

## Autonomous Robotic Vehicle Project

## Sponsorship Package 2023-2024



## OVERVIEW





### WHO WE ARE

Founded in 1996 at the University of Alberta, The Autonomous Robotic Vehicle Project (ARVP) is the oldest interdisciplinary Project Team on campus. ARVP develops technologies and students in robotics. Currently, ARVP focuses on Autonomous Underwater Vehicles (AUVs) to compete annually in the international RoboSub Competition held by the US Navy.

We serve students from all faculties, particularly engineering and computing science, so they may solidify their understanding with real-world problems through our four sub-teams. Each member is provided with the education and experience to become a subject matter expert in one portion of ARVP's vehicle design. ARVP also engages in community outreach to promote post-secondary education and demonstrate practical uses of robotic technologies.

### MISSION AND VALUES

ARVP advances, advertises, and applies autonomous robotics to largescale systemic issues. Self-managed by students, our members from all disciplines are provided opportunities to solve complex design problems, manage projects, give back to the community, and develop worldwide professional connections within a cohesive social network.

### **ARVP'S TRIPLE MANDATE**

#### SKILL DEVELOPMENT

- SubTeam Onboarding Challenges
- Ongoing Project Mentorship
- Industry-Related Project Portfolios

#### SOCIAL NETWORK

- Monthly & Weekly Social Events
- Philanthropic & Educational Outreach
- Cross-ESP & RoboSub
  Engagement

#### CAREER OPPORTUNITIES

- Company Visitations
- Industry Partnerships
- Vetted Resume Database

# COMPETITION







## ACHIEVEMENTS

In our aim to provide members with experiential learning opportunities, ARVP's rapidly expanding team has successfully achieved many technical milestones.

- Won **3rd Place** in the RoboSub 2023 **Autonomy Challenge** with Arctos
- Won best Team Video, Design Presentation, & Leader in Data Sharing for RoboSub 2023
- Doubled our team size and dramatically increased funding for RoboSub 2023
- Won 4th Place in the RoboSub 2022 Autonomy Challenge with Auri
- Won 4th Place in the RoboSub 2022 Technical Presentation with Auri

### WHAT IS ROBOSUB?

RoboSub is an international competition where **50+ teams** develop an Autonomous Underwater Vehicle (AUV) to complete an obstacle course.

Tasks include seafloor mapping, sonar localization, and underwater object manipulation. The weeklong competition normally takes place at the San Diego US Naval Warfare Systems Transdec Pool.

This event is held by RoboNation, a non-profit partnered with companies such as SolidWorks, Blue Origin, and Nvidia to promote STEM through 9 student competitions that **engage more than 250,000 students annually**.





# **COMPETITION 2023**



### CHIEF OF NAVAL OPERATIONS

What added an extra layer of excitement to this year's Robosub 2023 was the unexpected visit from Admiral Lisa Franchetti, the Chief of Naval Operations.

Her visit was fueled by admiration for the remarkable innovation and dedication exhibited by the competing teams. In a rare gesture, she personally awarded her coveted challenger token to the top team, a distinction typically reserved for outstanding service in the US military.





Our team's unwavering commitment extended deep beneath the surface as we relentlessly pursued our goal, resulting in our best performance to date. This extraordinary effort earned us the prestigious title of not only the leading team in Canada but also the top team from all of North America.

### OUR JOURNEY

At RoboSub 2023, a dedicated team of 28 ARVP members embarked on a remarkable 10-day journey. Notably, our AUV, Arctos, had its maiden plunge in February, which created a unique challenge for our team. We arrived to competition with a vision model that required comprehensive training and testing in a relatively short time frame.

The Software Team worked tirelessly, conducting late-night pool tests, with divers in the pool providing invaluable assistance in evaluating Arctos from electrical, mechanical, and software perspectives. These overnight sessions were crucial to Arctos' refinement.

Following these intensive overnight sessions, we embraced a demanding 12-hour day at the U.S. Naval Warfare Systems Transdec pool, where teams from across the competition came together to put their vehicles to the test, gather crucial data, and foster networking opportunities.



# STRUCTURE & PROJECTS

<u>arvp.org</u>





# ARVP HISTORY







# **ARCTOS SPECIFICATIONS**

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#### Torpedoes

**Dropper & Markers** 

Release two dropper markers that sink straight

down accurately for 10m as the markers'

helical fins induce the gyroscopic effect. The

nose of the marker dropper is machined out of

aluminum in-house on a CNC mill to balance

the dropper for sinking downwards.

The spring-propelled torpedo system is actuated by a single high-torque waterproof servo. It fires two torpedoes accurately to distances up to 2 meters. Torpedoes are balanced internally with foam and weights to improve flight stability. The torpedo housing is primarily 3D printed and uses sheet metal in the internal release mechanism.

#### Aluminum Hull

Claw

deformation.

Utilizes a parallel plate

mechanism with a soft gripper design

for ease of software integration and

robust manipulation of complicated

geometries. The soft gripper

mechanism is made out of 3D printed

TPU to allow for deformation and has

3D printed PETG ribs to control the

It has two entry points: the top lid contains and protects batteries, while the front lid allows for vision and PCB access. Both entry points utilize double O-ring seals for redundant safety waterproofing. Hull design and O-ring seals are rated for depths up to 20 meters.



### **Key Printed Circuit Boards**

#### **Battery Monitoring**

The 5 batteries, 8 ESCs, and 8 thrusters feed into the Battery Monitoring board where it monitors the voltage and current for Arctos. Includes reverse polarization protection and connection to a kill switch.

#### Carrier Board

Mother-Daughter setup to split power into 5V and 12V. Connects to respective distribution blocks and the network switch.

#### • Internal Environment Board

Essentially provides environment information. This includes temperature, pressure, and humidity. Displayed on an OLED screen.

#### Actuator Board

Provides information to Dropper, Torpedo, Claw1, and Claw2 Servos. Communicates with these to drop, fire, or grab.

### COOLING

The main heat generators, NVIDIA Jetson Orin and Li-Polymer batteries are positioned directly against the walls of Arctos. This allows the thermal properties of the aluminum hull to water-cool these components. When in water, the onboard computer only reaches a maximum temperature of 40 degrees Celsius.

#### SOFTWARE STACK

Arctos' vision detection system's machine learning models communicate object positions to our mapper, and sensor fusion updates the position of the robot. From there our behavior tree compares conditions to launch specific missions including motion, object interaction, and recovery behavior.

## COMPONENT SPECS

- On-Board Computer: NVIDIA Jetson Orin
- Main Sensor Nortek Nucleus 100 Doppler Velocity Log
- Vision Systems: ZED 2i Stereo Camera
  - Thrusters: 8x Blue Robotics T200
- Batteries: 5x 100Wh Hobby Lithium Polymer Batteries

### SOFTWARE DEPENDENCIES

RO2

C++

claw

- NVIDIA CUDA
- - Gazebo Simulator
- Python 3
- OpenCV
- YOLOv7
- Py Trees

<u>arvp.org</u>

2023 ARVP Formal

## ARVP'S COMMUNITY

As part of our triple mandate, ARVP makes a continual effort to provide learning opportunities for our members. In particular, we focus on interdisciplinary projects involving collaboration with all teams. With this method, ARVP is able to provide productive hands-on learning while still opening members up to knowledge from other fields - effectively mirroring the structure our sponsors and partners in the robotics industry!

ARVP hosts monthly social events for our members. School is often an alienating and lonely experience. Thus, ARVP strives to make conditions for strong social networks including snacks, holiday events, seasonal competitions, and weekend get-togethers. We also strive to improve bonds with the other student project teams by sharing resources, documentation, opportunities, and direct teaching.

ARVP's social focus also extends beyond UofA. Our primary focus is educational outreach to primary, middle, and high school students. This takes the form of live demonstrations of Arctos' capabilities and guest teaching robotics classes. As we gain non-profit status, our scope is expanding to mentoring high school robotics teams and potentially hosting robotic competitions.

The team is also closely tied to the robotics industry in Alberta. Throughout the year, the team provides demonstrations and tours from our company sponsors - preparing our students for industry application of their technologies.

REACH

2023 Copperstone Visit

2023 UofA Open House

2023 ARVP Highschool Meet



# GOALS







# FINANCES

\$20,000

\$11,850

ESC

Replacements

\$ 2,500

\$ 5,000

\$ 5,000

PCBs

\$ 4,750

BUDGET

BUDGET

Electrical

CATEGORY

BUDGET

Project

Completion

BUDGET

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ELECTRICAL

15.4%



ADMIN

39.6%



\$15,000

\$1,200

Pinger

\$ 3,000

\$ 11,500

\$ 11,400

Acoustic

Modem

\$1,600

# SOFTWARE 25.1% All Competition

Q2

Q3

04



## TOTAL \$ 29,450 TOTAL \$ 11,850



CATEGORY	Equipment	Manufacturing	Testing Procuremen	t Other	TOTAL
BUDGET	\$ 28,900	\$ 5,400	\$ 2,000	\$ 1,700	\$ 38,000
Equipment	Replacements	Obstacles	Tools	Stock Material	TOTAL
BUDGET	\$ 9,400	\$ 900	\$ 1,100	\$ 17,500	\$ 28,900

### \$ 15,000 \$10,000 \$ 5,000 **\$** 0 Q1 Q2 Q3

All Equipment

## Software

CATEGORY	Sensors & OBC	Subscriptions	Computers & Laptops	Other	TOTAL
BUDGET	\$ 39,500	\$ 600	\$ 6,000	\$ 2,000	\$ 48,100
EQUIPMENT	Cameras	Jetson Orin	DVL	Fiber Optic Gyroscope	TOTAL
BUDGET	\$ 1,500	\$ 5,000	\$ 10,000	\$ 23,000	\$ 39,500



## MECHANICAL 19.9%

\$ 5,000

\$ 20,000

**\$** 0

QI

\$ 51,500

# SPONSOR BENEFITS



### **DEVELOP THE FUTURE**

ARVP's core objective is to serve as a wholesale development process for young adults interested in mechatronics and robotics. By sponsoring ARVP at the partnership level, you allow students to grow their technical strengths while simultaneously improving your technology. Furthermore, our vetted resume database can expedite your company's search for newly graduated talent.

### **EXPAND YOUR REACH**

Our team is composed of passionate students starting internships, running community outreach events, presenting our work to UofA donors, and sharing their passion with other young adults internationally. By sponsoring ARVP at the support level, you allow the team to champion your brand through our events, achievements, and testimonials to help reach your target audience.

### SUPPORT THE COMMUNITY

As part of our triple mandate, ARVP is committed to being a social hub for all students. Social events, skill building, and a common goal are all fundamental to ARVP creating a support network for every student we can. By providing a donation to the team, you help foster our community, greenlight small projects, and contribute to the overall improvement of our members' university experience.



Donations and sponsorships are accepted in both cash and in-kind contributions. Benefits are maintained for three years.

Lifetime contributions are maintained through ARVP's website and support plaque. The plaque is displayed predominately in the ARVP workspace with a banner stand-in at the international RoboSub competition.



Thank you to our generous sponsors. Our continued success is only possible through your contributions and support.

















