Welcome!

Thanks for your interest in UR@B's mechanical engineering subteam! In the past, members have joined the team after submitting an application and participating in interviews. This year, we're using an introductory project to obtain new members. You don't need any prior experience or major requirements to complete this project; as long as you follow the instructions on this page and submit the assignment, you can start the onboarding process.

What is the mechanical engineering subteam at UR@B?

There are four subteams at Underwater Robotics at Berkeley: mechanical, electrical, perception, and controls. The mechanical engineering subteam is in charge of the design and construction of an autonomous underwater vehicle (AUV). This means designing the layout and arrangement of parts (thrusters, cameras, manipulator arms, etc. attached to a frame), determining the materials used for each part, and manufacturing of components using UC Berkeley makerspaces.

What do I need to do to join this subteam?

Computer-aided design, or CAD, is an integral part of our design process. When we have an idea for the AUV's shape or one of its components, the first step is to translate this idea to a 3D model that we can share with teammates. The intro project to join this subteam is intended to solidify your skills in CAD and give you an opportunity to contribute your ideas to our design process. Your assignment is to use one of the two CAD programs we use, SolidWorks or Autodesk Fusion 360, to create a 3D model of an AUV chassis you think would do well being used for an underwater robot.

NOTE: The intro project is not meant to be intimidating. The goal of the project is to get you skills that you may not already have, or get you an idea of how we use skills differently. The mechanical team lead will walk you through the entire project if necessary, but we encourage you to complete as much on your own as possible. Please contact the mechanical lead, Ronan Loberg, if you need assistance.

How do I complete the intro project?

Follow this series of steps to submit your intro project:

1. Download one of the CAD programs used at UR@B. Fusion 360 is free to download as a student. If you already have Solidworks from a class, you are free to use that, otherwise solidworks licenses will be given out to dedicated members in a few weeks.

To download fusion, use these steps:

a. Follow this link to visit the Autodesk website's page for educational access.

b. Click the "Sign in" button on the top right corner.

c. Click ‘Create Account” and fill out the information on the next page, using your UC Berkeley email address.

d. Follow the instructions on the web page to verify your email address.

e. While signed in, return to the educational access page and click on “Products” on the left menu. Under “Educational access,” click “Download your software.”

f. Choose Fusion 360 to download onto your device.

2. Use online tutorials to get more familiar with CAD software.

If you’re new to the CAD program you’re using, consult online resources to learn the basic functions you’ll need to complete a design. If you’re using SolidWorks, visit their training website for lessons on various features and modeling types. There are also several training videos online that walk you through CAD programs. If you’re using Fusion 360, scroll through Autodesk Academy to find training videos, articles, and online courses.

3. Think about the general requirements for the AUV.

The AUV will need to complete different tasks each year, but there are several components that are necessary no matter what the tasks are. For the intro project, the required components are the chassis (frame), thrusters, and electronics housing (or region for electronics). Feel free to add more components if you have time or curiosity.

● Chassis: a frame structure on which to attach the rest of the components. For inspiration, look online at past robots.

● Thrusters: motors with propellers to move the AUV through the water. Typically, we have six thrusters in total: two for vertical motion, and four for horizontal motion, arranged in a vector configuration. This typically yields omni-directional motion. An example of a thruster (and the kind that we use) can be found here. If you have an alternate idea for how to arrange the thrusters or how many to include, go for it!

● Electronics housing: a watertight container to protect onboard electronic equipment, including a battery, PCBs, ESCs, etc.

- Extra components you can add include Camera (front facing and/or downward facing), Claw, launcher, or buoyancy apparatus.

The Robosub competition requires all AUVs to fit inside a six-foot-long, three-foot-wide, three-foot-high box (in metric, 1.83 m by 1.91 m by 0.91 m). This is a large size limit, but it’s beneficial to make the AUV even smaller to help it move more quickly through the Water. We also get bonus points for having a small bot, and more points for a sleek looking design.

4. Look at the Robosub task ideas.

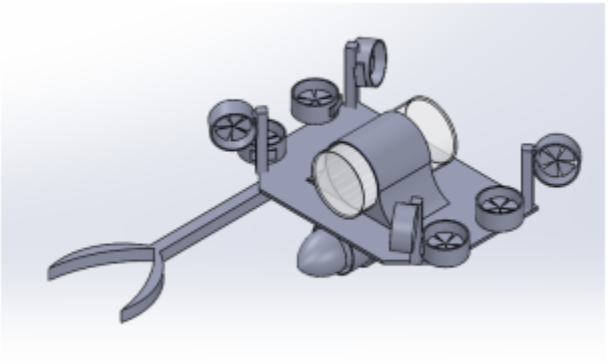
Reviewing the information released for last year’s competition will give you an idea of what the AUV will need to do during the mission. This will tell you what payload tools

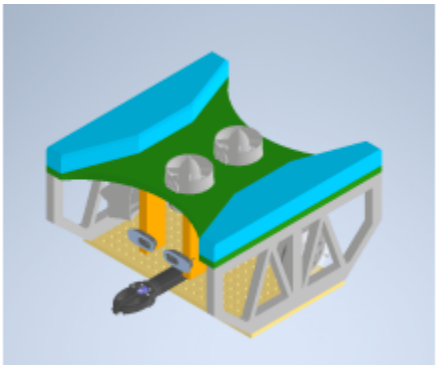
are needed in addition to the components described in the above step. A claw arm, hook, or even a torpedo launcher may need to be on the vehicle, depending on the task descriptions for the year. The handbook for the 2022 competition is found here. The details are left purposely vague.

5. Take inspiration from past competitive designs and professional AUVs.
The Robosub website has an archive of past competitions, where you can look at technical documentation from winning teams in previous years. You can also look at AUVs built by professional engineers, such as the ones at MBARI or WHOI. Take note of how these examples arrange components, address size constraints, and protect sensitive equipment.

6. Consider how the chassis can be manufactured.
There are many different possible approaches to manufacturing the chassis, and this determines what shape can be produced. Some teams use laser cutting or CNC machining to create frame panels, while others construct frames from rods and custom joints. Decide which manufacturing strategy will lead to the best product while retaining feasibility. You can look at the Makerspace websites across campus, such as Jacob's Hall, to find potential tools for manufacturing. We will teach you any hardware/manufacturing skills that you need.

7. Put together a CAD model of an AUV based on the above criteria.
Use the software you've downloaded to visualize your own design idea. This model doesn't need to have all the specifics down— exact dimensions, detailed design of payload tools, etc. — but should include a reasonable chassis design and thoughtful arrangement of parts. See some examples below from past years (these may include different components from the ones in the current competition):





8. Bring your finished project to a mechanical subteam meeting.
If you have any questions or concerns that weren't addressed on this page, send an email to the mechanical sub team lead at ronanloberg@berkeley.edu or dm via slack or discord to Ronan Loberg.