



# Caltech

# 2016 - 2017

## SOCIAL MEDIA

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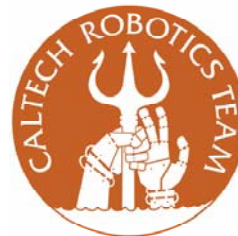
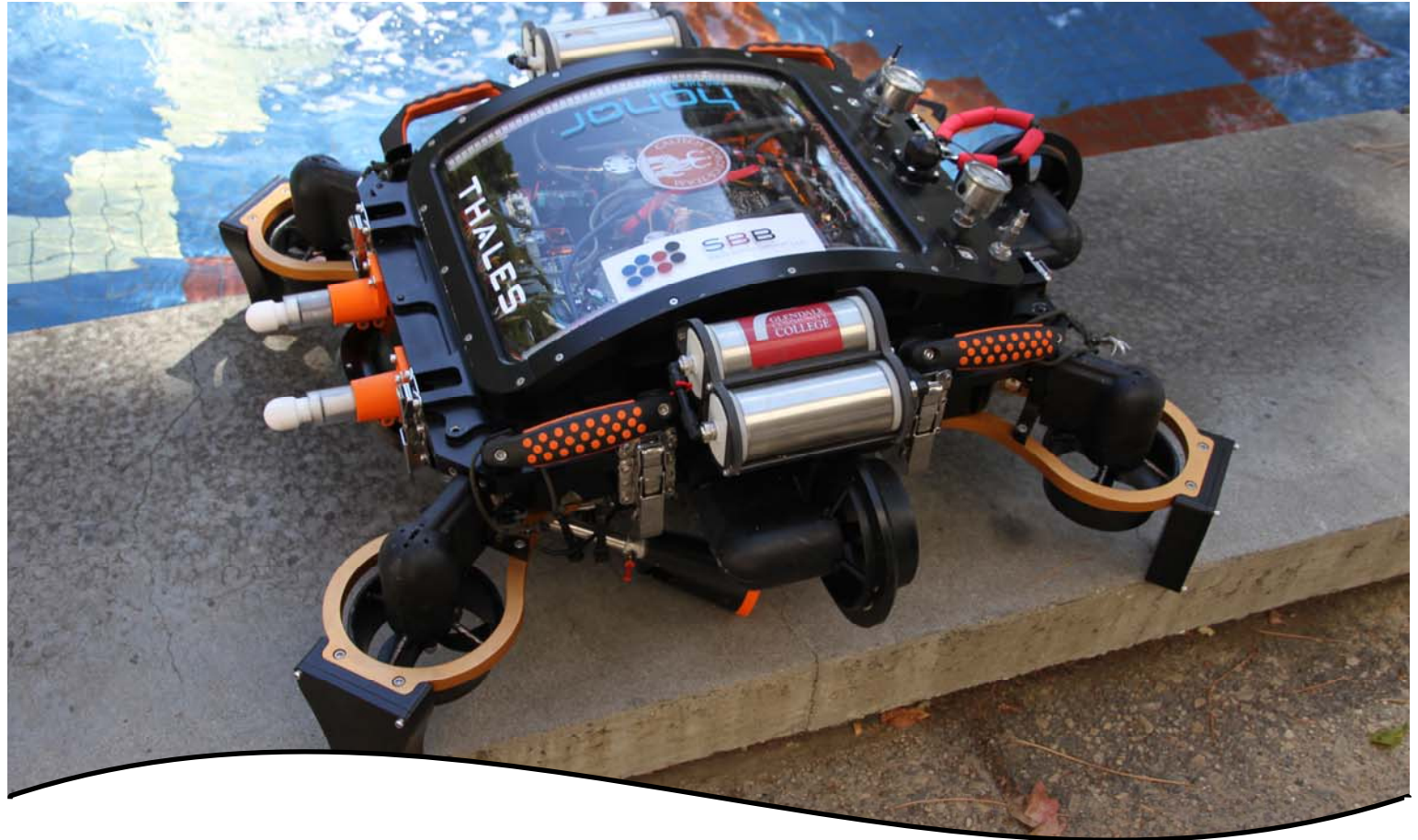
[Twitter.com/CITSubTeam](https://twitter.com/CITSubTeam)

Julia Deacon

Fundraising & Outreach  
Manager

[jcdeacon@caltech.edu](mailto:jcdeacon@caltech.edu)

805-319-9400



# CALTECH ROBOTICS TEAM

# WELCOME

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## THE TEAM

Consists of 45 undergraduates passionate in exploring the cutting edge of unmanned systems.

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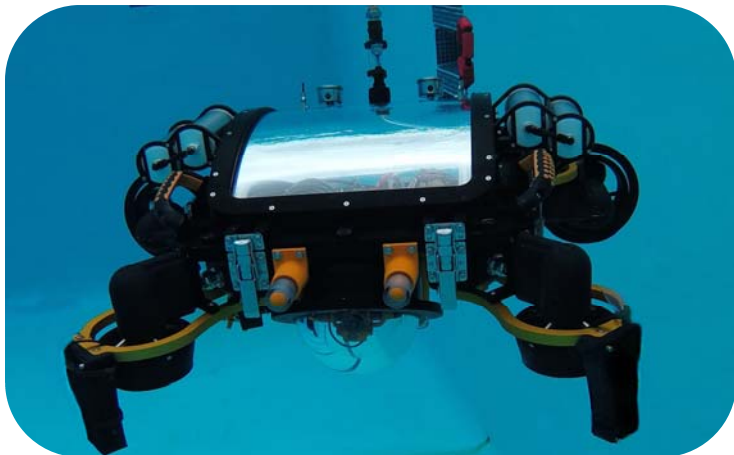
## THE ROBOT

Can navigate underwater obstacles, aim and shoot torpedoes, and recognize competition elements completely autonomously.

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## THE CHALLENGE

Is AUVSI/ONR's International RoboSub competition where participants must complete a punishing, underwater obstacle course completely autonomously.



# SPONSORSHIP LEVELS

## Pond Level (\$1+)

Logo placement in our final research paper and website.

## Lake Level (\$100+)

Logo placement in CRT literature.

Logo placement in our final research paper and website.

## Sea Level (\$1000+)

Logo placement on team jerseys.

Prominent logo placement in CRT literature.

Prominent logo placement in our final research paper and website.

Access to all Caltech Robotics Team résumés.

Access to design teams and students.

## Ocean Level (\$5000+)

Prominent logo placement on submarine.

Prominent logo placement on team jerseys.

Premiere logo placement in CRT literature.

Premiere logo placement in our final research paper and website.

Lead mention in all Caltech media outreach.

Priority access to all Caltech Robotics Team résumés.

Priority access to design teams and students.



# WHY SPONSOR US?

For undergraduates at Caltech, the benefits of the team are innumerable. They include working in design teams, project planning, and time management; design-making in an uncertain environment; discovering the benefits of prototyping, testing, and creating modular, easy-to-repair devices; working alternatively between design and manufacture; and experiencing open-ended problem solving.

The sponsorship of the Caltech Robotics team provides many benefits beyond the satisfaction of helping student-engineers pursue their passion for robotics. Sponsorship entitles company representatives to attend the pre-competition send-off reception dinner and final vehicle test run, meet the students, peruse our team resume book, as well as receive visibility in the form of logos on our jerseys, submarine, and team banner that we will take with us to the RoboSub Competition.



## Mechanical Team

This team led by Jeffrey Orenstein designs and manufactures the chassis of the submarine using the principles of hydrostatic stability and hydrodynamics. One of their main responsibilities is to design a sealing system to make sure that the inside of the hull stays dry under twenty feet of water. They also construct the propulsion system and design a pneumatic system to operate a gripper and torpedo launcher.

## Programming Team

This team led by Kushal Agarwal makes the submarine intelligent and controllable. They program both the low-level microcontroller code and the high-level AI and computer vision code. Their main responsibility is to take the platform provided by the electrical and mechanical teams and mold it to complete the specific tasks required by the competition. For tools, they use C++ on ArchLinux and OpenCV for computer vision.

## Electrical Team

This team led by Frank Zhou powers and wires the submarine and provides computing hardware to the programming team. In addition, they design and implement the sonar pinger heading system. The team will implement a serial bus so that each PCB on the sub (eg the sensor input board, the motor/actuator board, etc.) can communicate easily with each other and the computer.

## Outreach Team

This team led by Julia Deacon raises the funds necessary for the project to complete its objectives. They forge partnerships with corporations who want to support students to gain real-world engineering experience. In addition, this team works with K-12 students—especially students underrepresented in STEM fields—to encourage the pursuit of STEM education.



# THE TEAM AT A GLANCE

The Caltech Robotics Team is comprised of 45 undergraduates with specialties spanning 10 majors and freshman through senior classes, as well one faculty mentor. Through the rigorous core curriculum at Caltech and the atmosphere of total scientific and engineering immersion, the team members begin taking on roles of leadership their freshman year and continue to gain extremely valuable technical experience through their four years at Tech.



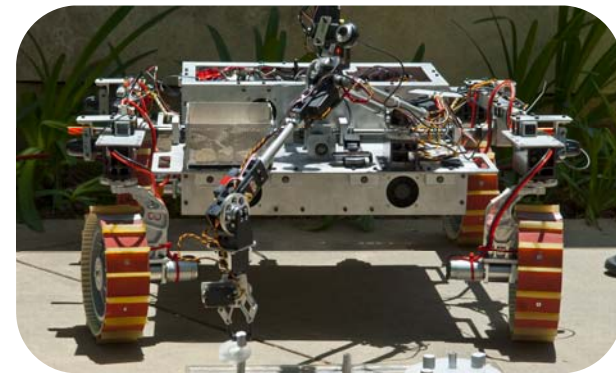
## THE MISSION

The Caltech Robotics Team researches new solutions to existing problems in robotics through competing in various robotics competitions. Through this we aim to gain both knowledge and experience of the various disciplines which comprise the field of robotics, including computer programming, electrical and mechanical engineering, and systems engineering. In creating these robotic vehicles, we pursue our multi-faceted interests in cutting-edge technology and look to share these interests with others through community outreach. We believe in the importance of inspiring interest in the STEM fields, and aspire to use the knowledge and experience gained from designing and building these vehicles during and after our time at Caltech to impart the beauty and importance of our fields.

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# OUR EXPERIENCE

The Caltech Robotics Team was founded in 2011 to compete in the NASA RASC-AL Robo Ops competition. We tele-operated a rover over the internet to collect colored rocks on rough terrain using an omni-swerve drive system, rocker-bogey suspension, and six degrees of freedom arm. We placed 2nd and won \$4000. Two years ago we participated in the 2014 AUVSI RoboSub competition. Our entry, "Bruce", charged through gates and detected buoys to a powerful performance in the competition. At the end of the competition we earned 7th place and were presented with the \$500 prize for Best New Entry. Last year we returned for the 2015 competition with a more robust entry, "Crush", who advanced all the way to the finals and finished 4th, earning us \$1000.



**This past summer, we returned once again for the 2016 Robosub competition with our most highly developed entry, "Dory." Earning us \$6000, Dory achieved first place!**

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# THE LEADERS

**TYLER OKAMOTO**

**Project Manager**



Tyler Okamoto is a senior at Caltech studying mechanical engineering. Tyler most recently worked as an intern at SpaceX.

**JEFFREY ORENSTEIN**

**Mechanical Team**



Jeffrey Orenstein is a junior at Caltech studying mechanical engineering. Jeffrey most recently worked at JPL.

**FRANK ZHOU**

**Electrical Team**



Frank Zhou is a senior at Caltech studying electrical engineering. Frank most recently worked in the Hajimiri Lab at Caltech.

**JULIA DEACON**

**Fundraising & Outreach Team**



Julia Deacon is a sophomore at Caltech studying computer science. Julia most recently worked on a bunch of different projects.

**KUSHAL AGARWAL**

**Programming Team**



Kushal Agarwal is a senior at Caltech studying computer science. Kushal most recently worked at Google.



# THE SPONSORS

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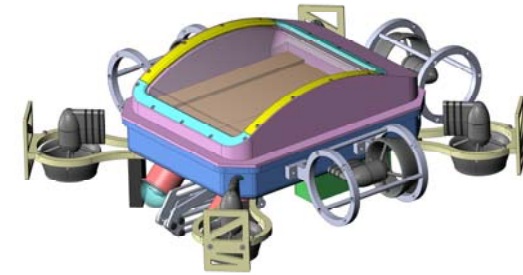


# ABOUT THE COMPETITION

The RoboSub competition sponsored by the Association for Unmanned Systems International (AUVSI) Foundation and the Office of Naval Research will be taking place at the TRANSDEC facility at SSC Pacific in San Diego in July 2017.

The competition consists of a variety of tasks to complete autonomously including:

- Identifying and ramming a correctly colored buoy
- Shooting a torpedo through the correct cutout
- Locating a SONAR pinger
- Turning a wheel and pulling a lever
- Passing over a bar at a specified depth



## THE VEHICLE

The mechanical design of our 2017 vehicle represents a major leap forward from previous years. The vehicle will support two wide-angle cameras, a servo-actuated manipulator arm, electromagnetically released torpedoes and markers, an all-new pressure hull design, and the latest videoray M6 thrusters. These systems build off of the team's successful heritage of vehicle design and construction, while still presenting an exciting challenge to our members. Our reliance on electromechanical systems allows the elimination of a high-pressure pneumatic line, which greatly simplifies system design and execution. All in all, our 2017 vehicle will be our best yet.

## THE MENTOR

**JOEL W. BURDICK**

**Richard L. and Dorothy M. Hayman Professor  
of Mechanical Engineering and Bioengineering at  
Caltech**

Professor Burdick focuses on robotics, kinematics, mechanical systems and control. Active research areas include: robotic locomotion, sensor-based motion planning algorithms, multi-fingered robotic manipulation, applied nonlinear control theory, neural prosthetics, and medical applications of robotics.

