

# TAKING ART TO THE SKIES: VISUAL ART WITH QUADROTORS AND MULTI-ROBOT SYSTEMS

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Brown University

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<b>Office Hours</b>	3:05-4:00pm	Location: ERC Commons
<b>Time</b>	12:15pm-3:05pm	
<b>Classroom</b>	B&H 751	

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**Teaching Assistant** Hammad Izhar

**Office Hours:** 10:00am-11:00am Location: ERC Commons

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## Course Description

We are in a period of radical technological changes. Chat-GPT is a major disruptor, in both Silicon Valley and schools around the world. Stable Diffusion can generate images from written prompts. You can get an Uber in San Francisco with no driver. With the increasing automation that surrounds us, comes ever increasing automation angst: the fear of the future this automation will produce. Some at the top of the field are leaving out of concern for the current state of AI and moving to the study of safety and ethical AI. The field has reached something of an arms race between companies trying to develop the newest and greatest model. In Ukraine, drones, both fixed wing and hobby quadcopters, have played an important part in the war and will shape the geo-political landscape of the future. The world around us is changing rapidly, in what feels like a tumultuous blur. Art has historically been a reflection of society, a tool of introspection and expression, a way to understand our place in the world around us. As technology has changed, so too have techniques and aesthetics in art. This course is a conscious effort to take a breath and pause, to think about the world around us, and to consider what art can teach us about what it means to be human in a world of automation.

The course will feature three modules: 1) Robotic methods, 2) Art's relationship with technology, and 3) ethics in robotics. Each module will last roughly 1 week and contain one main assignment. There will be a final project, which will be an art piece choreographed and made in small groups of 3-4 students.

## Learning Objectives

1. Students should be able to analyze a nascent technology, recognizing its potential strengths and weaknesses, identifying stakeholders and how they might be affected, and judging the risk/reward tradeoffs of the technology.

2. Students should be able to summarize how a quadcopter functions, both physically and on the software level. In particular, students should be able to attribute errors or crashes to certain parts of the pipeline (state estimation/communication/control). Students will learn how to compose these modular components together to produce a complex system containing both software and physical components.
3. Students will be able to identify and explain the impact that art and technology has had on society and on themselves. Students will then design and create a robot art piece and reflect on the entire process of art creation.

## Course Pages

- All course content such as announcements, slides, code, and assignments will be available on Canvas: <https://canvas.brown.edu/courses/1091833>. Slides will be posted after class sessions on Canvas.
- Assigned Readings for the next day will be made available at the end of each class. Please check Canvas everyday after class to see if any readings have been assigned.
- Questions about course concepts, assignments, and materials can be posted on Canvas discussion boards. Remember, if you have a question, chances are that other students have that question as well.

## Diversity and Inclusivity

This course studies Robotics, AI, and technology which will shape the world in our near future. We believe that discussions around these topics *require* a diverse set of perspectives that encompass various backgrounds, experiences, and voices. We strive to create a space where individuals from all walks of life can engage in open dialogue, share their unique insights, and contribute to the collective understanding of complex issues.

## Expectations

The material in this class is best absorbed through interactive learning practices.

- My Expectations for You (The Student):
  - Come prepared to class having completed assignments to the best of your ability. Preparation is important for participation and participation is key for learning.
  - We will cover a wide range of topics, from math and physics to art and ethics. Some topics you may have seen before. Some topics will be out of your comfort zone. It will always be important to put in effort to engaging with the material and your peers in a meaningful and productive way.
  - We will be working on projects in an active research lab environment. You must follow appropriate safety guidelines at all times when in the lab. The lab is a shared space and you must also respect the other graduate and undergraduate students working there.
- Your Expectations for Me (The Instructor):
  - I will create an environment where all students feel comfortable participating in discussions and group activities.

- I will create an engaging and student-centric curriculum that promotes engagement and interaction. I won't lecture for 3 hours straight, I will create diverse learning experiences.
- Labs, assignments, and lecture notes will all be posted in a timely fashion.
- I will periodically collect feedback from students and adapt the course according to feedback.

### **Tentative Course Schedule**

- Day 1: What is a Robot, anyways? Overview of the class. Introduction to Robotics.
- Day 2: How to fly: Quadcopter dynamics and Control
- Day 3: How to keep flying: Motion capture and state estimation
- Day 4: How to not hit other robots: Introduction to Multi-Robot Systems
- Day 5: How to fly good: Quadcopter tuning
- Day 6: What is art? What isn't art? Philosophy of Art.
- Day 7: Is time a flat circle? Were cave paintings tik-tok for ancient humans? Art of the past and art of the future.
- Day 8: A Boid is not a bird from Boston: Emergent patterns in nature and quadcopters.
- Day 9: If post-modernism started in the 1920s, are we in post-post-post modern times? Radical, rebellious, and revolutionary Art.
- Day 10: Who should I sue if I get run over by a Tesla? Ethics of AI day 1: Ethics in research and deployment.
- Day 11: Asimov's laws are insufficient and that makes me sad. Ethics of AI day 2: Value alignment
- Day 12: Final Project Work Day 1
- Day 13: Final Project Work Day 2
- Day 14: The end already? Looking back and forward.

### **Flight Lab**

We will utilize the flight space in ERC 347 multiple times throughout the course. It is imperative that students follow safety protocol and all instructions while in the lab. The flight space is where all drone flights will take place. It is an active research lab (forgive the clutter) and we will share it with other members of the lab.

We will have guided labs in the flight lab to explore PID Tuning, light-painting, and other drone art as well as time for the final project.

### **Final Project**

The final project will be the culmination of this class. It will be a group project of 3-4 members. The goal of the project is to create art with a group of crazyflies.

Possible Project Ideas:

- Choreograph a movement to a musical selection
- Choreograph a dance with you and the crazyflies
- Create an image with light-painting
- Design some autonomous behavior (e.g. flocking) and create some AI generated art

A Detailed Final Project guide with specifications will be released in the final week of class. Students will have in class time to work on the project. We will provide sufficient Lab hours and support for each group to successfully run their final project.

**Chat-GPT Policy:**

Chat-GPT exists. You know it. I know it. It can be helpful at times and detrimental at other times. In this course, we expect it to be helpful if you ask it general concept questions (How does a PID Controller work?). It does not work to write code on our crazyswarm project (People have tried, it produces nonsense code that looks close but is actually very wrong). Anything you submit, has to be entirely your own words. Submitting Chat-GPT work (even only partial snippets) is cheating. We have no way to know for sure if you have used Chat-GPT (although there are some telltale signs), but you are only harming your own learning experience if you choose to use it.