itu auv team.

Master Catalog
2026

presents.

content.

autonomous underwater vehicle.

AUVs are autonomous underwater robots that, using various onboard sensors, perceive environmental conditions and make appropriate decisions based on predefined mission flows. They can navigate autonomously, capture and process images, perform object detection, and interact with surrounding objects through their manipulators.

us.

ITU AUV Team was established in 2018 within Istanbul Technical University by our founders, who sought to combine their two years of underwater robotics experience with autonomous technologies after beginning their work in 2016. As one of the few teams representing our country in international AUV competitions such as RoboSub, SAUVC, and RAMI, as well as national competitions like Teknofest, we continue our work with determination.

team structure.

Mechanics

Responsible for the entire physical design of the vehicle, as well as the simulation and manufacturing of the designed components.

Creative

prepares the necessary visual and physical materials for the team’s promotion—such as digital presentations, catalogs, and brochures—and is responsible for their overall design.

Organization

manages the overall administration of sponsorships, finances, media and the team’s strategies.

Software

responsible for developing the software modules related to the mission flow of the vehicle.

Electronics

designs and develops the electronic components that ensure communication for all onboard sensors and meet the power requirements of the propulsion system.

Team Responsible

Yağmur Yasmin Emri

Technic Mentors

Sencer Yazıcı
Batuhan Özer
Emre Orkun Kayran
Selen Cansun Kırgöz

Academic Advisor

Doç. Dr. Bilge Tutak

turkuaz.

Turkuaz, developed between 2018 and 2022, won a world championship.”

#SAUVC2022

CHAMPION

#RoboSub2021

FINALIST

taluy.

Taluy, whose design began in 2022 and whose production was completed in 2023, was engineered for use in challenging environments. In 2023, it earned 2nd place at the 10th RAMI Competition in Italy, known for its demanding missions. In 2024, at the 27th RoboSub competition in the United States, it successfully performed two missions simultaneously and was awarded the ‘Best In Style’ prize.

#TEKNOFEST**2025**

3RD PLACE

MOST INNOVATIVE SOFTWARE

#RoboSub**2025**

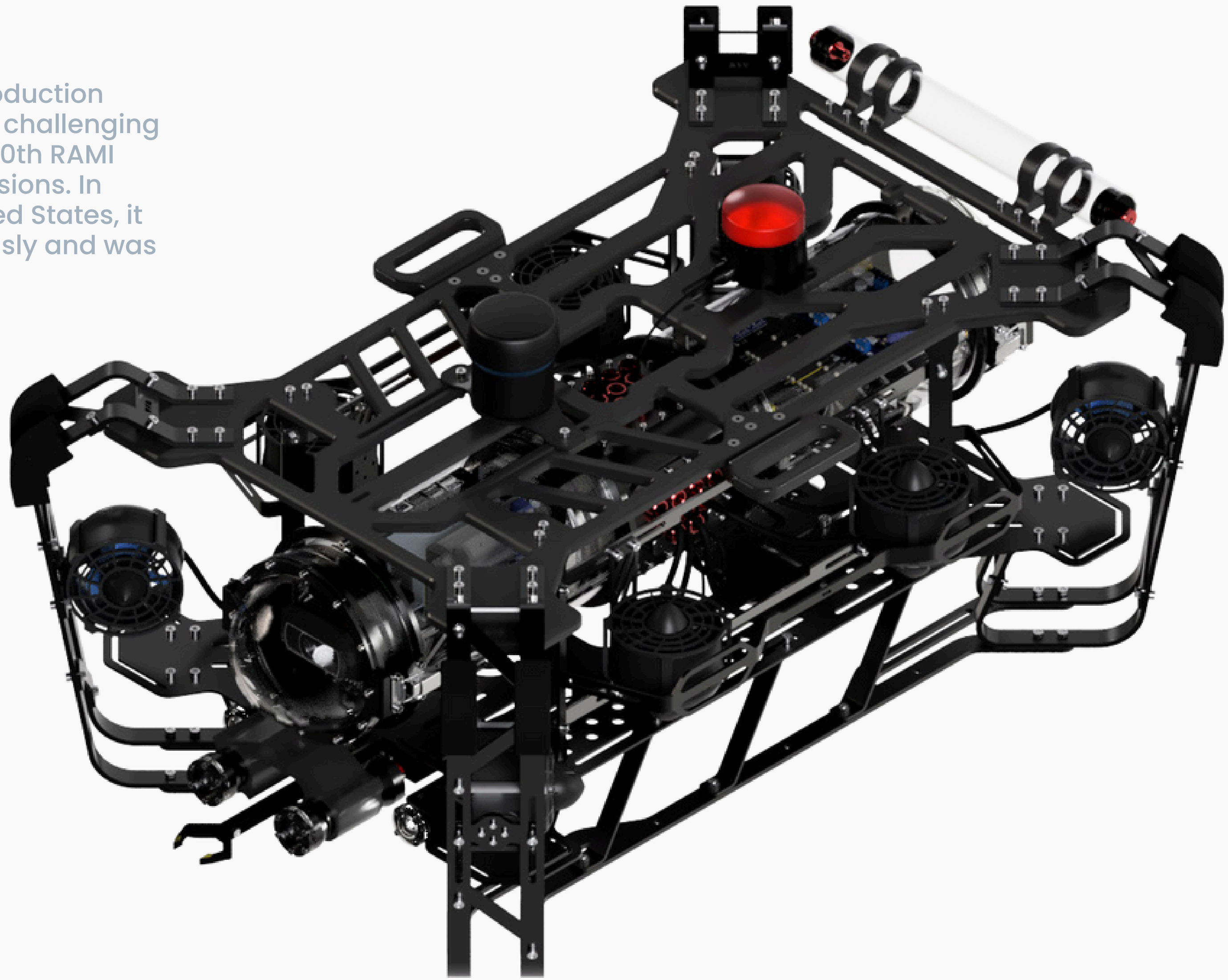
3RD PLACE

#RoboSub**2024**

BEST IN STYLE

#RAMI**2023**

2ND PLACE



taluy mini.

Taluy Mini, developed in 2025, was awarded 3rd place in the world at the RoboSub 2025 competition in the United States.

#RoboSub**2025**

3RD PLACE

sauvc 2022.
world champion.

robosub 2024.

“best in style” award.

robosub 2025.
3rd place.

rami 2023.

2nd place.

teknofest 2025.

3rd place.
most innovative software award.

mechanics.

Taner Özpınar

Bartu Bekci

Hivşa Delal Şahin

İlbey Fatih Şahin

Mehmet Salih Akbulut

Salih Alkan

Halil İbrahim Çandarlı

Kağan Ortaç

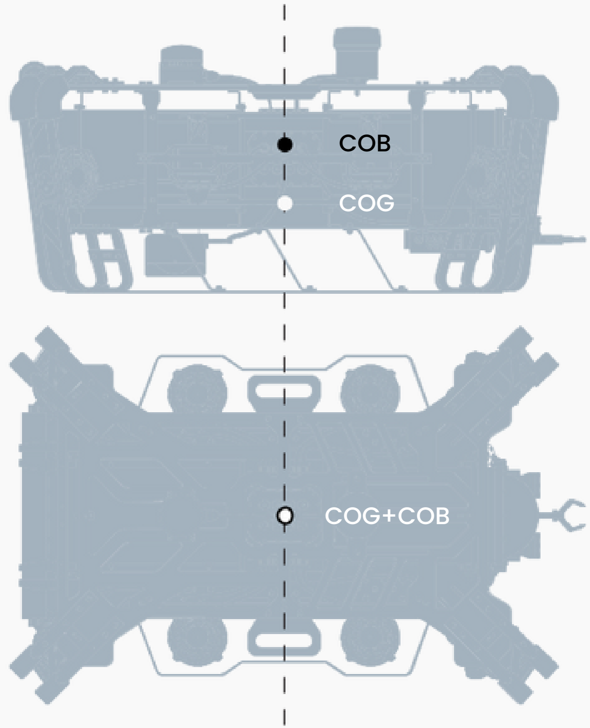
Maximum Weight
26 Kg

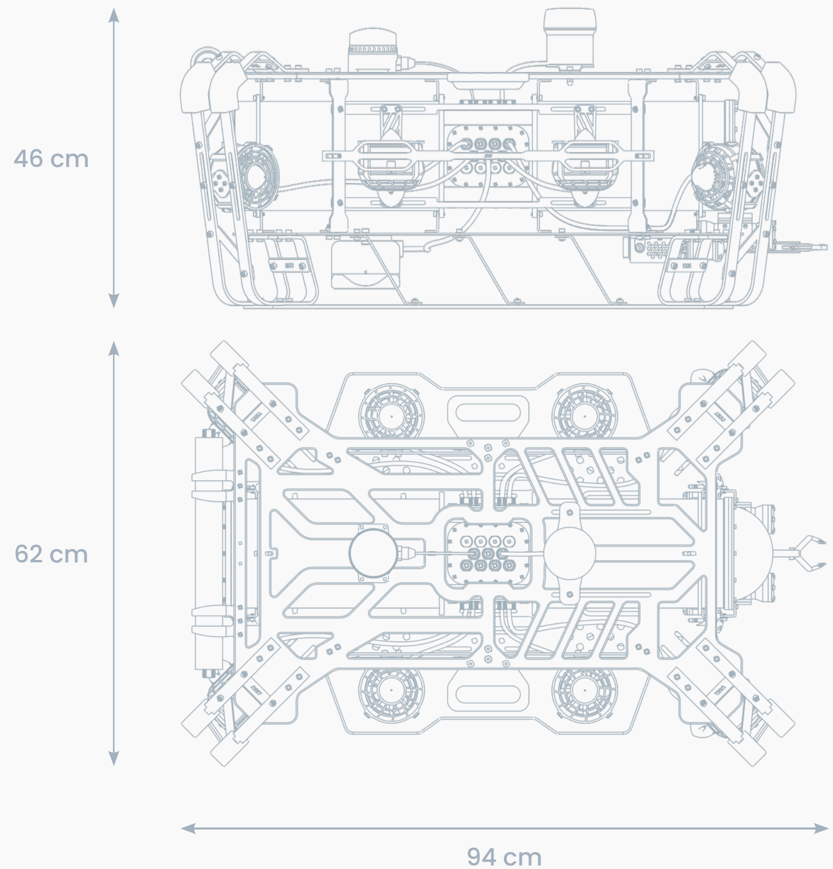
Maximum Velocity
4 Kn

Dive Depth
300 m

Payload Capacity
100 N

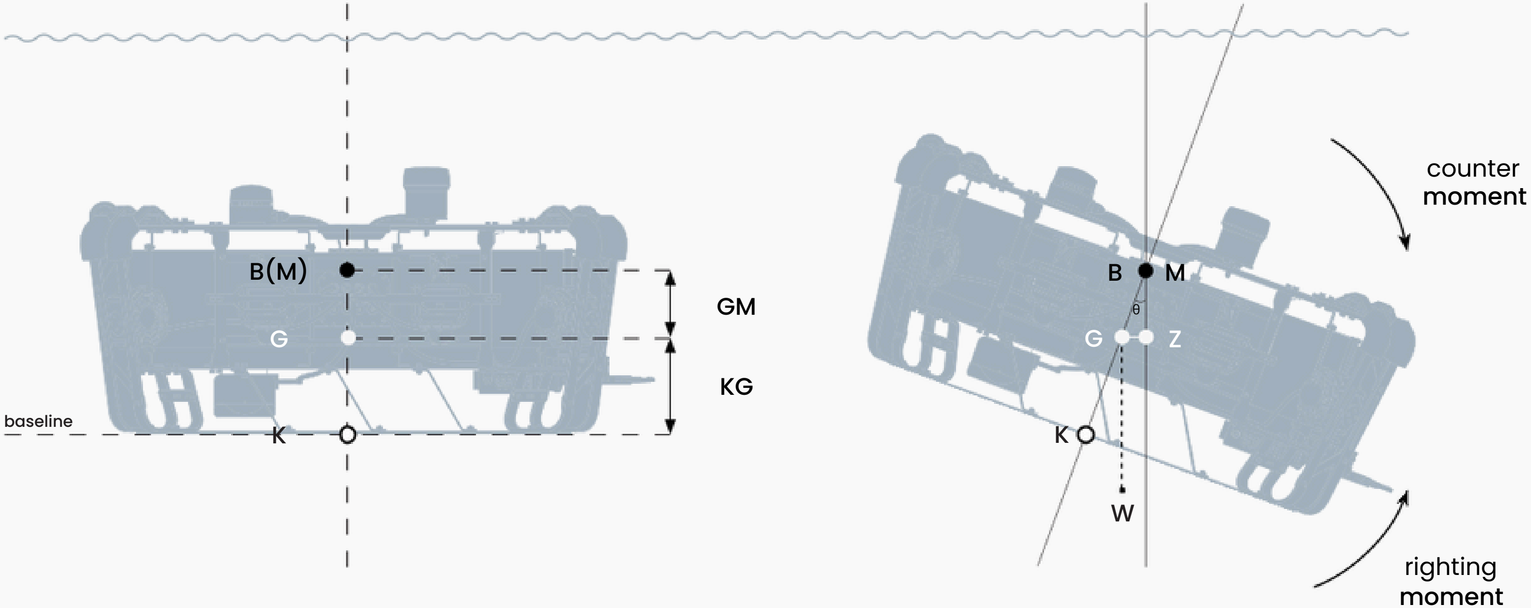
Mission Duration
4 Hours





design.

Structurally, our vehicle consists of three main components: the chassis, the electronics enclosure unit, and the mission equipment. The positions of these components have been determined by considering the distribution of buoyancy and the center of mass.
By aligning the VCG (Vertical Center of Gravity) with the VCB (Vertical Center of Buoyancy), the vehicle is prevented from developing a roll angle while stationary. Similarly, aligning the LCB (Longitudinal Center of Buoyancy) with the LCG (Longitudinal Center of Gravity) ensures that no trim occurs in a static state. In this configuration, the vehicle remains statically stable.
During the design and modification process, the positions of the VCG, VCB, LCB, and LCG are calculated simultaneously using a MATLAB script. This allows the stability state of the vehicle to be mathematically monitored throughout the design process.



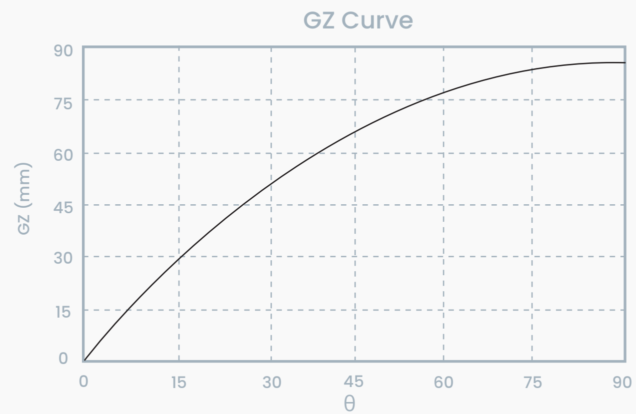
KM	288.5 mm
GM	84.6 mm
KB	288.5 mm
KG	203.9 mm

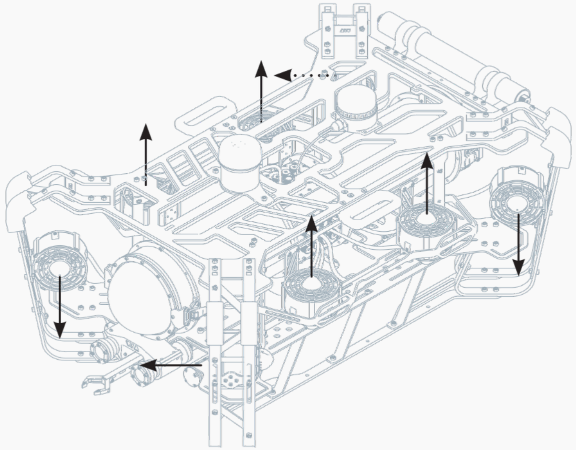
dynamic stability.

Dynamic stability is a key design element for autonomous underwater vehicles. The stability analysis of Taluy was conducted by examining its GZ curve. The area under this curve represents the vehicle's ability to restore itself to a stable orientation. Since the displaced volume does not change, the metacentric point (M) coincides with the center of buoyancy (B). Undesired forces encountered underwater are counterbalanced by the vehicle's own righting moment. Dynamic stability is determined by multiplying the vehicle's weight by the area under the GZ curve within a specific angle range.

$$\mathbf{DS} = W \int_{0}^{\theta} GZ \, d\theta$$

These evaluations are crucial for assessing the vehicle's stability performance and implementing necessary adjustments. The analyses show that the righting moment is significantly high at critical angles.





mass
added mass
damping
environmental forces

General Equation of Motion: $\mathbf{M}\dot{\nu} + \mathbf{C}(\nu)\nu + \mathbf{D}(\nu)\nu + \mathbf{g}(\eta) = \boldsymbol{\tau}$

$$\boldsymbol{\nu} = \begin{bmatrix} u \\ v \\ w \\ p \\ q \\ r \end{bmatrix}$$

body-frame velocity matrix

$$\boldsymbol{\eta} = \begin{bmatrix} x \\ y \\ z \\ \phi \\ \theta \\ \psi \end{bmatrix}$$

position and orientation matrix

$$\boldsymbol{\tau} = \begin{bmatrix} F_x \\ F_y \\ F_z \\ M_x \\ M_y \\ M_z \end{bmatrix} = \mathbf{B}\,\boldsymbol{T}$$

thruster matrix

$$\mathbf{B} = \begin{bmatrix} b_{11} & b_{12} & b_{13} & b_{14} & b_{15} & b_{16} & b_{17} & b_{18} \\ b_{21} & b_{22} & b_{23} & b_{24} & b_{25} & b_{26} & b_{27} & b_{28} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ b_{61} & b_{62} & b_{63} & b_{64} & b_{65} & b_{66} & b_{67} & b_{68} \end{bmatrix}$$

allocation matrix

Damping and hydrodynamic viscous effects: $\mathbf{D}(\nu) = -\mathbf{D1}\,\nu - \mathbf{D2}\,|\nu|\nu$

Thruster Forces $T_i = K_t V_i$

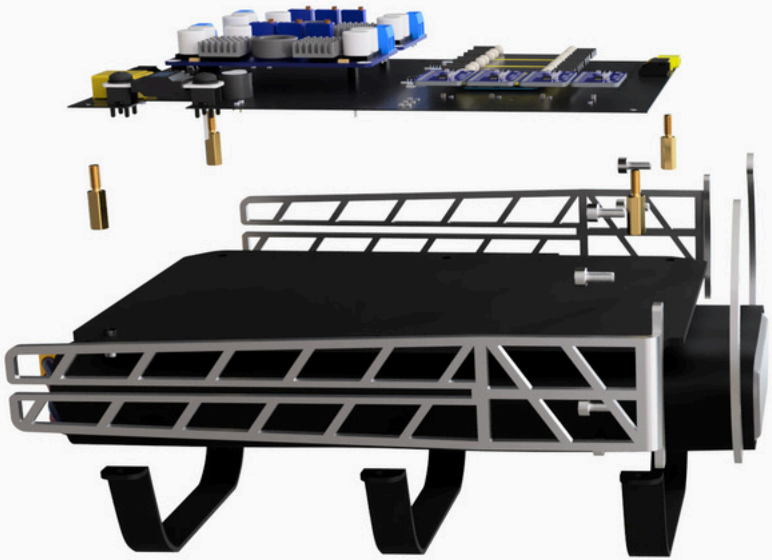
bi j : represents the force/moment contribution of each thruster relative to the axes.

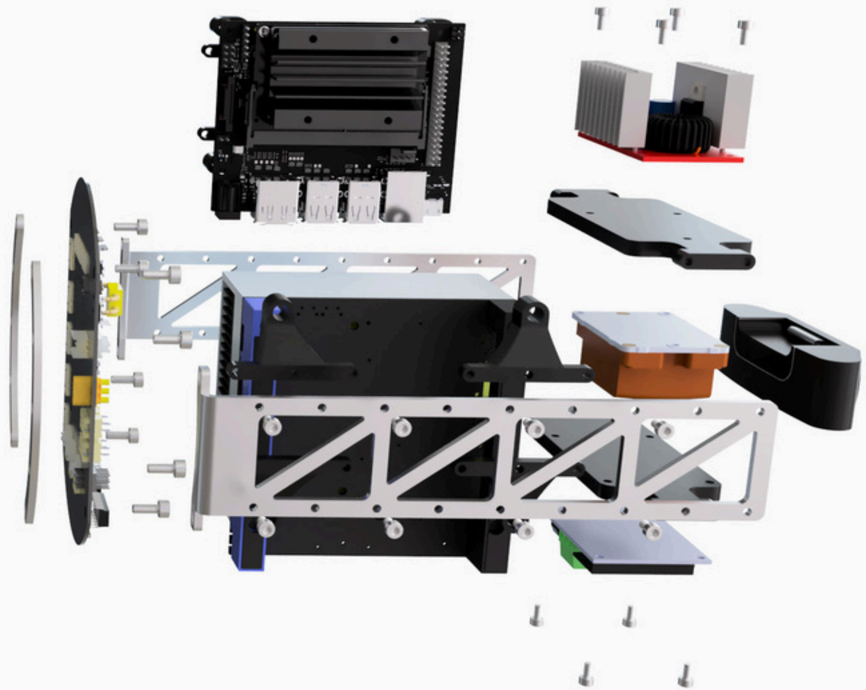
motion & maneuverability.

The motion of an autonomous underwater vehicle with six degrees of freedom is defined by the Newton–Euler equations. These equations account for the vehicle's mass, added mass effects, hydrodynamic forces, damping, and environmental disturbances. The vehicle's motion is modeled using an allocation matrix that describes how the forces generated by the thrusters are distributed over the hull. With eight thrusters (4 in the Z-axis and 4 in the X–Y plane), both linear and angular velocities are controlled. This formulation enables precise characterization of the vehicle's translational (surge, sway, heave) and rotational (roll, pitch, yaw) motions.

penetrator.

To ensure the waterproofing of electronic components underwater, BlueRobotics WetLink penetrators were used. These penetrators provide watertight sealing without the need for epoxy. Composed of five separate parts, the penetrator prevents water ingress up to 950 meters by using a silicone gasket and an O-ring that compress around the cable once it is inserted.

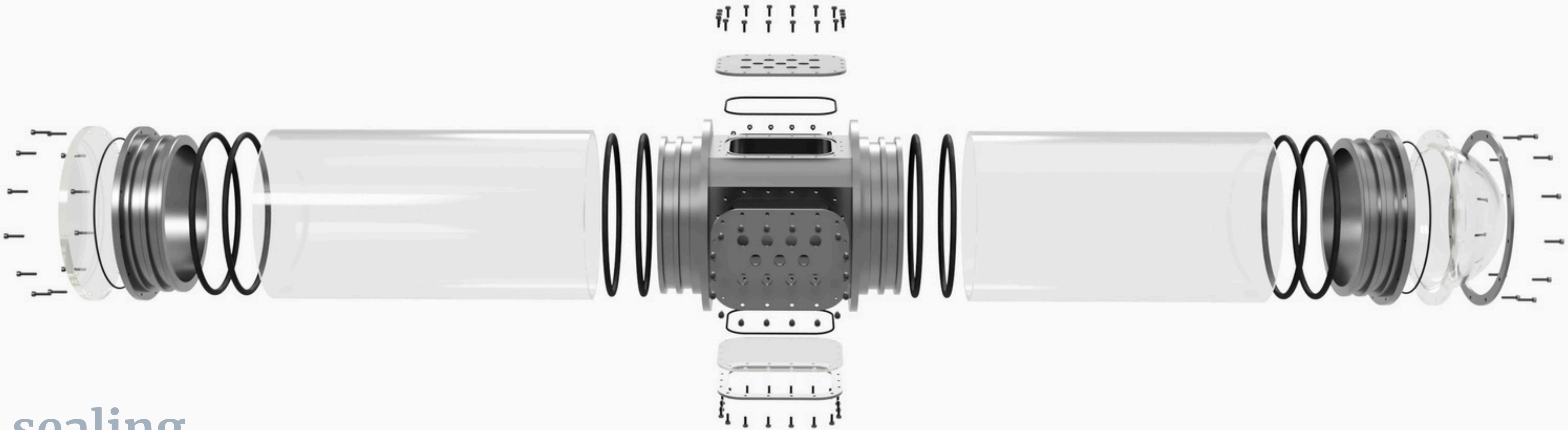




electronics enclosure.

This section houses the vehicle's motor controllers, cameras used for image processing, batteries, electronic components, and all parts that must remain isolated from water. It consists of two cylindrical PMMA tubes, an Aluminum 6061 central flange positioned between these tubes, PMMA front and rear end caps, and Aluminum 6061 front and rear flanges.

The cylindrical tube geometry was chosen because a circular cross-section distributes underwater pressure most effectively. PMMA (acrylic) was selected as the tube material due to its sufficient pressure resistance at the operating depth, its transparency which allows visual inspection of the electronics during development, and its cost efficiency.



sealing.

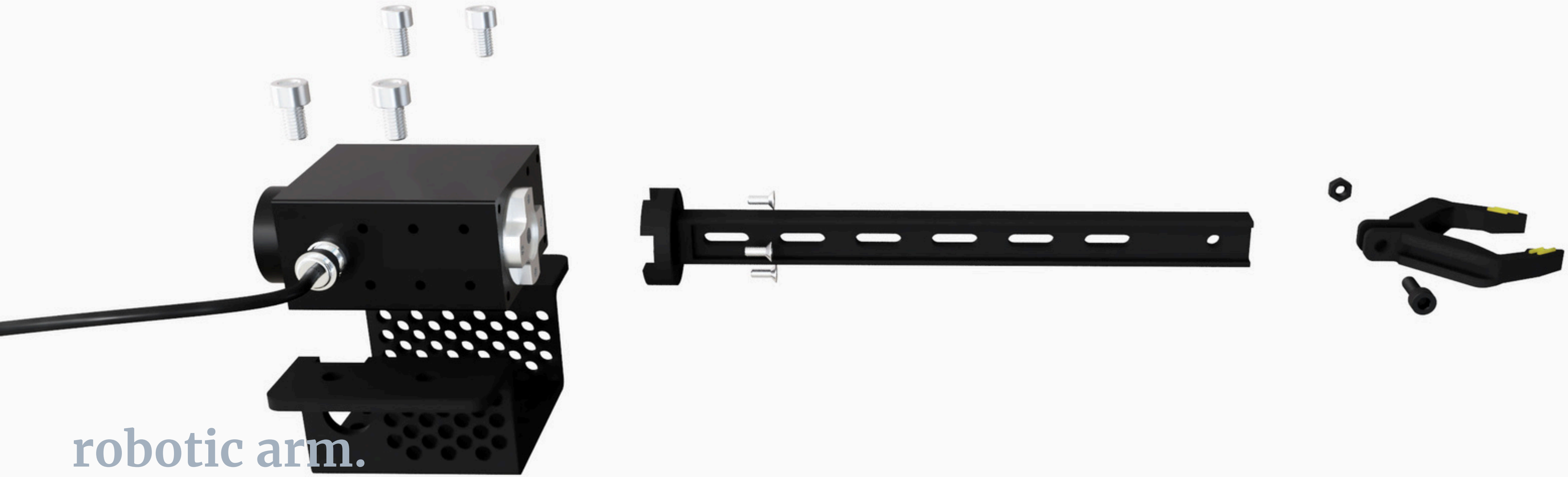
For waterproofing, a front and rear flange, along with a central flange that connects the two tubes, were used. These flanges, which ensure both the structural connection between the cylinders and the sealing between the end caps and the tubes, contain O-ring grooves. To ensure that the groove dimensions conformed to manufacturing standards, Trelleborg's seal design tool—commonly used for designing sealing products—was utilized. The grooves were designed by considering the O-rings' fill ratio, compression ratio, and stretch ratio.
The front end cap was manufactured as a hemispherical dome, providing a wider field of view underwater by taking advantage of light refraction principles. The central flange features four rectangular cutouts, and the covers of these cutouts contain eleven penetrator pass-through holes. Cables of the external components that must interact with water are routed through these penetrator holes and connected to the electronic boards housed within the tube.

stereo camera.

A single camera is insufficient for estimating the depth of objects underwater. For this reason, our software and mechanical teams developed a camera unit that mimics human binocular vision. This unit can perceive how far objects are from the vehicle by interpreting perspective. Thanks to the 2.8 mm focal length and 155° field of view provided by the bullet cameras housed within the chambers, object detection is greatly facilitated.
To ensure resistance to hydrostatic pressure at deep underwater levels and to improve heat transfer from the cameras to the surrounding water, the mechanical team selected Aluminum 6061 as the material for the chambers.

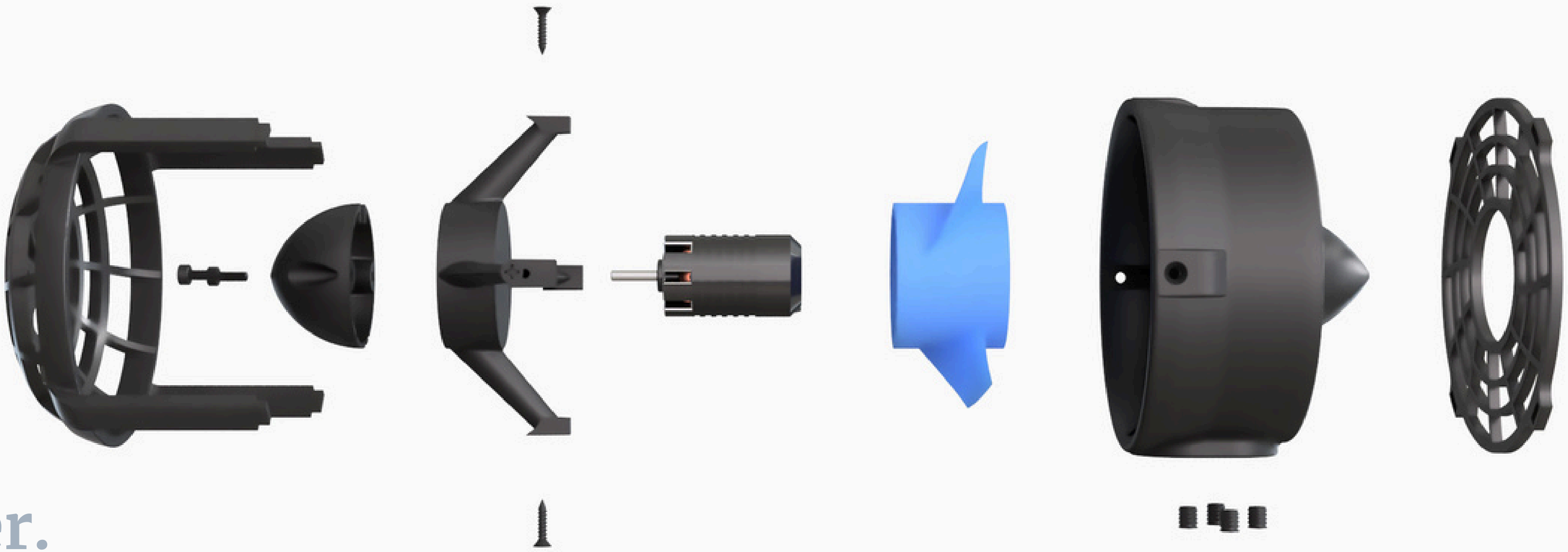
power distribution unit.

The motor drivers of the vehicle can reach very high temperatures when operating at high power. This not only affects the performance of other electronic components inside the main tubes, but also increases the internal pressure, creating a potential risk. Therefore, the motor drivers were isolated inside a separate aluminum housing, significantly improving the overall operational performance of the vehicle.
This housing was manufactured using a 3-axis CNC process and was specifically designed to accommodate the PCB developed by the electronics team. All thrusters are connected through this single housing, and the required power distribution is supplied by the battery inside the vehicle. In this configuration, the heat generated inside is transferred to the surrounding water through thermal pads.



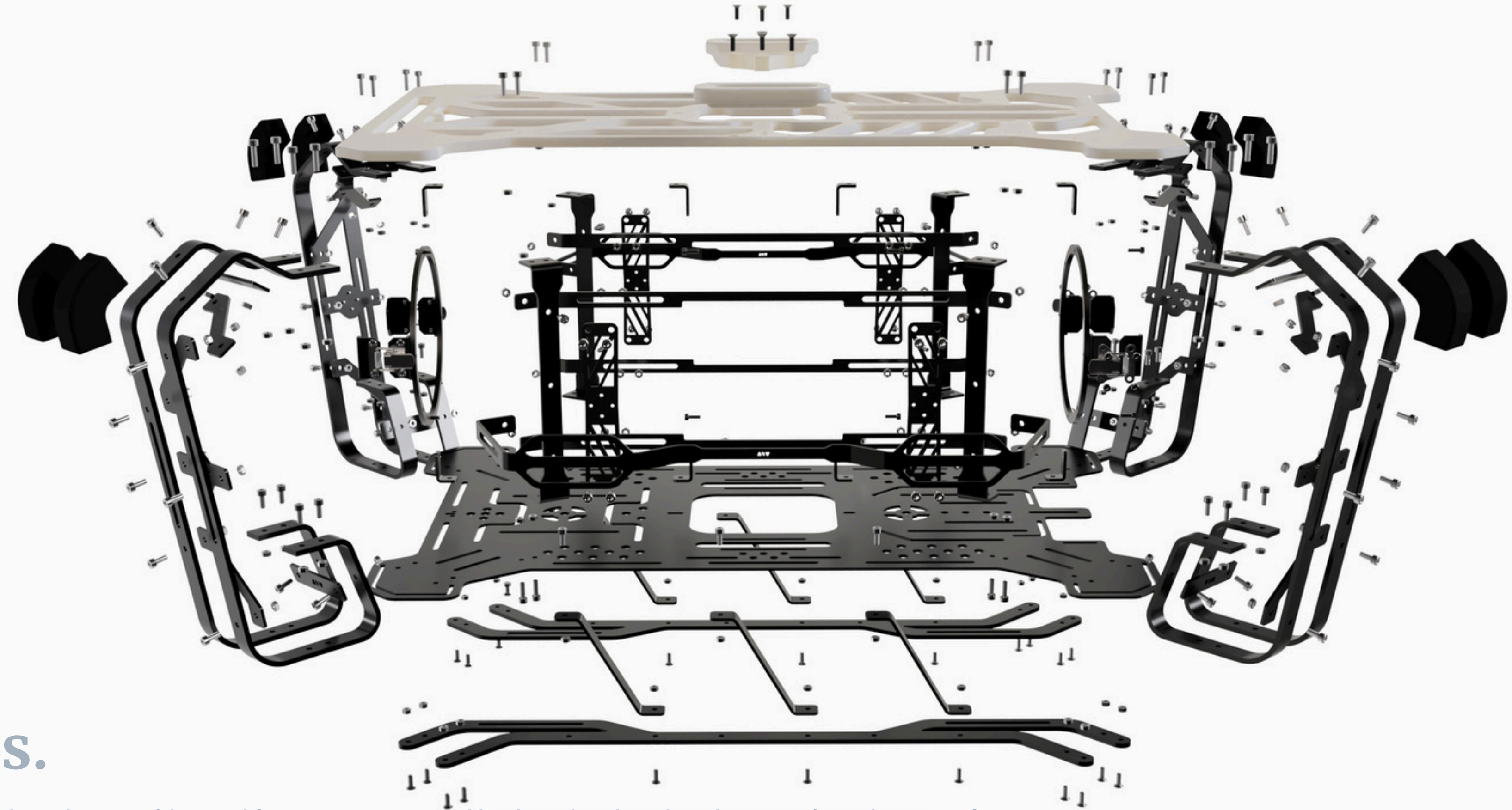
robotic arm.

The gripper mechanism was designed to be simple yet functional. The mechanism operates with a single servo motor. The servo is mounted to the aluminum plate located beneath the vehicle using four bolts and a 3D-printed mounting component. The part connected to the motor's rotor was designed according to the 'I-beam' principle, allowing the motor to operate reliably under torques up to 3.5 N·cm.
The gripping arm at the end of the mechanism is designed to allow roll motion and can be replaced depending on the operational environment. Developed and simulated by the mechanical team, this mechanism is capable of functioning flawlessly at depths of up to 150 meters.



thruster.

Our vehicle utilizes eight Blue Robotics T200 brushless DC thrusters. These thrusters are positioned to provide maneuverability with four arranged along the Z-axis, two along the X-axis, and two along the Y-axis, enabling full motion control in six degrees of freedom. The T200 model was chosen due to its high thrust output and efficiency underwater.
Analyses showed that the selected motor configuration and quantity provide sufficient speed and maneuverability for the vehicle. The thruster placement was determined to facilitate the autonomous motion the vehicle is required to perform.



chassis.

It is essential for the robot to withstand forces encountered both on land and underwater in order to perform its missions effectively. To balance the internal volume of the tubes, the vehicle's weight is calculated with high precision. The vehicle's structural components are grouped into three main sections: corner cage systems, upper and lower plates, and side cage systems.
Each of the four corners is manufactured from 5 mm Aluminum 6061 using the press brake bending method. The corner cage systems contain slotted channels for positioning the thrusters responsible for motion in the X–Y axes. The thruster height can be adjusted if the vehicle's buoyancy center changes. The upper plate is made of HDPE, while the lower plate is manufactured from a 5 mm Aluminum 6061 flat sheet.
The side cage systems house the thrusters that provide motion along the Z-axis. Because this section is subjected to high moments, it is produced from stainless steel. The lower frame of the vehicle is reinforced with Z-shaped aluminum strips, also manufactured using the press brake bending method, to support mission equipment and the weight of the vehicle on land. This design significantly increases the vehicle's payload capacity.

electronics.

Ravza Betül Karakaş

Nihat Memduh Arslan

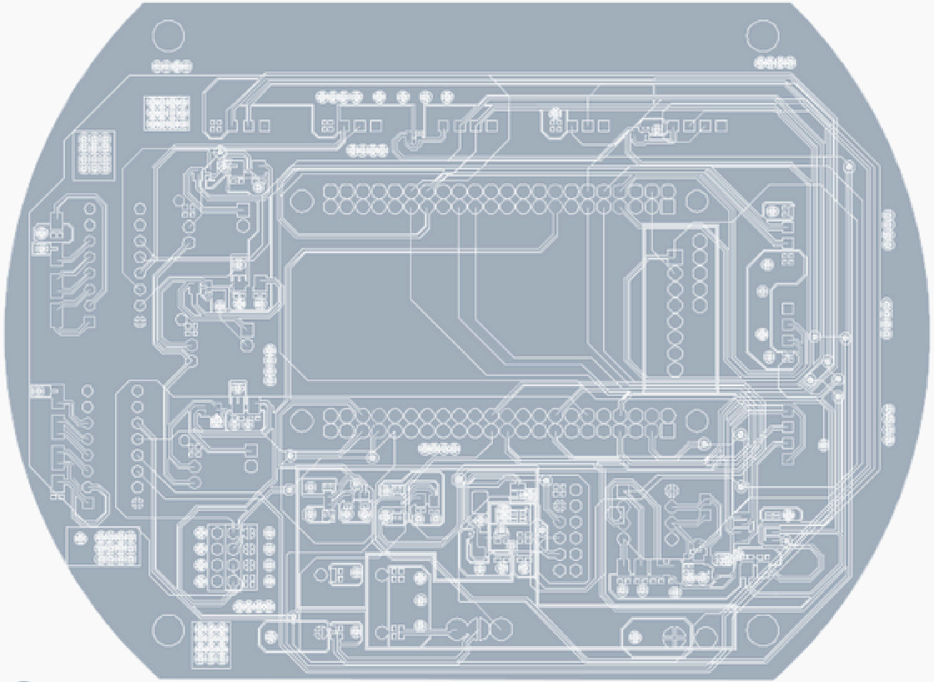
Ahmet Baş

Mehmet Erkılıç

Tolga Öztürk

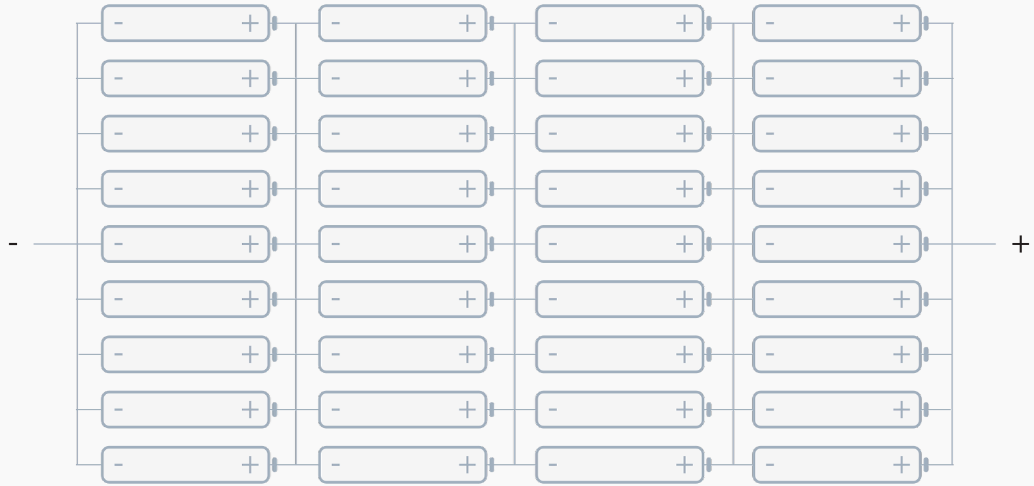
Hamid Mammadli

Emir Arda Akpınar



vehicle electronics.

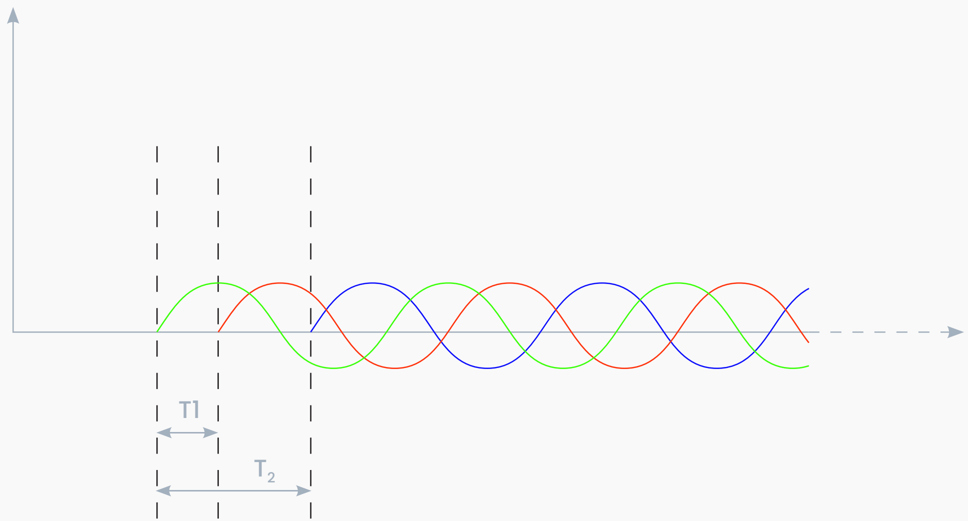
To accomplish challenging tasks in harsh environments, the vehicle is equipped with a variety of sensors. At its core, the main board serves as the primary low-level processing unit, operating with a Real-Time Operating System (RTOS) to manage safety features, communication with all sensors, control algorithms, and input/output (I/O) operations.
The onboard sensor suite includes active sonars, passive sonars, an Inertial Measurement Unit (IMU), a Doppler Velocity Log (DVL), a pressure sensor, a temperature sensor, and several monocular and stereo cameras. The main board is also responsible for communicating with other circuit boards within the system. These include the Battery Monitoring System (BMS), which provides data regarding the main onboard battery—such as temperature, current, voltage, and State of Charge (SoC)—and the Propulsion System Board (PSB), which controls all thrusters and provides data representing the power consumption of each thruster.
Additionally, the vehicle features an Auxiliary Power System (APS) designed to keep critical processing units operational in emergency situations that require the main onboard battery to be isolated.

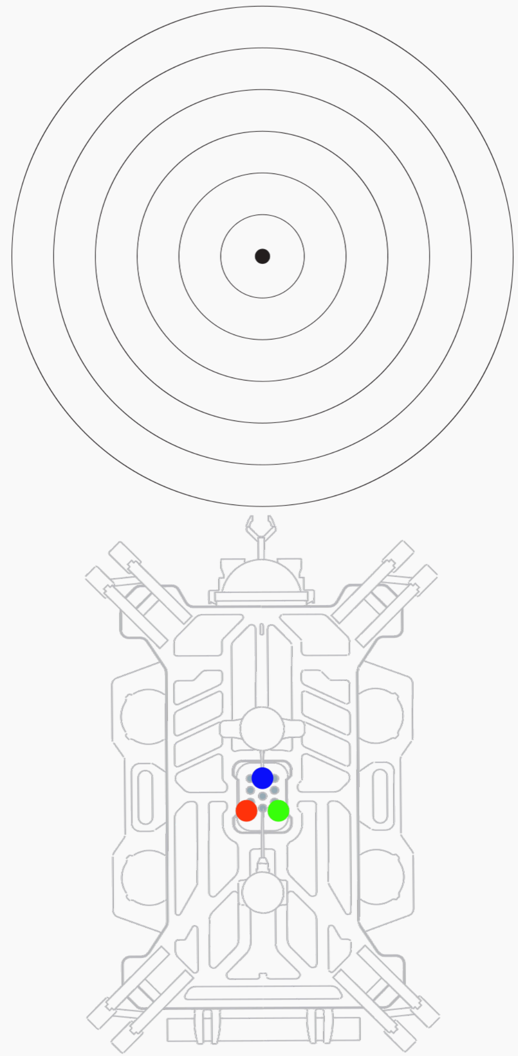


Li-ion

battery.

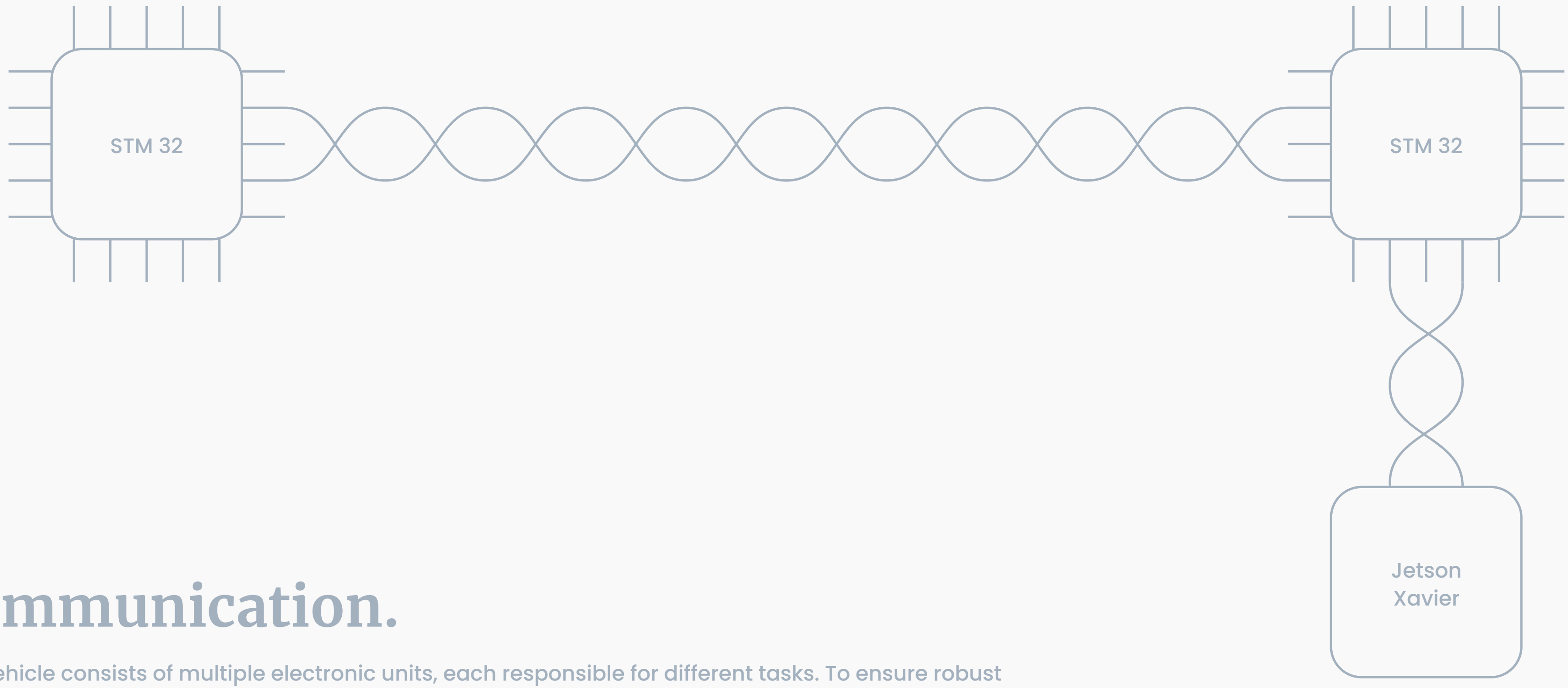
The vehicle operates using a custom-designed Li-ion battery pack configured as 4 series and 9 parallel cells. The battery pack includes a fuse to prevent short circuits and a battery management system (BMS) to balance and charge the series-connected cells. The pack uses Sony US18650VTC6 Li-ion cells.
With its 4S9P configuration, the battery pack provides an energy capacity of 400 Wh and can deliver 5300 W of peak power and 2000 W of continuous power. The four-cell series configuration supplies a higher voltage compared to the previously used 3-series packs, which, together with the reduced current draw, significantly decreases power losses.





acoustic.

Underwater acoustics is a critical field that encompasses solutions for a wide range of challenges such as communication, navigation, and ranging. To address these challenges, the vehicle is equipped with both passive and active SONAR systems. Together with our Acoustic Processing Board (APB), the passive SONARs (hydrophones) on the vehicle can detect underwater acoustic signals with high sensitivity in the 25 kHz to 50 kHz range.
The board provides advanced signal-processing capabilities through a custom-developed Acquisition Protocol (ACQ). With a sampling frequency configurable up to 2 MHz, it processes 16-bit captured data in real time using the Short-Time Fourier Transform (STFT). Direction of Arrival (DOA) algorithms such as MUSIC and WAVES allow the incoming sound angle to be estimated with extremely low error levels.



communication.

The vehicle consists of multiple electronic units, each responsible for different tasks. To ensure robust communication between onboard units, RS-485 is used. For higher-speed communication, USB High Speed is utilized, with the communication line kept under minimal Electromagnetic Interference (EMI). The vehicle's design allows sensitive digital/analog components to be placed in the front housing, while high-power components are isolated in the rear enclosure to further reduce EMI.
During testing, a main communication cable exits the vehicle through both ends, carrying Ethernet packets over a twisted-pair line driven by Fathom-X modules. Since the vehicle operates with ROS, the entire ROS network can be accessed via the Ethernet connection. This enables the surface computer to monitor sensor data or send commands to the vehicle. The software also includes safety mechanisms that shut down thruster operation in the event of a communication failure to prevent hazardous situations.

software.

Faruk Mimarlar

Mehmet Emin Meydanoğlu

Melih Okur

Ozan Hakan Tunca

Talha Karasu

Ömer Faruk Güveloğlu

Deniz Tuna Meral

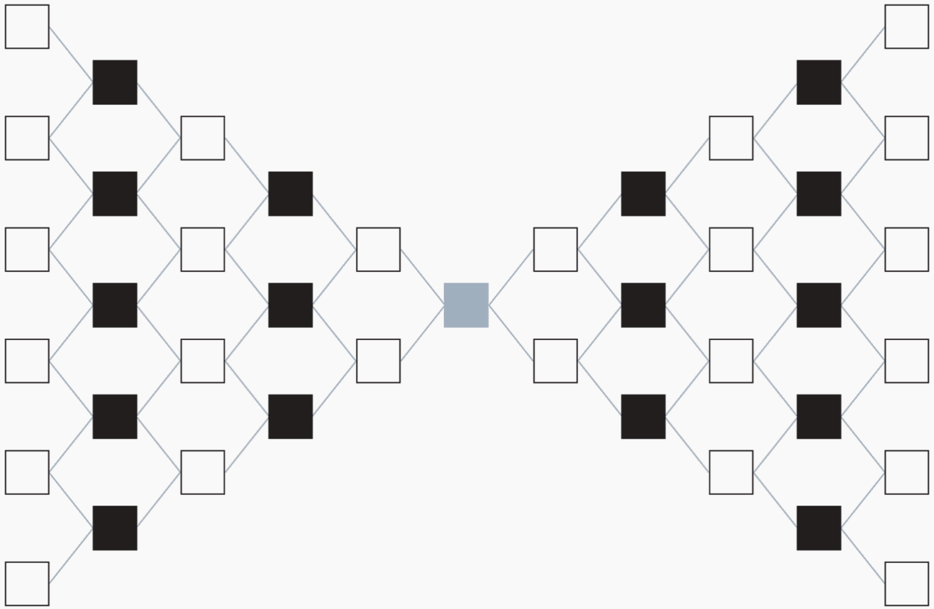
Şeyma Özer

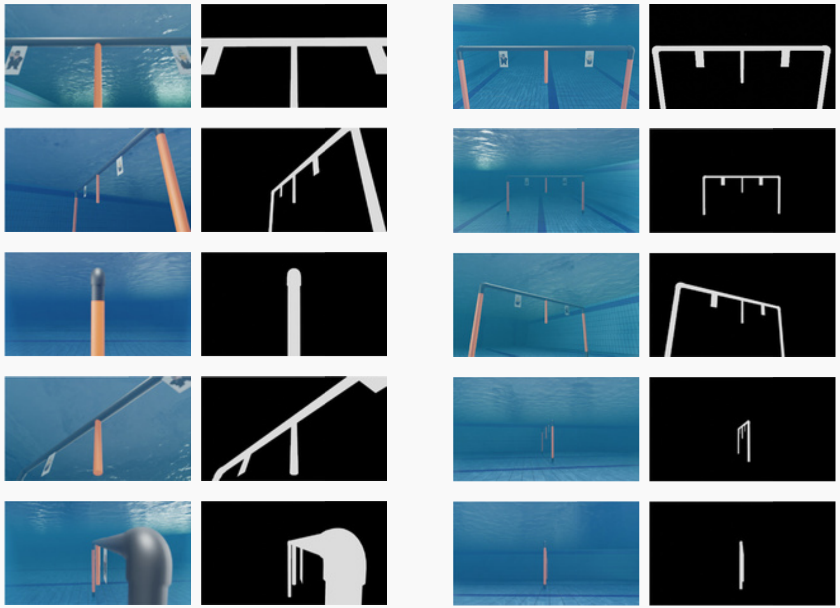
Tulgar Cem Güngör

Eyüp Saka

Melih Baykara

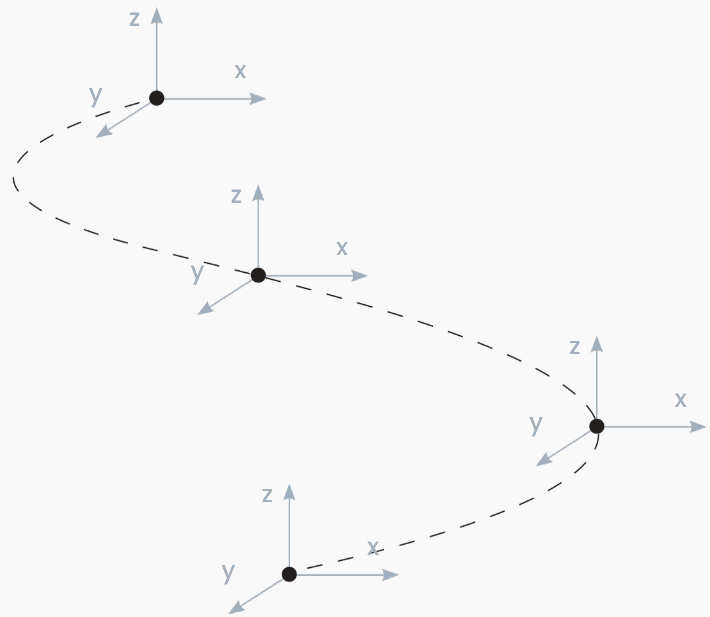
Ufuk Altıntaş

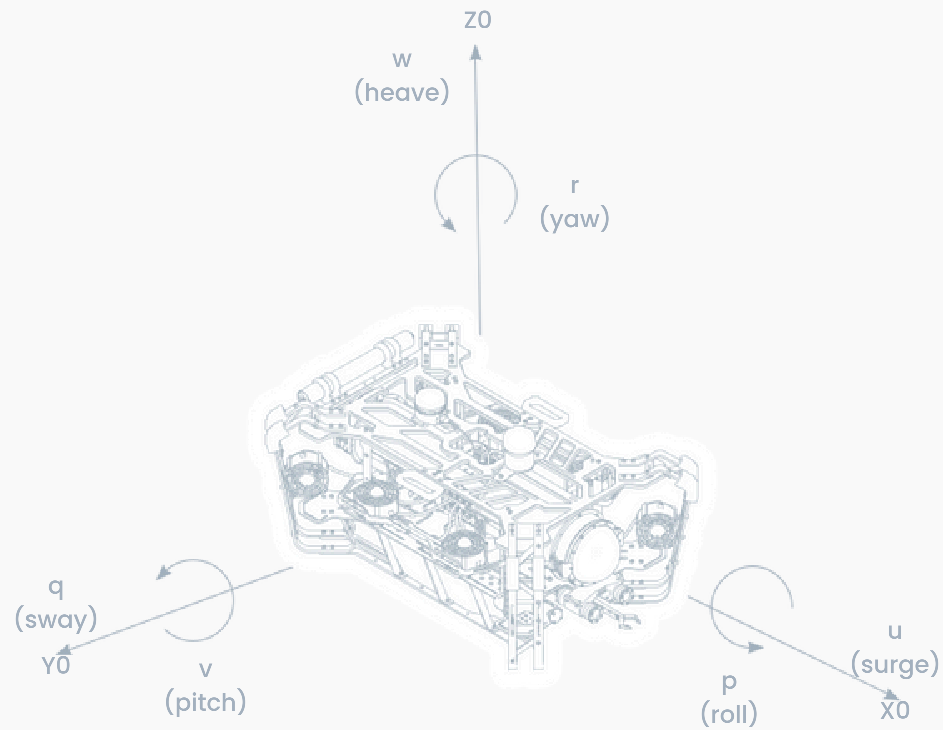




computer vision.

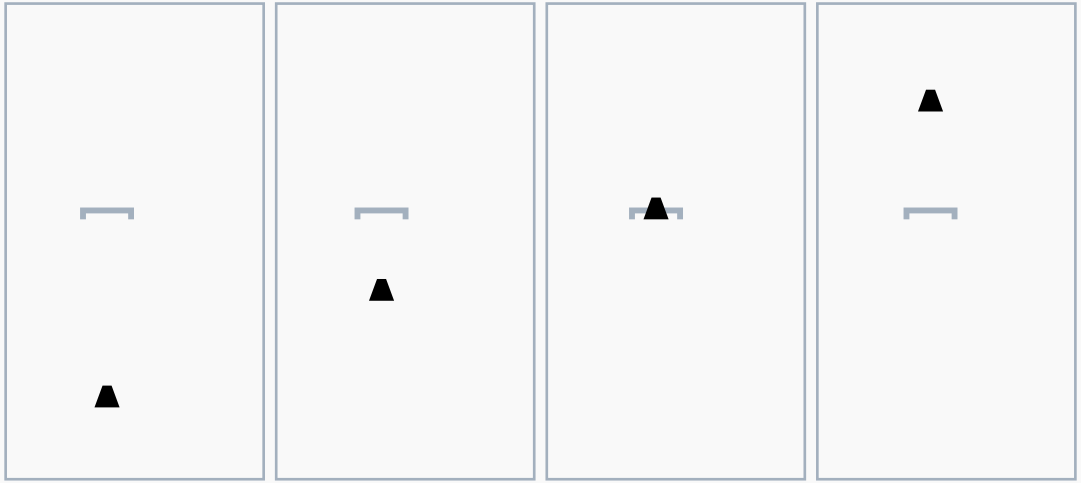
Detecting and identifying mission objects is a critical capability for an autonomous underwater vehicle. Therefore, a machine-learning–based object detection algorithm was developed using task-specific datasets prepared by our team. The large dataset required for training this algorithm was generated and annotated using the Blender 3D software along with custom automation scripts written specifically for this purpose.

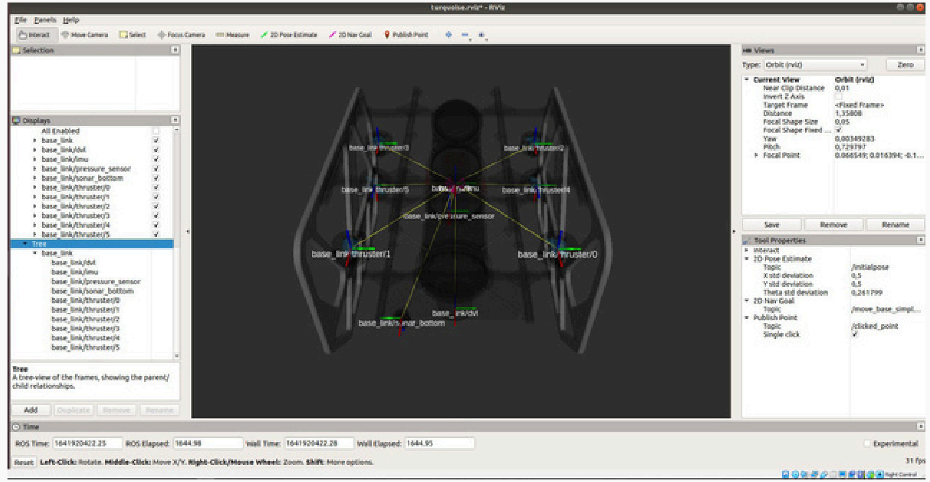




lokalization & navigation.

Localization enables the vehicle to determine its position and orientation, making safe navigation, mapping, and environmental interaction possible. The vehicle's localization is achieved using data from sensors such as the IMU, DVL, and barometer, along with visual input from onboard cameras. These cameras track markers on the seafloor, and algorithms such as ORB-SLAM are used for simultaneous localization and mapping.
The visual data are then fused with the acceleration, velocity, and position measurements from the IMU, DVL, and barometer using an Extended Kalman Filter (EKF), providing state estimates for both velocity and position in all Cartesian and polar coordinates.

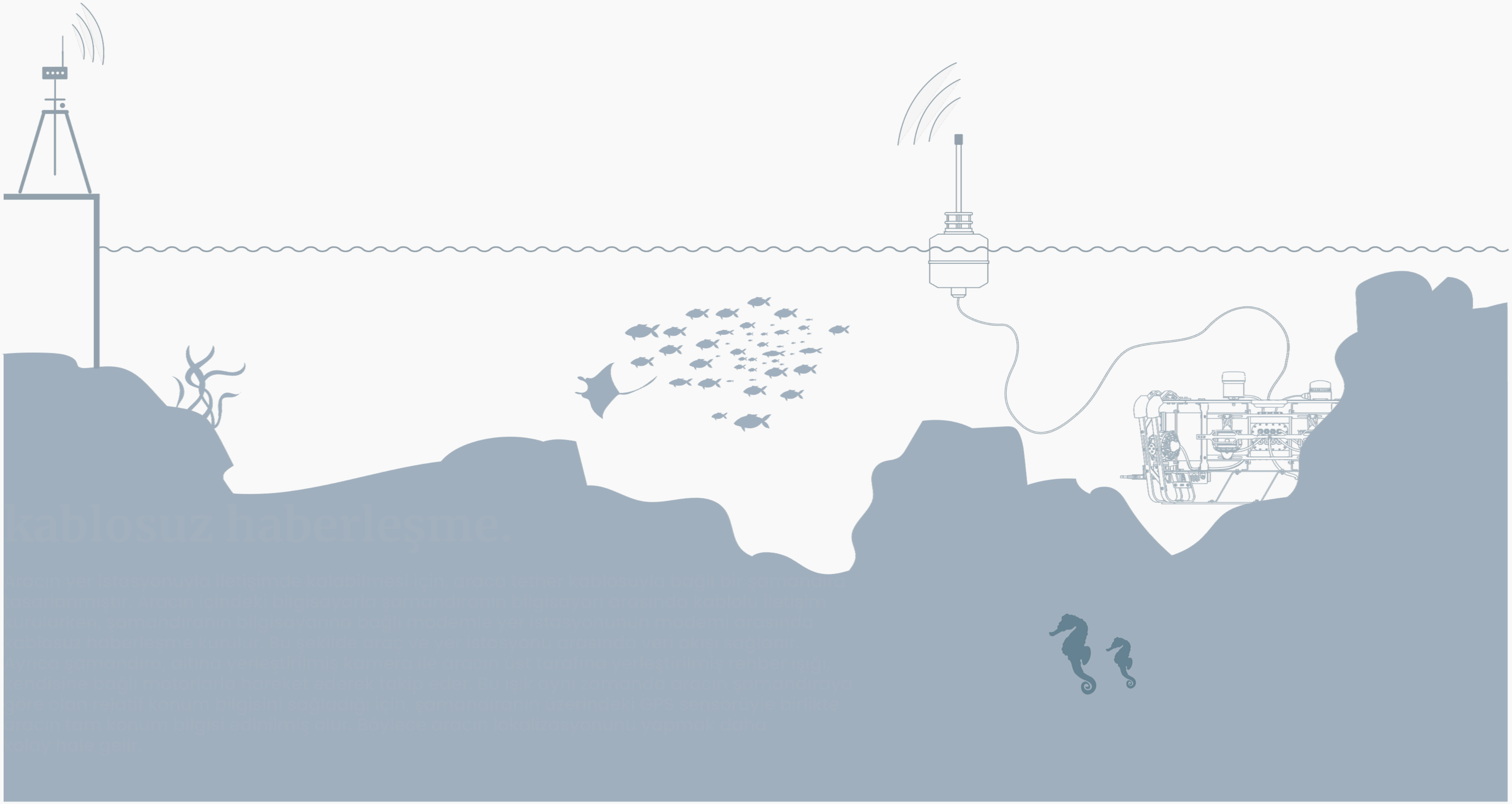




simulation & ros.

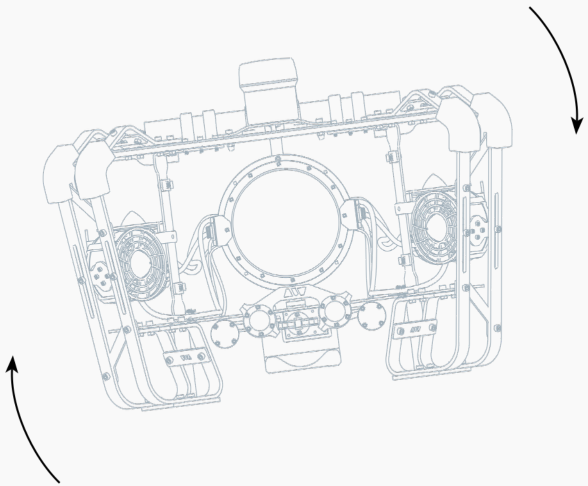
The software architecture of our vehicle is built upon the Robot Operating System (ROS). ROS provides an open-source platform with a modular and extensible structure, making it easier to integrate various robotic components. The platform offers hardware abstraction, allowing different sensors, cameras, and other components to be seamlessly incorporated into the system. Additionally, ROS's standardized communication framework facilitates efficient data exchange between modules.

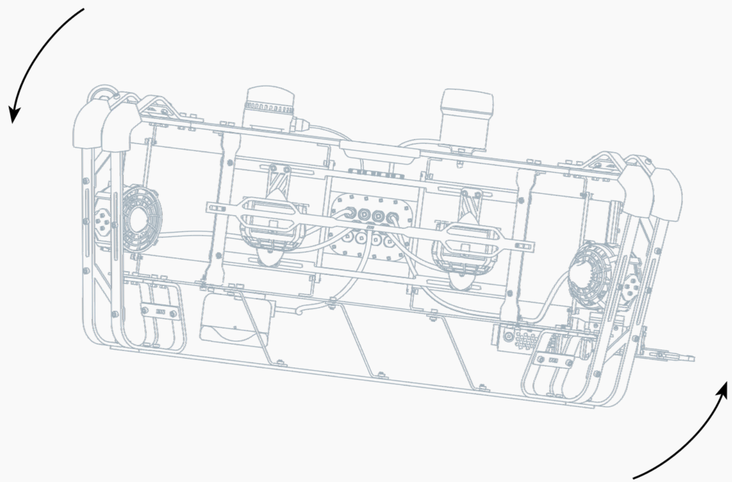
The mathematical model of the vehicle is rigorously tested in a Gazebo-based underwater physics simulation environment capable of running within ROS. This integrated approach enables us to optimize all processes—from sensor data processing to motion control—and continuously improve the overall performance of our vehicle.



kablosuz haberleşme.

Aracın yer istasyonuyla iletişimde kalabilmesi için, araca tether kablosuyla bağlı bir şamandıra tasarlanmıştır. Aracın içindeki bilgisayarla şamandıranın bilgisayarı arasında kablolu iletişim kurulurken, şamandıranın bilgisayarına bağlı modemle yer istasyonunun modemi arasında kablosuz haberleşme kurulur. Bu şekilde araç ve yer istasyonu arasında veri akışı sağlanır. Ayrıca şamandıra, altına yerleştirilmiş kamera ile aracın üst tarafına yerleştirilmiş rehber ışığı kendisine bağlı motorlarla hareket ederek takip eder. Bu ışık aynı zamanda aracın şamandıraya göre olan relatif konum bilgisini sağladığı için, şamandıranın üzerindeki GPS sensörüyle birlikte aracın tam konum bilgisi edinilmiş olur. Böylece aracın lokalizasyonunu yapmak daha kolay hale gelir.





auto-leveling.

An automatic stabilization algorithm has been developed to maintain the vehicle's balance and motion. This system continuously measures the vehicle's orientation and uses four upward-facing thrusters together with a PID (Proportional-Integral-Derivative) controller to perform real-time adjustments, effectively minimizing roll and pitch motions. This approach enables the vehicle to maintain stability even in turbulent sea conditions, allowing it to carry out its missions with high accuracy and precision.

creative.

Zeynep Sena Gülek

Melih Okur

vision.

The Creative Team is responsible for developing the project presentations and promotional content of the team. By utilizing all available resources, it ensures that the team stands out and attracts support from potential investors. It is composed of the ‘invisible heroes’ who create memorable visual designs, spark curiosity, and contribute to everything that elevates the team’s image.

action.

The team defines the visual communication direction of the project by producing graphic content and conducting video and photo shoots throughout the production process. It is responsible for designing posters, catalogs, business cards, logos, and team uniforms, as well as overseeing their printing. The team also records the vehicle’s performance and ensures that the footage is edited and produced in a format suitable for social media content.

organization.

Yağmur Yasmin Emri

Zeynep Demirbaş

Şeyma Özer

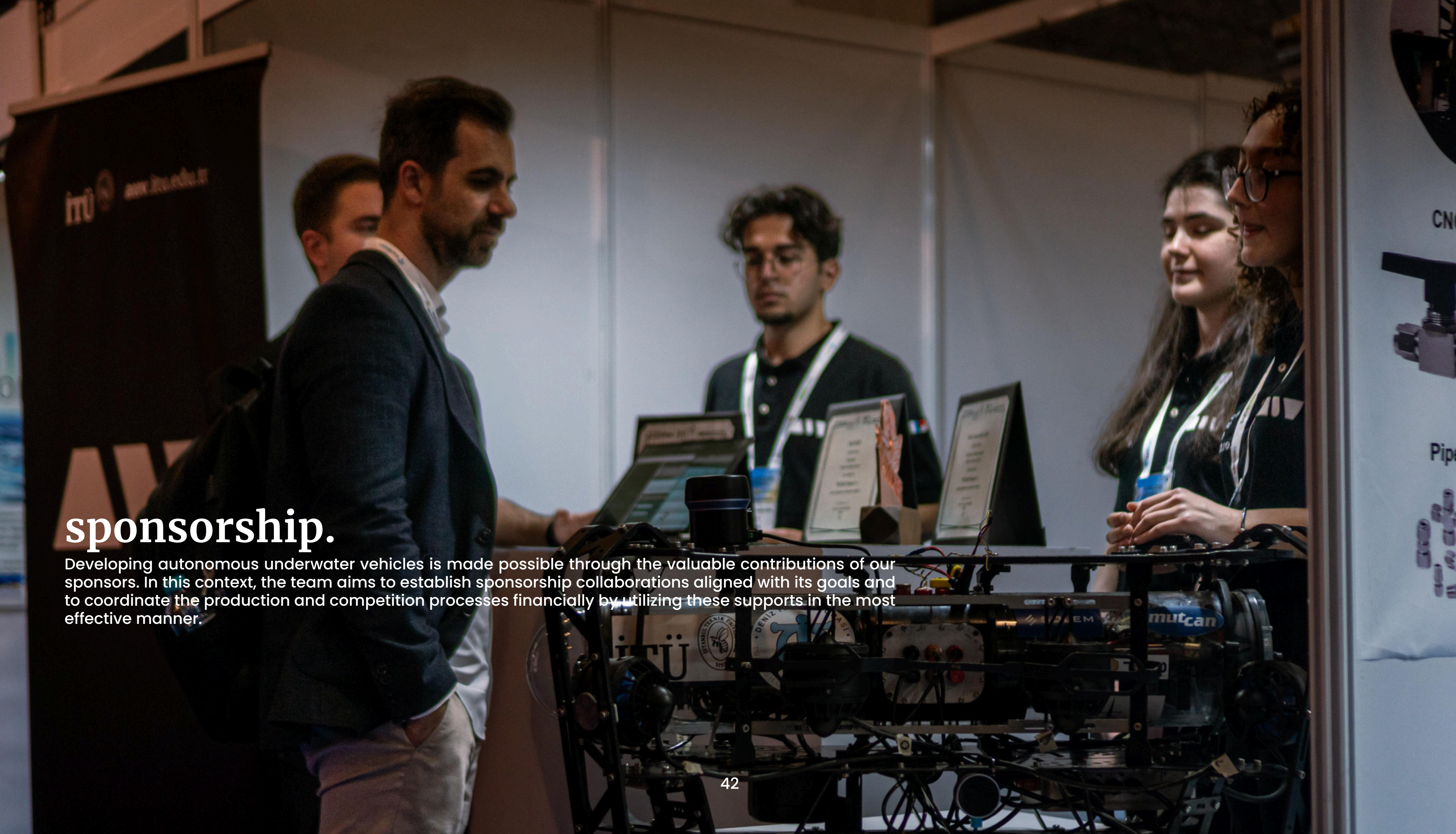
Ayşe Rana Karakuş

İlbey Fatih Şahin

Zeynep Sena Gülek

team.

This team undertakes essential responsibilities to ensure that the organization operates efficiently and effectively. Its duties include coordinating internal team activities, organizing testing processes, and maintaining communication with the university and faculty administration. The team also follows all competition-related documentation and requirements.



sponsorship.

Developing autonomous underwater vehicles is made possible through the valuable contributions of our sponsors. In this context, the team aims to establish sponsorship collaborations aligned with its goals and to coordinate the production and competition processes financially by utilizing these supports in the most effective manner.

sponsors.

T.C. SANAYİ VE TEKNOLOJİ BAKANLIĞI

#MİLLİ TEKNOLOJİ HAMLESİ

TÜBİTAK

TURKISH AIRLINES

İTÜ

İSTANBUL TEKNİK ÜNİVERSİTESİ 1773

İ.T.Ü. GELİŞTİRME VAKFI 1993

İMEAK DENİZ TİCARET ODASI TURKISH CHAMBER OF SHIPPING

INCE SHIPPING GROUP

TÜRKİYE GEMİ İNŞA SANAYİCİLERİ BİRLİĞİ 1971

AUTODESK

DenAr

LİNARİTE.AI

material suppliers.

PHOENIX CONTACT

PROCASE BOX INDUSTRY

İZELTAŞ

ÜNAL HARİTA

EKOM simply electronics

tesa

HUTEK Thermoforming Molds

SOLDEX

Altium

previous sponsors.

previous sponsors.

previous sponsors.

requirements.

Mechanics

- Production Cost
- Hardware Requirements
- Maintenance Cost

Creative

- Printing Expenses
- Rental Services
- Software Licenses

Organization

- Logistical Support
- Accommodation Expenses
- Competition Registration Fee

Software

- Server Setup
- Hardware Components
- License Fees

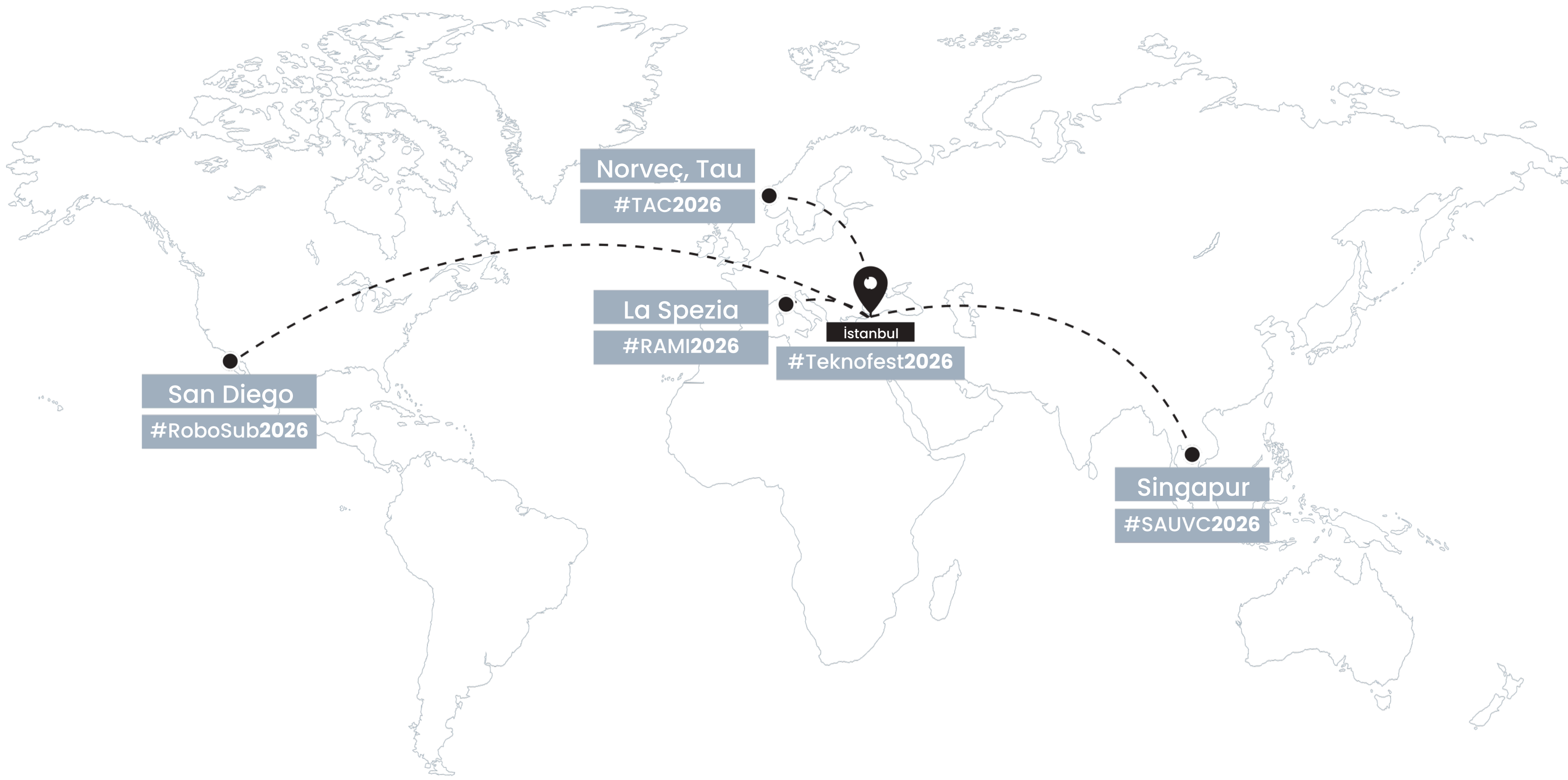
Electronics

- PCB Production
- Sensor Costing
- Component Support

packages.

	main sponsor	diamond 500 k	platin 250 k	gold 150 k	silver 70 k	bronze 30 k
thank-you post on social media	●	●	●	●	●	●
Inclusion of the company logo in the team portfolio	●	●	●	●	●	●
company name and logo featured on the team website	●	●	●	●	●	●
tax exemption	●	●	●	●	●	●
email newsletter	●	●	●	●	●	●
back sponsorship placement on the competition jersey	●	●	●	●	●	●
company logo placement on competition roll-up banners	●	●	●	●	●	
company logo placement on the RoboSub vehicle	●	●	●	●	●	
organization of social responsibility projects in partnership with the company	●	●	●	●		
Joint media and promotional collaborations	●	●	●			
promotion of the company on the team's YouTube channel	●	●				
chest sponsorship placement on the team uniform	●					
naming rights for the RoboSub vehicle	●					
decision rights over the RoboSub vehicle's color scheme	●					
team naming rights	●					

flight packages.



	thank-you post on social media	inclusion of the company logo in the team portfolio	company name and logo featured on the team website	tax exemption	email newsletter	back sponsorship placement on the competition jersey	company logo placement on competition roll-up banners	company logo placement on the RoboSub vehicle	organization of social responsibility projects in partnership with the company	joint media and promotional collaborations
1-2	●	●	●	●	●	●	●	●		
3-4	●	●	●	●	●	●	●	●	●	
5+	●	●	●	●	●	●	●	●	●	●

contact.

Phone

+90 530 862 80 05

E-mail

auv@itu.edu.tr

WEB

auv.itu.edu.tr

Social Media

LinkedIn @ituauvteam

Instagram @ituauvteam

Twitter @ituauvteam

YouTube @ituauvteam

Address

İTÜ Ayazağa Kampüsü BisikletEvi

34469 Maslak / İstanbul

catalog design.

Graphics & 3D Modeling

Namiq Mahmudov

Emre Orkun Kayran

Ozan Hakan Tunca

Content

Batuhan Özer Dinçer

Öykünç Emre Orkun

Kayran Namiq

Mahmudov Selen

Cansun Kırgöz

Sencer Yazıcı

Mustafa Yunus Diler

Photos

Namiq Mahmudov

Emre Orkun Kayran