

# Undergraduate & MS Research

## Advanced Robotics and Control Laboratory

### Vanderbilt University

#### What We Do

**We work on robotics.** We use **physics** and **dynamics** to derive models of robots. We use **numerical methods** to predict the way robots move. We develop **control methods** to make robots move as we want them to move. We use **optimization** to improve the performance of robots, make them faster, stronger, or more energy-efficient.

You can find an introduction to what we do here:

- [Next-Generation Robots to Help Humans \(Paper, Video\)](#)
- [Robots Teaching Robots \(Paper, Video\)](#)
- [Data-Driven Optimal Control of Robots \(Paper, Video, Video\)](#)
- [Theory of Human Performance Augmentation \(Paper, News\)](#)

#### Who We Seek

Are you interested in robotics? Are you **willing to learn new things**?

We are interested in highly motivated, curious, resourceful, responsible, and independent individuals to join our team. We want your **curiosity** to lead you into the unknown and your **perseverance** to tackle the challenges with us.

#### Type of Projects

Our projects fit into the following categories:

##### **A. Hardware project (ME, BME)**

Would you like to build small prototype robots?

##### **B. Software project (CS, ME, EE, CompE)**

Would you like to develop control methods or numerical simulation methods?

##### **C. Physics-based modeling and prediction (Phy, ME)**

Would you like to develop mathematical models for robots?

We are excited to involve Undergraduate and Master's students in these projects.

Below you will find the guidelines to work with us.

## How to Apply

Send an email to Prof. Braun ([david.braun@vanderbilt.edu](mailto:david.braun@vanderbilt.edu)).

Include the following:

1. **Subject Line:** Research Opportunity
2. **Body of the Email:** Name, year and major, expected graduation date, GPA, research interests, preferred start date, course load, relevant skills, contact info.
3. **Answer the following questions:**
  - **Why** do you want to do research with us?
  - **What** is your strength in the school?
4. **Attachment:** A single PDF attachment with the following information:
  - CV
  - Unofficial transcript
  - Shortlist of references and their contact information

**You can apply at any time**, but preferably before the beginning of a semester.

## What To Expect

Subject to the availability of projects and space in the lab, **you will be invited to meet with Prof. Braun in person to discuss the details. If you join the Advanced Robotics and Control Lab, you will be mentored by Ph.D. students.** You will be expected to learn essential skills before you work on your independent project.

**The project you will work on depends on your interest.** You can find some projects here: <https://lab.vanderbilt.edu/arclab/>

**Here are the basic tools we use:** (1) MATLAB (solving equations), (2) Mathematica (deriving models), (3) LaTeX (preparing reports and papers), (4) Adobe Illustrator (preparing figures) Adobe Photoshop (editing photos), Adobe Premiere (preparing videos), (5) SolidWorks (creating designs).

## What is the Time Commitment

You are expected to spend at least 12 hours/week. Similar to classwork, the more effort and time you commit to research, the more proficient you will be with the new skills. **Research requires dedication, adventure in the unknown, and asks for perseverance and patience.**

Research typically requires 2-3 months to get oriented to the lab and acquire basic skills and knowledge relevant to the field. Therefore, you should be prepared to **commit to a minimum of one semester of research**. You are required to discuss your weekly progress with your mentor (Ph.D. students).

### **What is the ideal outcome of your research**

- Create a new robot prototype.
- Invent and implement a new control method or a numerical simulation method.
- Publish a scientific paper at a top international conference or journal.

If you do great research, your work will be acknowledged by the scientific community and will help you secure a great job or a position at a top graduate school (where a good GPA is not enough).

### **What are the possible research opportunities**

- **Your research can count as Technical Elective.**
  - a. Undergrad students: ME 3860
  - b. Master of Engineering students: ME 7899
  - c. Master of Science students: ME 7999
- **You can be a paid researcher if you demonstrate expertise and commitment after the first semester you work with us.**
  - a. [Vanderbilt Undergraduate Summer Research Program](#)
  - b. [Vanderbilt University School of Engineering Summer Research Program](#)
  - c. Full-time summer research supported by external research funding

### **What are the deliverables**

- **A final formal-written report** in journal paper format.
- **A PowerPoint presentation** to the lab.
- Additionally, **one or more of the following**:
  - a. Experimental results
  - b. Functional prototype
  - c. Derivation
  - d. Software
  - e. Simulation

If you are perusing Honors Degree, a formal written report is required. Please notify Prof. Braun in the beginning.