



ILLINOIS AUV

Sponsorship Prospectus 2017-18

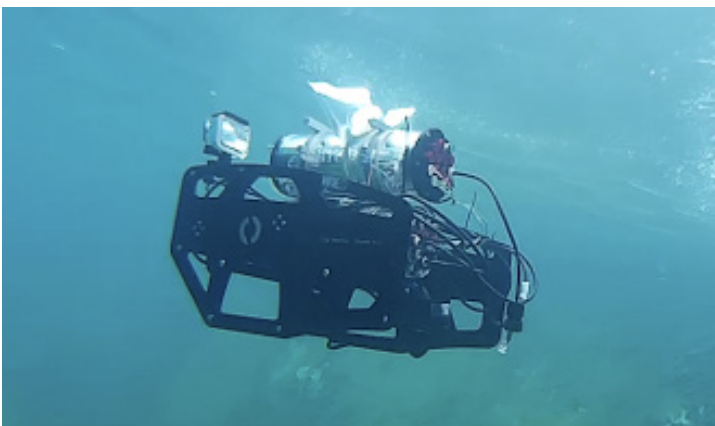
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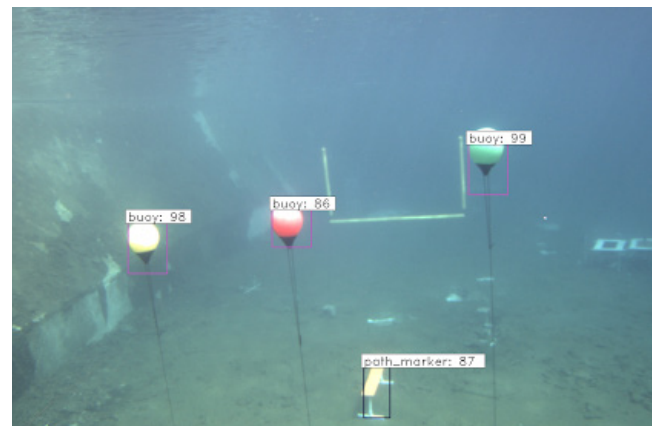
The Illinois AUV team at RoboSub 2017 in San Diego, CA



Configurations to the submarine (Enigma) before its semi-final run



Enigma during its last semi-final run



Our neural network in action helping the submarine in identifying buoys

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overview

We are a student-run organization with an aim to build an autonomous underwater vehicle to compete at the international RoboSub competition organized by RoboNation, sponsored by the Association for Unmanned Vehicle Systems International (AUVSI). The competition is held at the Space and Naval Warfare Command Research facility in San Diego, California. The overarching goals of our organization are:

- Implementing cutting-edge technologies such as deep learning, computer vision and artificial intelligence
- Conducting thorough research to investigate different ways to build autonomous robots and find best practices
- Bringing people with different skillsets from different backgrounds to pursue a common goal
- Create a collaborative learning environment and knowledge base for improving resources to learn and skills relating to artificial intelligence and robotics
- Build a submarine that is worthy of achieving our ambitious goals and representing the University of Illinois in the Robosub pool
- Cause disruption by aggressively pursuing challenging projects such as inter-submarine communication

Areas of Interest



ACM and SIGBOT

Illinois AUV is a part of SIGBOT, a special interest group within ACM@UIUC focused on the applications of robotics.

ACM is a group of dedicated people who are interested in exploring the possibilities of computers and learning more about how to use and develop them. ACM@UIUC is largest student run group on campus.



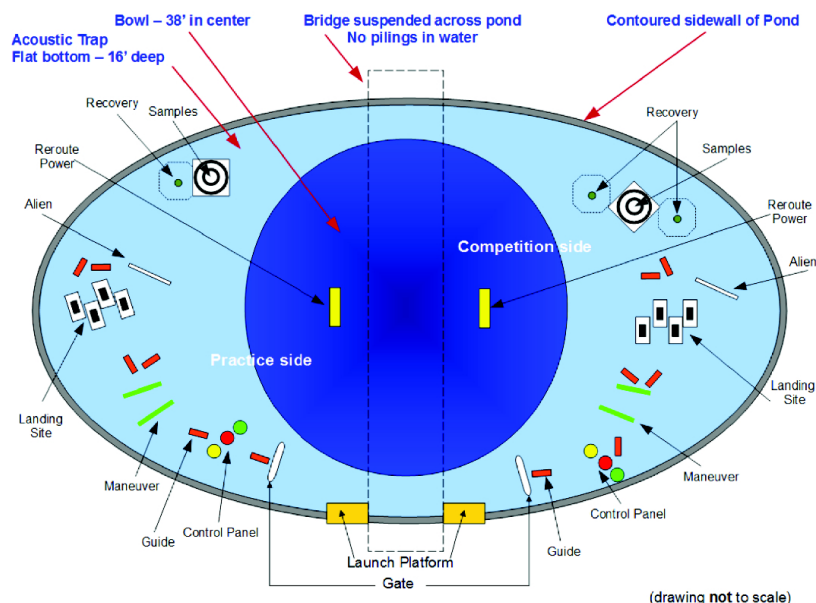
about the competition



The international RoboSub competition receives participation from 50 teams from around the world. All participating teams have to **make an autonomous submarine from scratch to perform a variety of visual and acoustic-based challenges** designed by competition judges. The course design and tasks are subject to change each year. The competition design and rules are released one month before the competition.

The objective of the competition is for the submarine to autonomously navigate the underwater course. This involves recognizing objects such as buoys, dropping markers, shooting torpedos at targets, following pipelines and a variety of other complex tasks.

- To begin the course, the vehicle must pass through a validation gate.
- Then, the vehicle must past three colored buoys in a pre-defined sequence.
- The vehicle must then pass through a gate marked by a horizontal pipe capped by risers on either side.
- The vehicle must then fire torpedoes through designated holes marked by various numbers after removing their covers.
- An acoustic pinger leads the vehicle to an object that must be captured by the vehicle when it surfaces. The vehicle must surface fully inside an octagon recovery zone.



faculty advisors



Dr. David Forsyth

Professor David Forsyth currently occupies the Fulton-Watson-Copp chair at the Computer Science department here at Illinois. Prior to UIUC, he was a full professor at UC Berkeley. He has published over 130 papers on computer vision, computer graphics and machine learning. He has also served as program cochair for IEEE Computer Vision and Pattern Recognition in 2000, 2011, and 2018, general co-chair for CVPR 2006 and 2015, program co-chair for the European Conference on Computer Vision 2008, and is a regular member of the program committee of all major international conferences on computer vision. Professor Forsyth has served six years on the SIGGRAPH program committee.



Dr. Volodymyr Kindratenko

Professor Volodymyr Kindratenko is a Senior Research Scientist at the National Center for Supercomputing Applications (NCSA) - home of Blue Waters supercomputer - one of the largest high-performance computing (HPC) resources available for open academic research. He is also an Adjunct Associate Professor in the department of Electrical and Computer Engineering. At NCSA, he works on the development and deployment of next-generation HPC systems based on computational accelerators and on the design and implementation of scientific applications for such systems.



Dr. Tim Bretl

Professor Tim Bretl received his B.S. in Engineering and B.A. in Mathematics from Swarthmore College in 1999, and his M.S. in 2000 and Ph.D. in 2005 both in Aeronautics and Astronautics from Stanford University. Since 2006, he is an Associate Professor of Aerospace Engineering and a Research Associate Professor in the Coordinated Science Laboratory. He received the National Science Foundation Faculty Early Career Development Award in 2010. Professor Bretl heads the Bretl Robotics Group, which works on many innovative robots.



Dr. Naira Hovakimyan

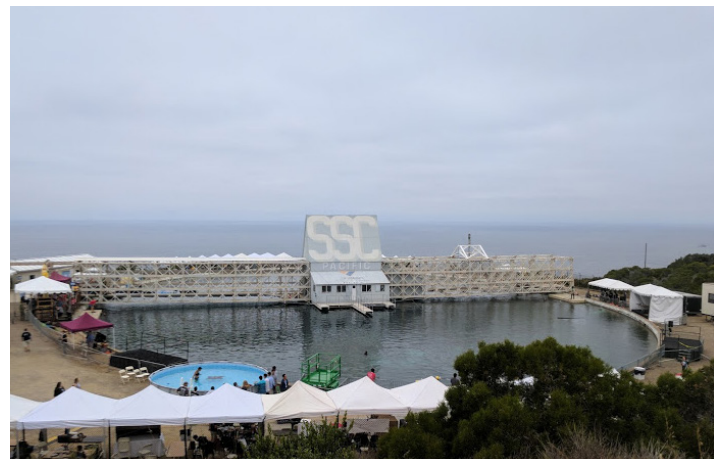
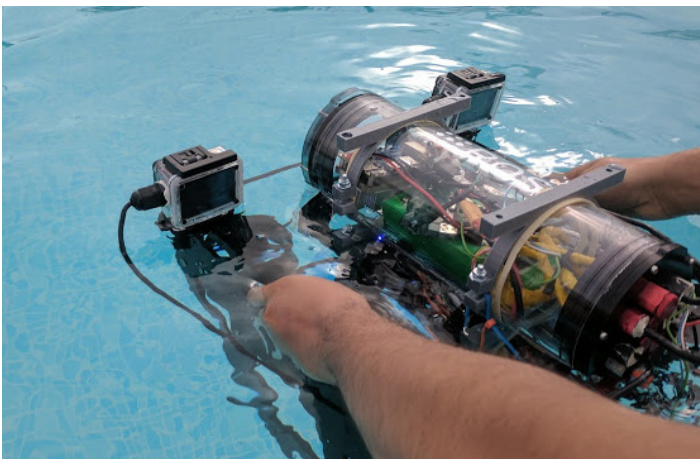
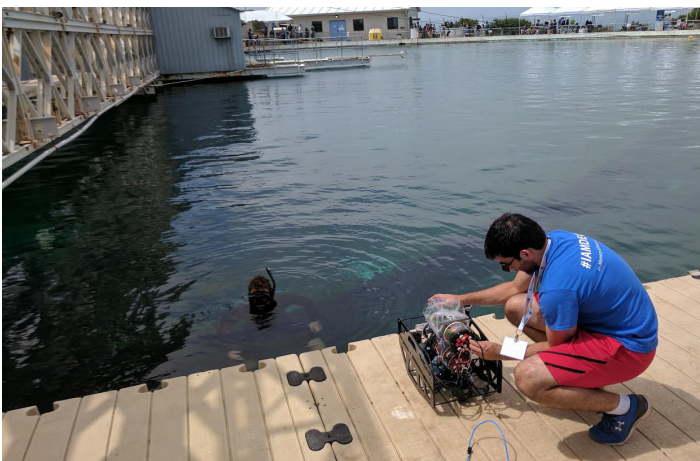
Professor Naira Hovakimyan received her MS degree in Theoretical Mechanics and Applied Mathematics in 1988 from Yerevan State University in Armenia. She got her Ph.D. in Physics and Mathematics in 1992, from the Institute of Applied Mathematics of Russian Academy of Sciences. She is currently W. Grafton and Lillian B. Wilkins Professor of Mechanical Science and Engineering at UIUC. In 2015 she was named as inaugural director for Intelligent Robotics Lab of CSL at UIUC. Her research interests are in control and optimization, autonomous systems, neural networks, game theory.

competition summary

Robosub 2017 was very successful for Illinois AUV. This was our first year at the competition. We were competing against the teams who have been coming to the competition for the past 10 years. Illinois AUV had the most powerful submarine relative to its size.

We were able to qualify for semi-finals, which is a great achievement for a first year team.

TRANSDEC navy pool is only open to public for the RoboSub competition during the summer. Therefore, collecting data specifically in the Transdec pool provides a major competitive advantage. The competition allowed us to gather a large amount of data, which we will use to train neural networks and improve the submarine's autonomous motion. We were able to make great connections with other teams and lay a foundation to build upon in the next competition.



innovation and roadmap

Innovation

For RoboSub 2018, our flagship innovation will be the implementation of an inter-submarine communication system. This has never been achieved before in RoboSub history, and will provide us great competitive advantage. Having multiple submarines will enable us to parallelize the tasks and finish the course much faster. The submarines will also be able to coordinate specific tasks, for instance, when shooting torpedoes one submarine will be able to provide a different frame of reference to obtain a better estimate of the target. To achieve this, we are working with an underwater wireless communication startup OceanComm.

One of the biggest challenges in the competition is accurate underwater localization. This task is extremely difficult since GPS doesn't work underwater. In addition, there aren't enough features in most of the pool for accurate visual mapping. Many teams use a Doppler Velocity Logger (DVL), a \$16,000 hardware which provides accurate velocity estimates. An extra feature of the OceanComm modems is position estimates using range and angle of arrival between two modems. These position estimates are accurate, and will allow us to localize the robot without the use of an expensive DVL.

To help improve position estimate accuracy, we will also be running Simultaneous Localization and Mapping (SLAM) and visual odometry in regions that contain enough features. Velocity and trajectory estimates generated by visual odometry will be used by SLAM for localization, resulting in better position estimates. We will calibrate these position estimates with those provided by the Oceancomm modem, which result position estimates accurate within a meter.

Fall 2017

- Final submarines with fully functional mechanical and electrical systems
- Neural networks running in real-time
- Inter-submarine communication working

Spring 2018

- Optimizing inter-submarine communication and software for dynamic tasks.
- 100 hours of water testing

Summer 2018

- Water testing and competition preparation
- Compete in RoboSub 2018 and reach finals

sponsorship opportunities

Expenditure

In addition to the guidance from our esteemed faculty advisors, we are primarily dependent on partnerships with generous sponsors to embark on this journey. We aim to build a submarine capable of navigating an underwater course, and reaching the finals of an international competition. This will require significant, but intelligent expenditure. A significant fraction of our expenditure will be utilized in buying parts, such as sensors, hydrophones, GPUs, depth sensors and batteries. In addition to using the software for analysis and CAD available in engineering labs, we anticipate the need for purchasing licenses for key softwares when we are out pool testing or at competition. After building the submarine, we'll also incur expenses relating to logistics, such as travel, lodging and transportation costs. Furthermore, there will always be things breaking, as we strive to build a submarine to navigate complex challenges through an underwater course. Hence, we must also take into consideration contingencies and miscellaneous costs.

Opportunities

Building an autonomous underwater vehicle is not for the faint-hearted. A partnership will provide access to driven STEM students working with world-class faculty on exploring cutting-edge technology and applying it to solve a real-life challenge. In addition, there are numerous opportunities for representation of your company's name and logo on team apparel, the website, posters, and even the submarine. In addition, we plan to host testing at the Urbana community pool, and reach out to interested high-school students and engage them. Before the competition, the team also publishes and submits a research paper, outlining the research and innovation that went into building the submarine. As a sponsor, your company's name will be included on that paper. We are also open to non-monetary sponsorships, through which donations of parts, software licenses and airfare waivers can be made. Partnering with us connects you with one of the best engineering talent pools in the world. Illinois Engineering is home to 16 state of the art engineering programs. You will be able to reach students working on some of the most challenging problems. With the help of ACM@UIUC we can help you to reach Illinois students by organizing information sessions. We will help generate the buzz and bring the best talent to your sessions.

sponsorship bundles

Diamond

\$5000

- Priority representation on submarine
- Priority representation on team apparel
- Priority representation on team website
- Company name on journal paper
- Priority representation on team poster
- Access to resume books (Both Illinois AUV and ACM)
- Assistance with setting up info sessions on campus

Gold

\$2500

- Representation on submarine
- Representation on team apparel
- Representation on team website
- Representation on team poster
- Access to resume books (Both Illinois AUV and ACM)

Silver

\$1000

- Representation on team apparel
- Representation on team website
- Representation on team poster
- Access to resume books (Both Illinois AUV and ACM)

Aqua

Not what you had in mind? Get in touch and we can work together to build a custom sponsorship bundle. Please look for contact information on the next page!

contact

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Thank you to our 2016-17 Sponsors

We are incredibly grateful to our 2016-17 sponsors, who helped us achieve a strong finish at our first ever RoboSub competition.

The Schlumberger logo, featuring the word "Schlumberger" in a bold, blue, sans-serif font.The Microsoft logo, consisting of four colored squares (red, green, blue, yellow) followed by the word "Microsoft" in a grey, sans-serif font.The Advanced Circuits logo, featuring a green stylized 'C' with a circuit trace, followed by the text "ADVANCED CIRCUITS" and "4PCB" in a grey, sans-serif font.The NVIDIA logo, featuring a green stylized eye icon above the word "NVIDIA" in a bold, black, sans-serif font.The Wittenstein SORF logo, featuring a stylized blue and black three-lobed icon above the text "WITTENSTEIN" and "SORF" in a blue, sans-serif font.