mechanical Engineering - 4th Year

Academic Advisor

Prof. Erhan İlhan Konukseven, PhD

METU Department of Mechanical Engineering



MECHANICAL DESIGN

As the Nautronics Design Team, we take charge of the design process of our projects and prepare technical drawings using CAD software. By following the project design phases, we carefully manage the research and development processes, bringing our ideas to production-ready solutions with innovative approaches.

Used Software

AUTODESK® FUSION 360™

nTop

GeoGebra

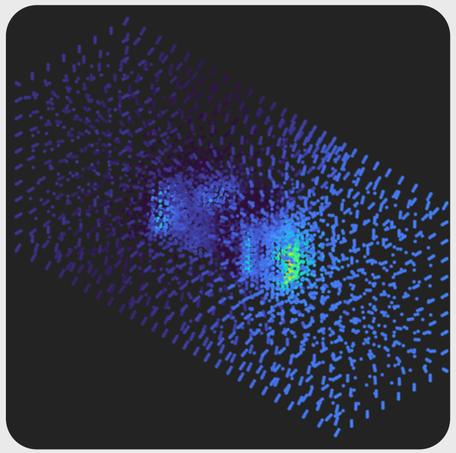
Modular, Optimized & Elegant

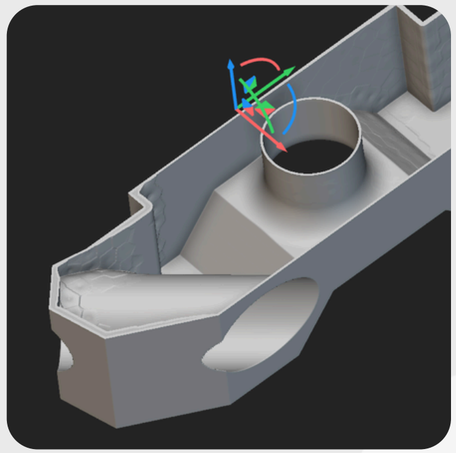
Shell

The vehicle's shell is shaped based on inspiration from stingrays and sharks, featuring an exterior form that supports fluid movement underwater. Using the Flow Topology Optimization result in nTopology, the shell will be produced with variable thickness, designed to protect the electronic components from external factors. To optimize the camera's field of view, transparent semi-circular cavities are integrated into the shell.

AUTODESK® FUSION 360™

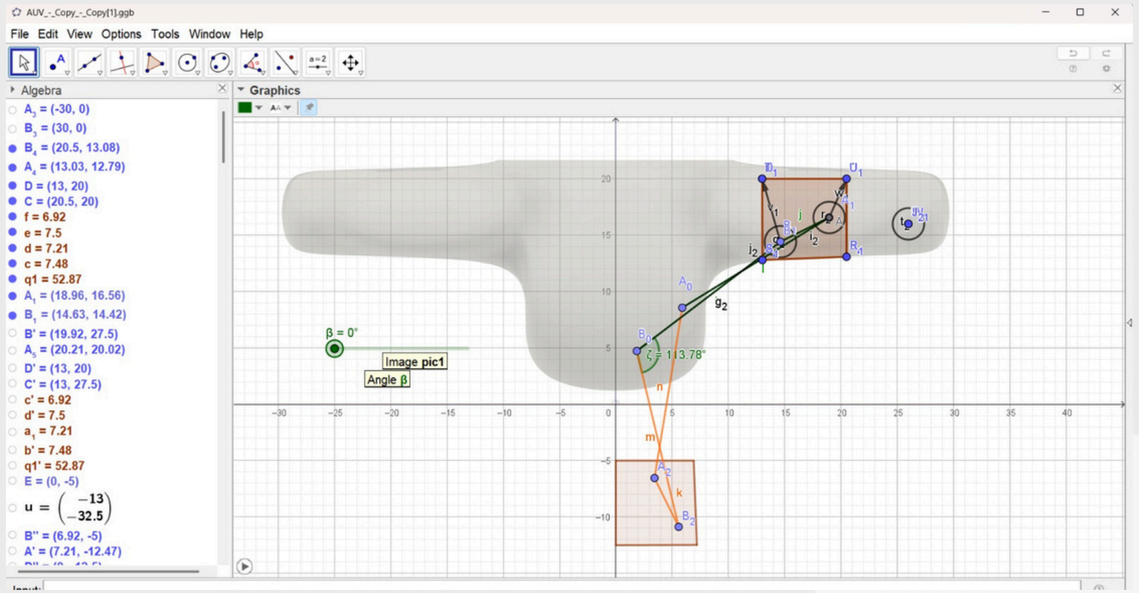
nTop

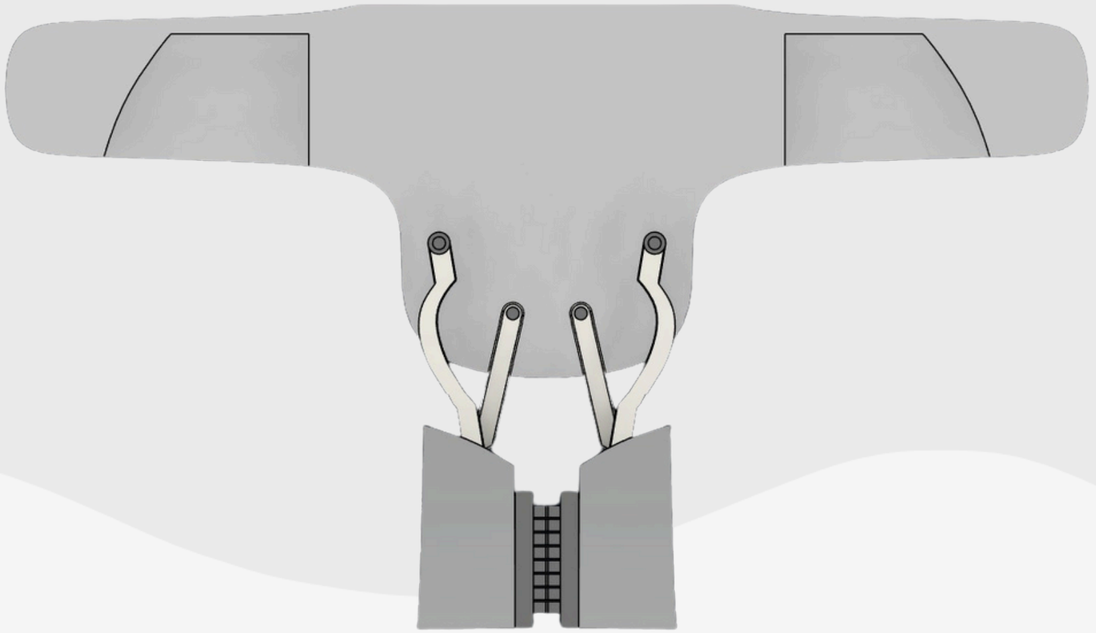




Grabber

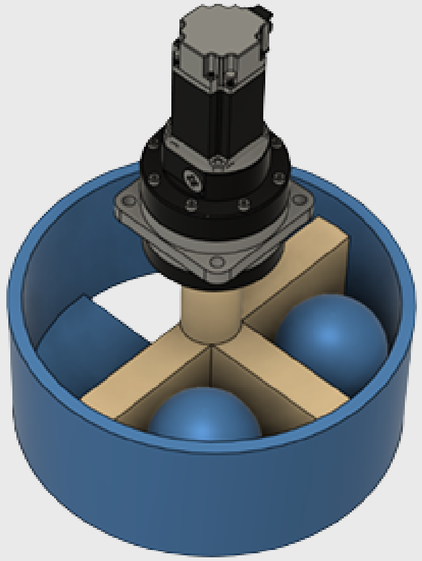
The vehicle's grabber mechanism will be optimized using the kinematic synthesis method to provide movement capabilities suited to the task requirements. During this process, calculations will be made using Excel, and visual analyses will be performed using GeoGebra. The arms of the designed mechanism will be shaped according to lightweight, strength, and manufacturability criteria through topology optimization. The grabber head features a pin-based structure, designed to adapt to and grip the shape of the object.

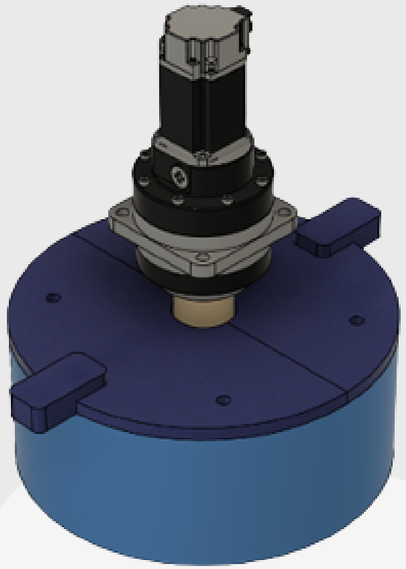


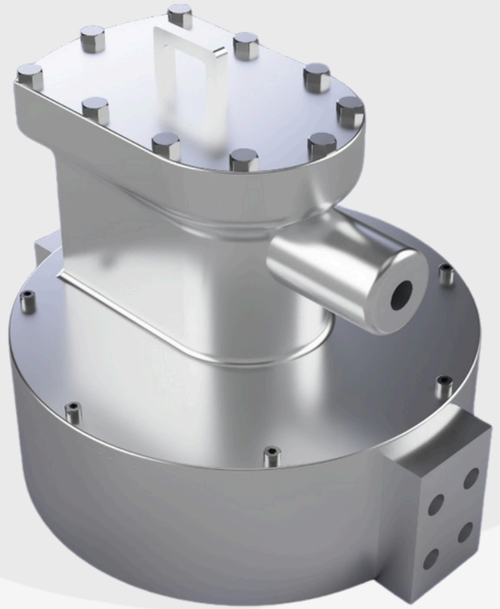


Mark Dropper

The marker dropper system is a compact and efficient solution developed to perform reliable and controlled tasks underwater. Its rotating mechanism ensures that markers are dropped in sequence and accurately, thereby enhancing task precision. The internal layout of the system saves space while maintaining waterproofing. The balance achieved between mechanical simplicity and task performance has made this system a reliable and functional component in the competition environment.



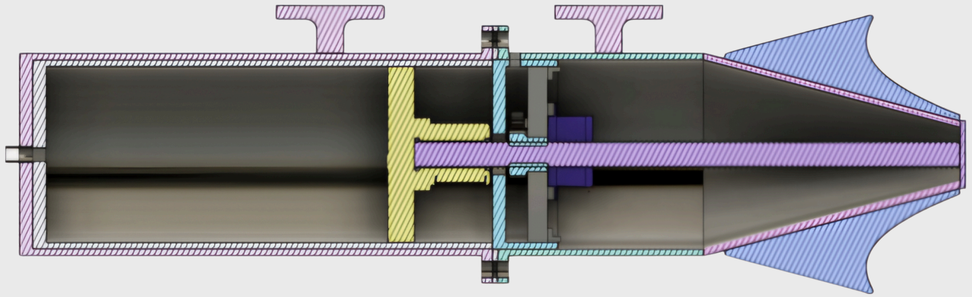


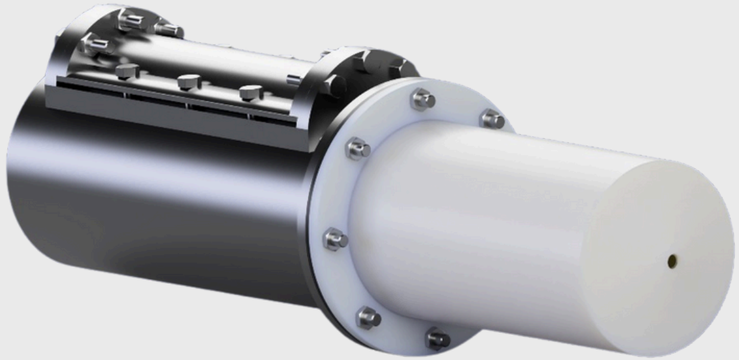


Sinking and Floating System

The sinking and floating operations of the vehicle are managed by a dual-chamber ballast system with a piston-cylinder structure. The movement of the pistons allows water to be taken into or expelled from the chambers, enabling the vehicle to dive or rise in a controlled manner. With its compact and balanced layout, the system enhances the vehicle's stability while providing efficiency in terms of volume and weight. The sealed outer shell protects the internal mechanism from environmental effects. The new design eliminates the complex control and filling issues of the previous system, offering a more reliable and effective solution.

AUTODESK® FUSION 360™

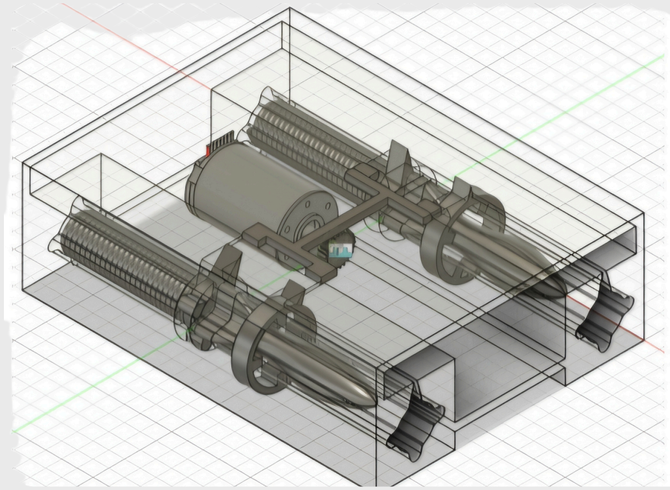


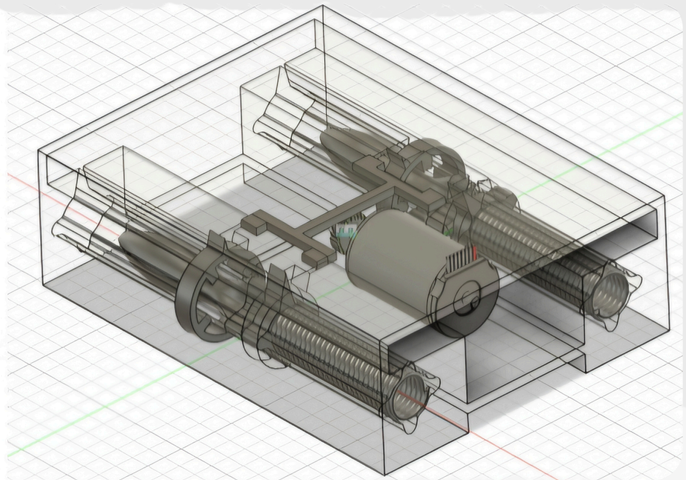


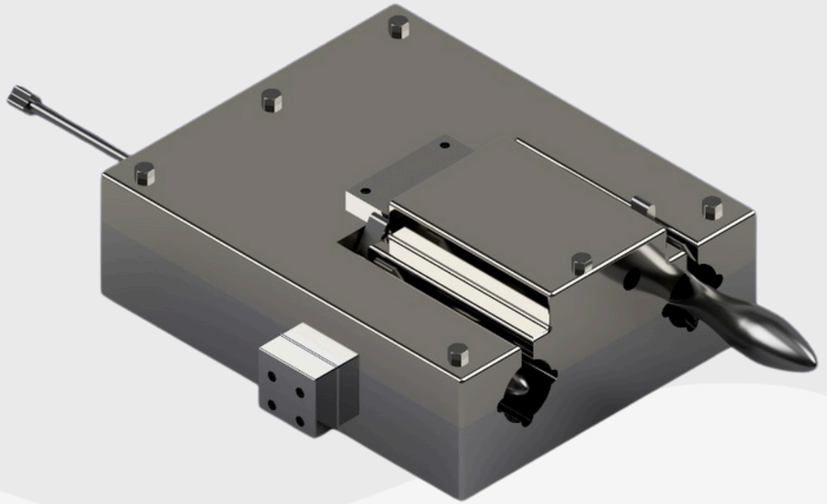
Torpedo System

The vehicle uses a compact and simple torpedo system designed for underwater conditions. This system is reliable and capable of performing its task without the need for complex electronic or pneumatic solutions. With a spring-driven launching mechanism and a stepper motor-controlled hatch system, both space and weight are optimized. The projectiles are designed with hydrodynamic properties to support balanced movement in water, and rotational motion is prevented by rails. The launching mechanism utilizes the energy generated by the spring to safely launch the projectile when the hatch system opens. The system can be quickly reset for a second shot. This ensures that the torpedo system provides effective, repeatable, and smooth performance during the mission.

AUTODESK®
FUSION 360™

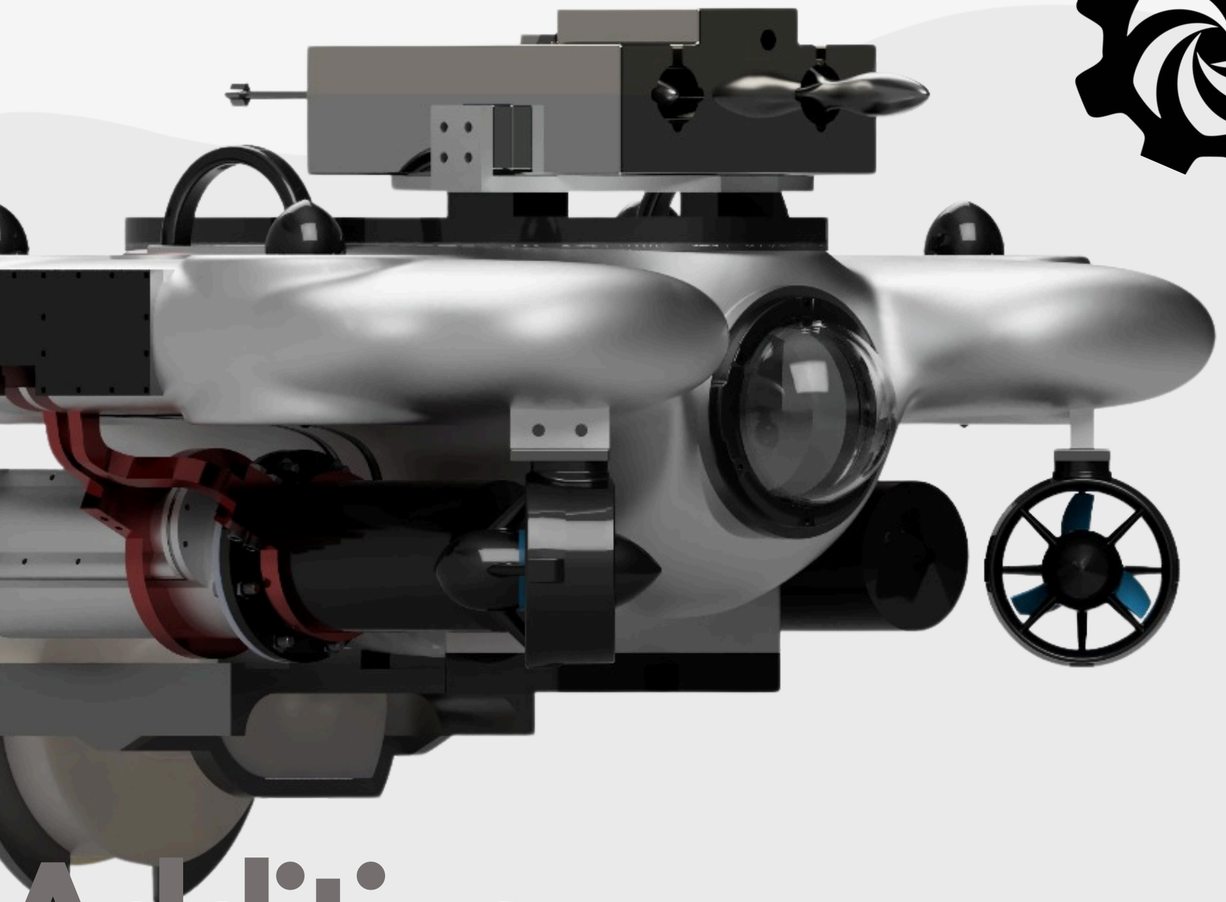






MECHANICAL

MANUFACTURING



Additive, Modular & Aesthetic

As the Nautronics Manufacturing Team, we are responsible for all the component production processes of our underwater vehicle. We meticulously handle material selection, production methods, quality control, and the production planning steps. Through prototyping and pre-production tests, we strengthen our steps before the actual manufacturing process.

Used Programs

materialise
innovators you can count on

cura.

Shell

Our manufacturing team uses Selective Laser Melting (SLM) additive manufacturing technology for the production of the vehicle's shell, as its structure needs to be complex and watertight. This method allows the production of parts with complex geometries while ensuring strength and weight optimization. To enhance long-term durability under underwater conditions and prevent biofouling, special protective coatings will be applied to the surfaces to guard against marine organisms. Throughout the production process, quality control, compliance testing, and surface treatments are carried out with great precision.

Grabber, Sinking & Torpedo

The dropper, gripper, and torpedo systems will be manufactured using the FDM (Fused Deposition Modeling) method due to their simpler structure and faster manufacturability. Special water-repellent filaments will be used in these parts to prevent water absorption and enhance resistance to marine environments. After production, post-process treatments will be applied to improve surface quality and increase waterproofing. This process allows for the creation of functional and durable parts while maintaining cost-effectiveness.

MECHANICAL ANALYSIS

As the Nautronics Analysis Team, we perform the analysis and simulations of the designed parts. We share the data we obtain through technical reports, supporting the decision-making processes of other teams. In this process, we use engineering software such as Ansys, MSC, Hexagon, and NX Siemens.

Used Programs

MSC Software

HEXAGON

Ansys

SIEMENS NX

Certified, Secure & Efficient

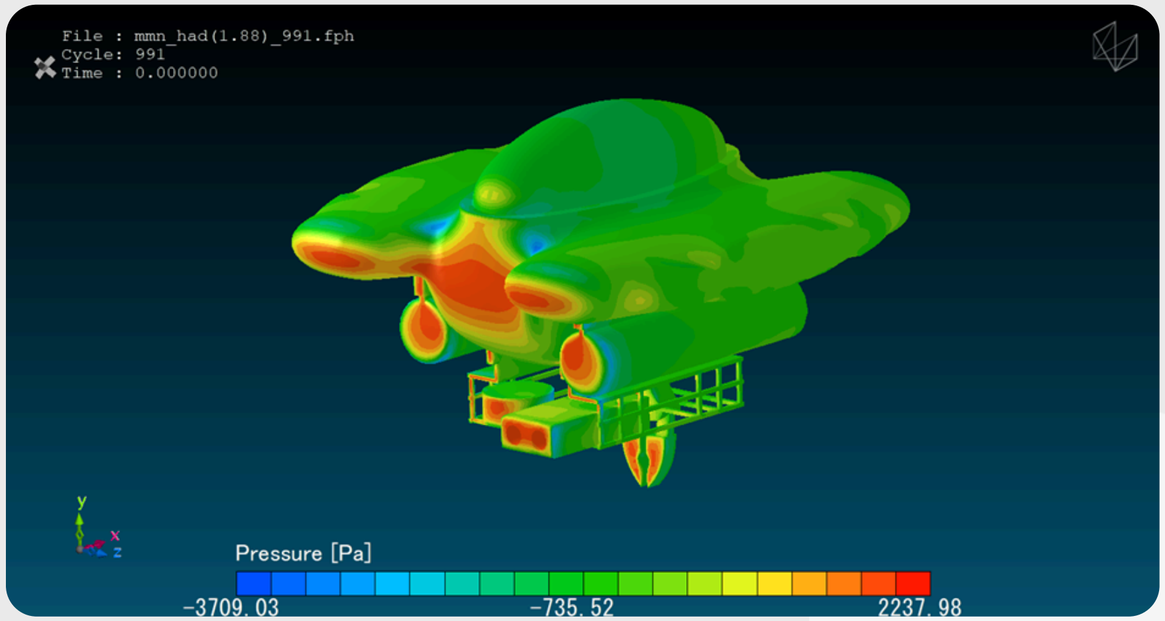
Entire Vehicle

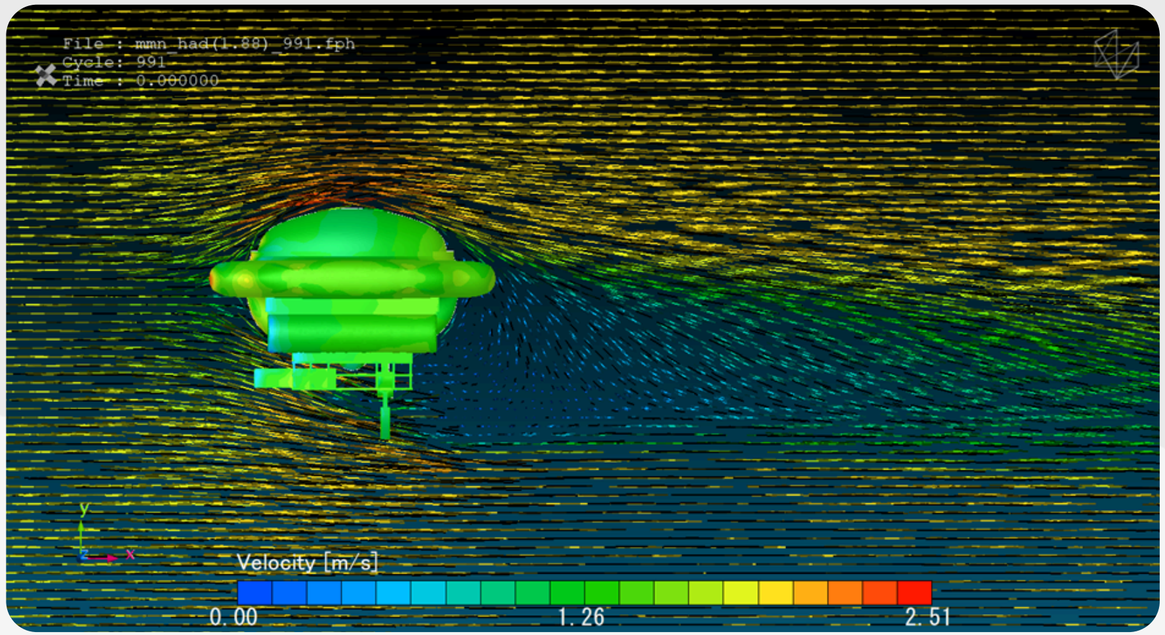
As the Nautronics Analysis Team, we conduct comprehensive engineering analyses to enhance the vehicle's performance and ensure its structural integrity. Through static, fluid, and thermal analyses conducted on the designed parts, we evaluate the system's behavior under environmental conditions. Using the pressure data field obtained during this process, topology optimization for the outer shell is performed to achieve a lightweight and durable structure. Additionally, the thrust force requirements, which determine the vehicle's mobility, are calculated through analyses. We utilize advanced engineering software such as ANSYS, MSC, Hexagon, and NX Siemens in our work, and the results are shared with other teams through technical reports.

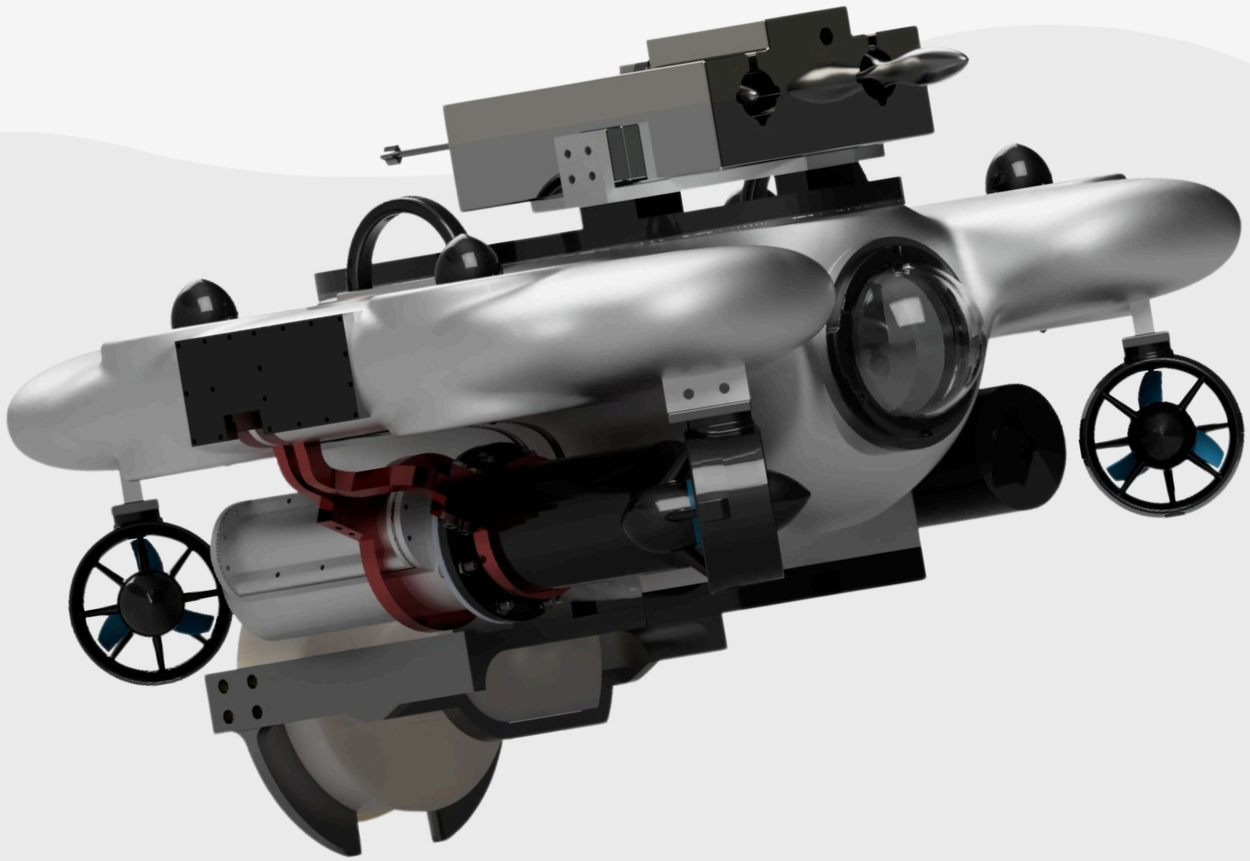
MSC Software

Ansys

nTop







ELECTRONICS

As the Electronics Sub-team, we are responsible for the hardware development processes of our vehicle. We handle component selection, assembly, communication, and power management. As an electronics sub-team, we work to find the most cost-effective and efficient solution possible.

Used Programs

MATLAB SIMULINK

LTspice

ARDUINO

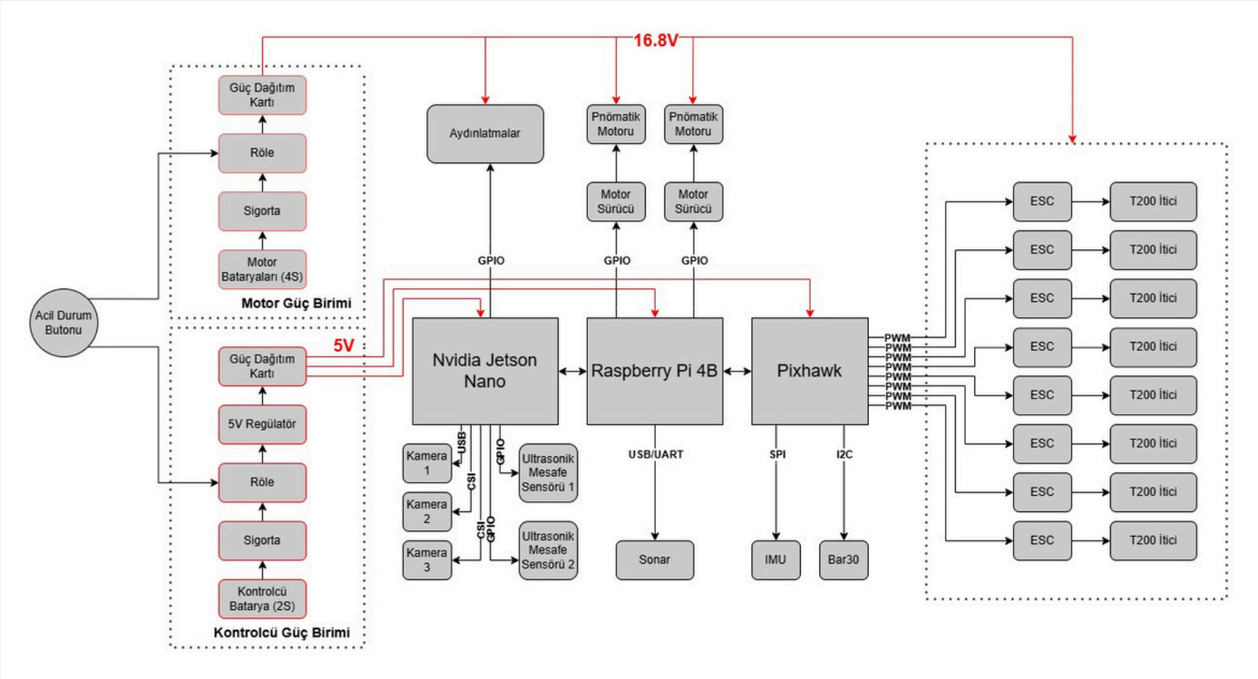
KiCad

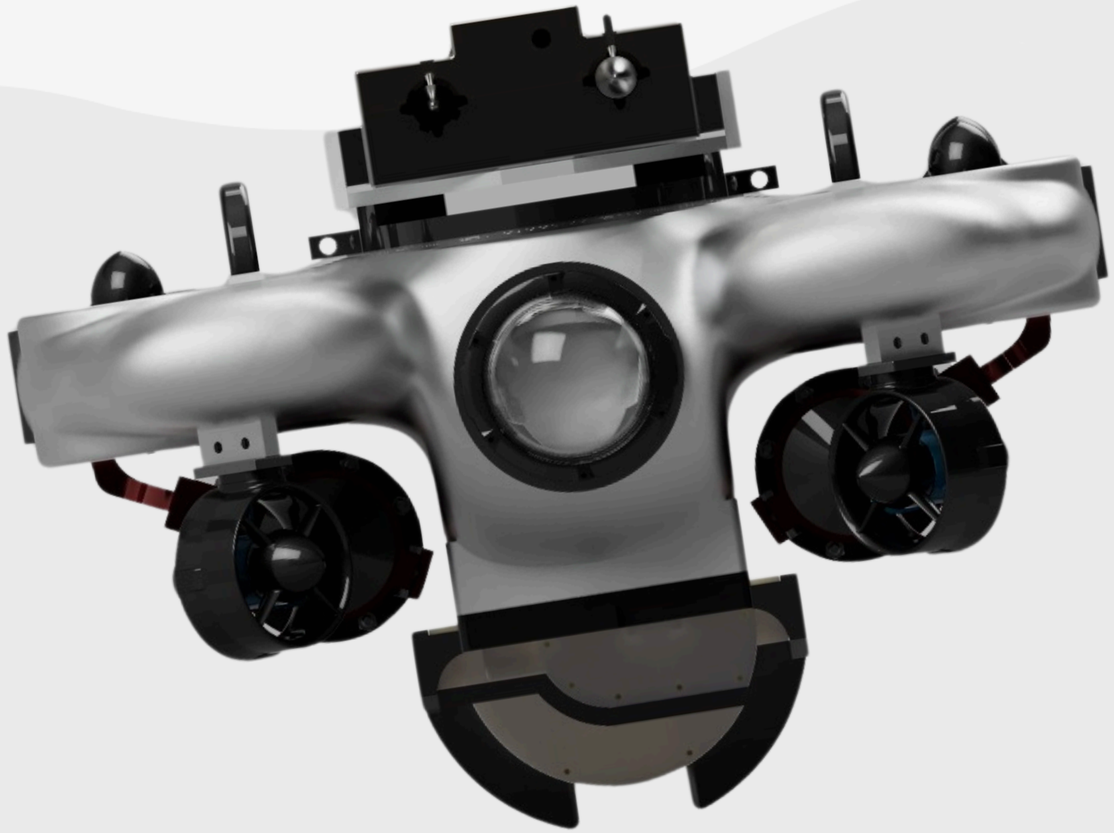
Safe, Precise & Stable

Our Electronic Infrastructure

The electronic system of our vehicle has been designed with a focus on safety, cost, and ease of manufacturing. Critical components for the vehicle were selected from the best available options within our budget. For other components, more economical and, where possible, domestic solutions were sought. Since our vehicle needs to compete in two different competitions, our design meets the requirements of both events. The propulsion, gripper, dropper, torpedo launcher, and pneumatic system will be powered by two Tattu 4s 10000mAh batteries. A single Gens ace G-Tech 2s 5000mAh battery will power the controller boards. To easily monitor the vehicle's voltage and current values, and to provide extra security in case of a short circuit, a single Sky-Drones SmartAP PDB will distribute power to the high-power consuming components.

The power for the sensitive components of the vehicle will be supplied by buck converters, and all components will be protected with appropriate fuses. The vehicle will also be protected in emergencies through an emergency circuit we designed. Additionally, leak sensors will be installed, and in the event of a leak, the vehicle will surface and trigger power relays to protect the electronic components.





SOFTWARE

As the software sub-team, our goal is to ensure that our vehicle performs all required tasks autonomously with high accuracy. To achieve this, we are working on control systems, algorithms, system integration, and artificial intelligence.

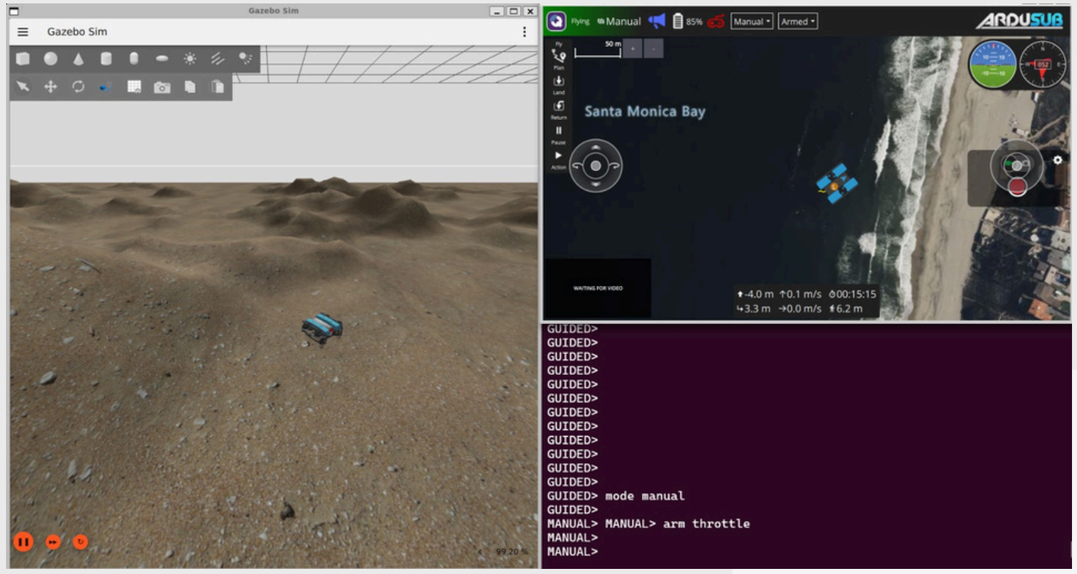
Used Programs

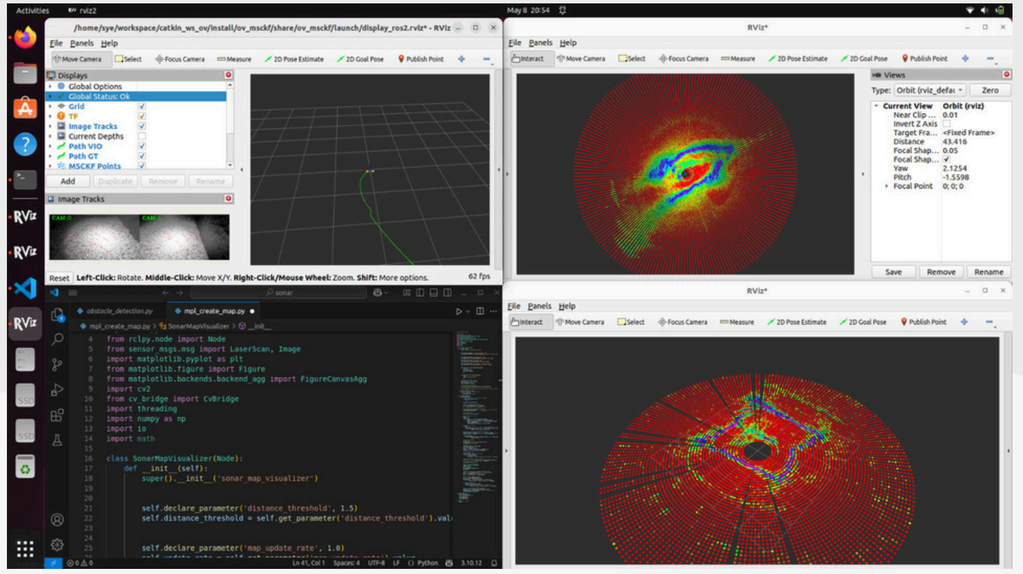
ubuntu · GAZEBO · OpenCV · ROS 2™ · git · docker · python™ · ultralytics YOLOv8

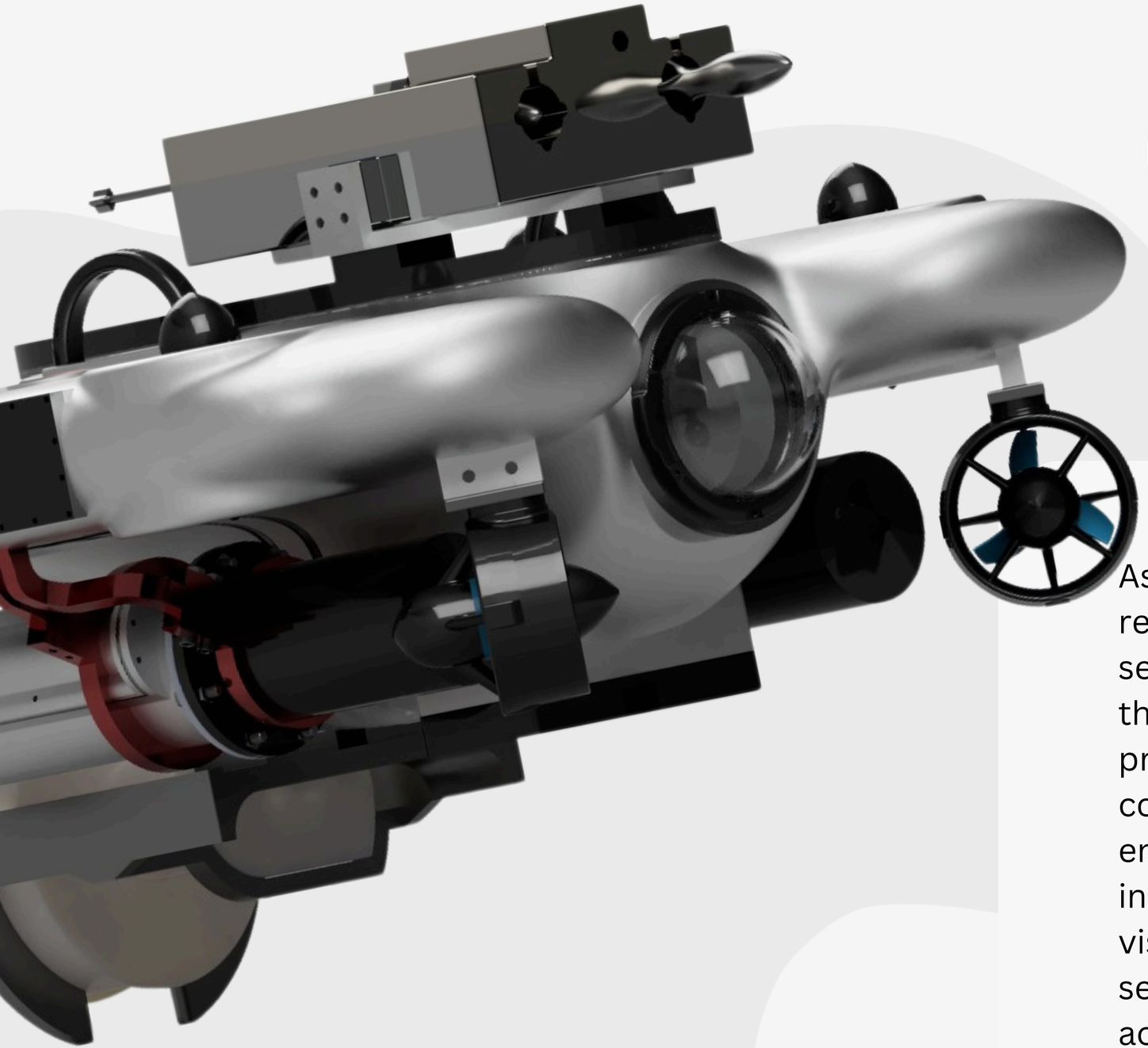
Stable, Optimized & Adaptable

Our Software Infrastructure

Underwater defense technology is a crucial component in both military and strategic terms. However, the slow development of this field can be attributed to the high cost and inefficiency of underwater navigation systems. In our project, we aimed to provide a low-cost and practical solution to the navigation problem of autonomous underwater vehicles. Visual Inertial Odometry (VIO) is a navigation system that combines camera and IMU data to make high-accuracy position estimations. Although it is commonly used in autonomous vehicles and has a high success rate, it is almost nonexistent underwater. The reasons for this include the lack of distinctive features, blurriness caused by particles, and insufficient light. Necessary optimizations and specific enhancements have been applied to overcome these challenges, enabling the use of visual inertial odometry systems underwater and ensuring accurate data.







MARKETING AND FINANCE

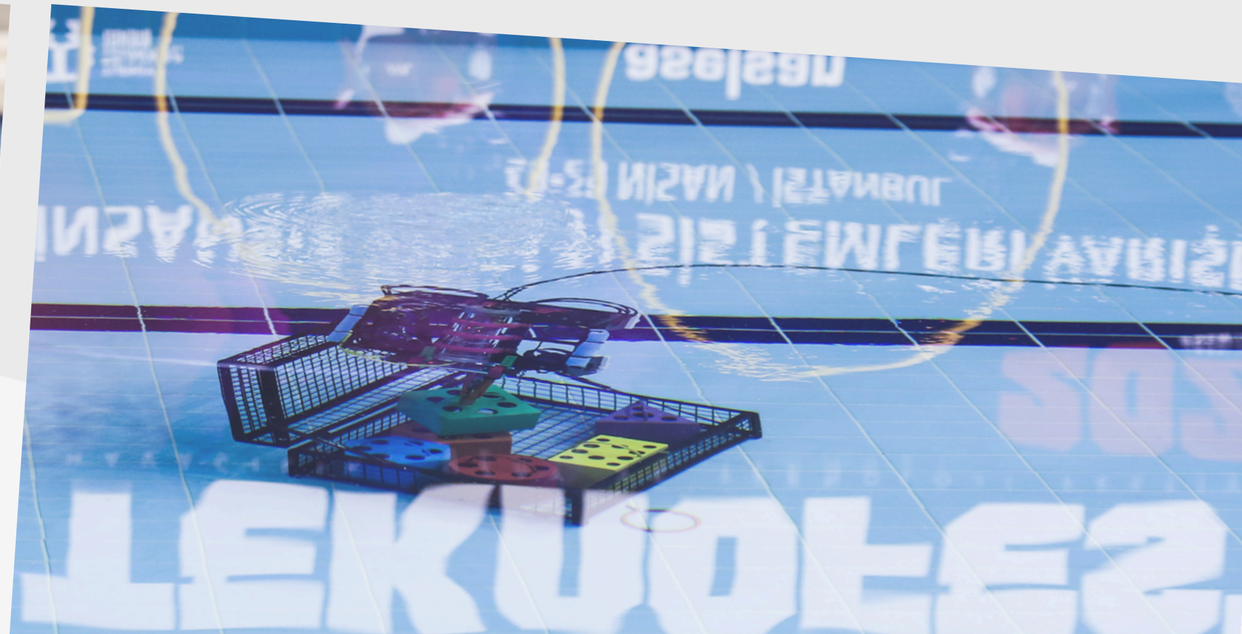
As the Promotion and Finance Sub-team, we are responsible for increasing the team's visibility, securing access to financial resources, and managing these resources effectively. We meticulously handle promotional activities, budget tracking, sponsorship communication, and legal compliance processes. By engaging with various companies, ministries, and individuals, we promote our team and increase its visibility. Through the meetings we organize, we secure funding to help our team achieve greater accomplishments.

Competitions in Our Field

International and national robotics competitions such as SAUVC, TAC Challenge, RAMI25, MATE ROV, RoboSub, and TEKNOFEST are prestigious events where students showcase their expertise in autonomous systems, software development, and mechanical design. TEKNOFEST, Turkey's largest technology event, encourages young people to innovate by hosting competitions in various categories, while focusing more on remote-controlled solutions in the field of underwater systems. Among these competitions, RoboSub stands out with its requirement for full autonomy throughout the process, high technical demands, and real-world task scenarios. Participants are expected to develop advanced image processing, sensor fusion, and decision-making algorithms. Robonation RoboSub not only offers engineering students the opportunity to apply their theoretical knowledge in practice but also enables them to compete globally in the field of autonomous marine technologies.

COMPETITIONS WE WILL PARTICIPATE IN: TEKNOFEST

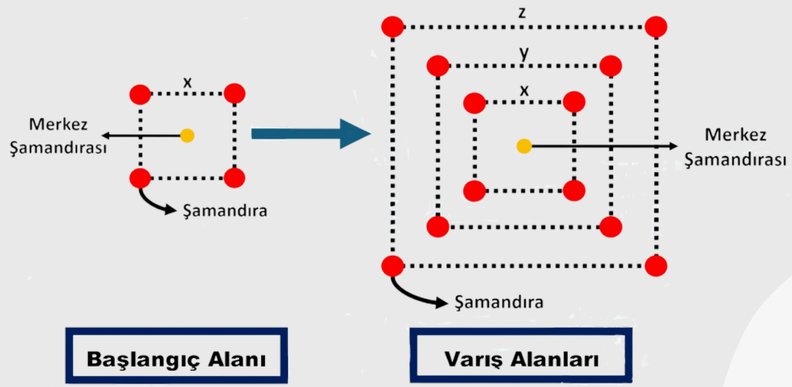
TEKNOFEST; the Aviation, Space, and Technology Festival, began in September 2018 with the slogan "The only festival with its feet off the ground." It has become a tradition, aiming to develop national technologies through seminars, award-winning technology competitions, local technology exhibitions, and an international entrepreneurship summit.



Tasks

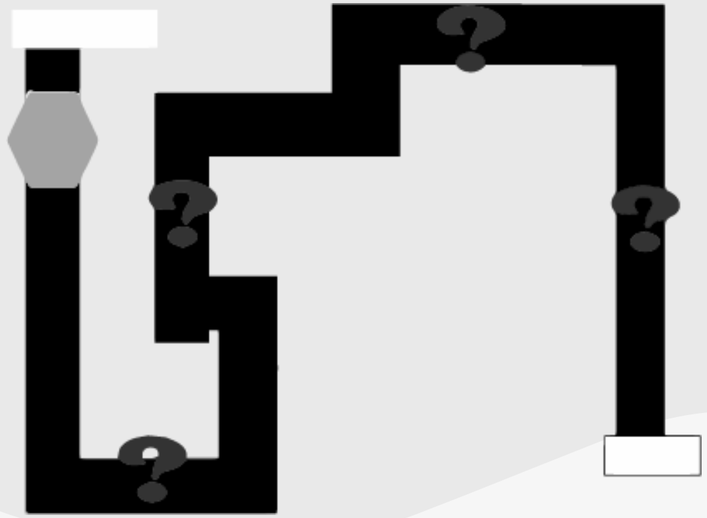
Reaching the Target and Surfacing

In this task, square start and finish areas are defined on the water surface, with teams being provided with coordinates and side length information before the competition. Teams are expected to submerge completely from the start area and reach the finish area with the smallest side length (x), only surfacing once they enter this area. The total time is limited to 10 minutes. It is prohibited to complete the route above the water's surface. Task duration points will only be awarded to teams that successfully surface in the finish area with side length x.



Underwater Cable Route Tracking and Anomaly Detection

The task aims for the vehicles to follow the underwater cable route and capture photos of the four anomalies, indicated by shapes, using the vehicle's camera, and deliver them.



COMPETITIONS WE WILL PARTICIPATE IN: ROBOSUB

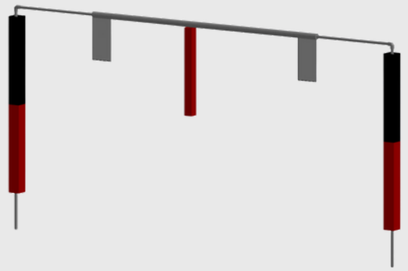
RoboSub is one of the most prestigious competitions in the unmanned underwater vehicle category, held annually in California, USA. It brings together engineering candidates from around the world to perform realistic underwater missions.

robosub

Tasks

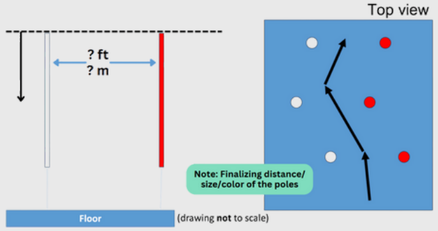
Data Collection

At the start of the competition, the AUV must choose one of two marine creatures to follow for the remainder of the competition after passing through an underwater gate: the Reef Shark or the Sawfish. Teams can earn extra points by passing through the gate in a "cool" way. This task tests the AUV's decision-making and movement control capabilities.



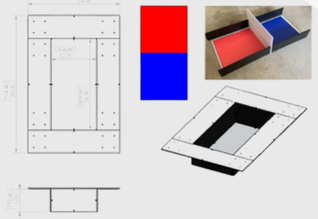
Channel Crossing (Slalom)

The AUV must move along a channel made up of white and red vertical pipes. This movement should be performed as a slalom maneuver, zigzagging between the pipes, and the AUV must not hit any of the pipes during the process. This task tests the AUV's precise navigation and maneuvering capabilities.



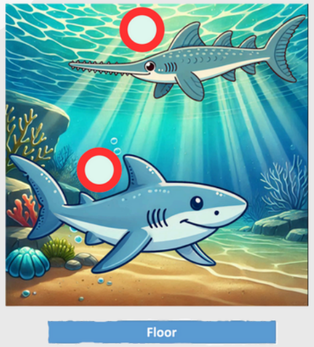
BRUV Deployment

BRUV (Baited Remote Underwater Video) is a system used in marine biology research. In this task, the AUV must deploy two markers into a box, one with an image of a Reef Shark and the other with an image of a Sawfish. Teams that place the markers in the section corresponding to the marine creature they selected in the Data Collection task will earn extra points. This task tests the AUV's precision in object deployment and targeting capability.



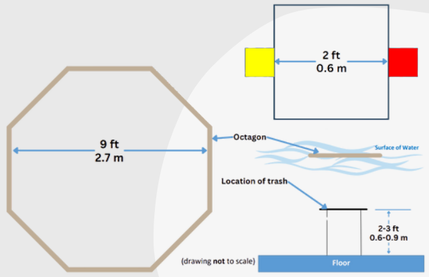
Marking

The AUV must hit the Reef Shark and Sawfish targets with torpedoes. The highest points are awarded to teams that hit the first target corresponding to the marine creature they selected in the Data Collection phase. If a successful shot is made at the second target, the other marine creature, extra points are awarded. This task tests the AUV's target detection, accuracy, and ability to aim at moving objects.



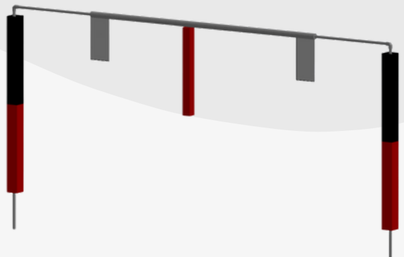
Ocean Cleaning

The AUV must be guided by an acoustic pinger placed in an octagonal area to collect underwater debris from a table. The AUV must place these debris into different collection bins based on their types. Extra points are awarded if the debris types are correctly sorted. This task tests the AUV's object recognition, manipulation, and interaction with the environment capabilities.



Return to Base

After completing the tasks, the AUV must return to the starting gate to finish the course. Extra points are awarded if the AUV successfully passes through the starting gate. This task is designed to measure the AUV's navigation, orientation, and task completion accuracy.



Our Sponsors

FOTONİKS

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NANOTECH

MAREN ROBOTICS

ODTÜ·TEKNOKENT

Tekno Geri Dönüşüm

AFB GROUP

Our Travel Expenses for Competition Participation

Expenses	Number of People	Cost Per Person	Total Cost
International Travel Expenses Flight Ticket	9	60.000	540.000TL
Accommodation Expenses	9 People, 14 Days	-	244.230TL
Per Diem	9	24.370TL	219.330TL
Total Cost			**1.003.560**

As the Nautronics team, the travel expenses required for our participation in RoboSub, which will take place in California in August as part of Robonation, and for representing our country, are as follows.

Our Sponsorship Packages

MAIN SPONSOR

DIAMOND PACKAGE
400.000TL

RUBY PACKAGE
250.000TL

GOLD PACKAGE
125.000TL

SILVER PACKAGE
80.000TL

BRONZE PACKAGE
45.000TL

	MAIN SPONSOR	DIAMOND PACKAGE	RUBY PACKAGE	GOLD PACKAGE	SILVER PACKAGE	BRONZE PACKAGE
Social Media Announcement and Thank You Message	●	●	●	●	●	●
Addition of the company to the team's portfolio	●	●	●	●	●	●
Tax exemption	●	●	●	●	●	●
Video about the company on the team's YouTube channel	●	●	●	●	●	
Visibility of the company logo on the stand at the competition venue	●	●	●	●	●	
Thank you plaque	●	●	●	●		
Inclusion of the company's logo in promotional posters	●	●	●	●		
Inclusion of the company's logo on the team uniform	●	●	●	●		
Invitation to MECH Talks and presentation rights	●	●	●	●		
Placement of the company's logo on the Teknofest vehicle	●	●	●			
Placement of the company's logo on the RoboSub vehicle	●	●	●			
Display of the company's flags at the competition venue (subject to competition regulations)	●	●	●			
Creation and sharing of joint social media content	●	●	●			
Right to decide on the vehicle's color	●	●	●			
Right to decide on the name of the Teknofest vehicle	●	●				
Right to decide on the name of the RoboSub vehicle	●	●				
Inclusion of the company's name in our team name	●					

Contact

We thank you for the support you have given and will continue to give to the MM Nautronics team.

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