



***Department of Mechanical Engineering***

***MEC 634 Aerial Robotics  
FALL, 2022***

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**Part 1: Course Overview****Course Information:**

**Course title:** Aerial Robotics

**Course catalog # and section:** MEC 634

**Credit hours:** 3

**Semester:** Fall 2022

**Course Meeting Time/Location:** SOCBEHAV SCI N107 WEST CAMPUS

**Prerequisites:** Graduate Standing

**Required Course Textbooks and Materials:** None

**Recommended Course Readings and Materials:** Small Unmanned Aircraft: Theory and Practice, Randal W. Beard & Timothy W. McLain, Princeton University Press, ISBN: 978-0-691-14921-9

**Course Description:** This hands-on course will cover a broad range of topics related to aerial-robotics. There will be a comparative analysis of the most common types of flying vehicles. A few of the most common navigation strategies such as visual servoing and dubins path will be covered as well. Lastly, we will look at the latest work in both the scientific literature and industry. In particular, this course will cover multicopters, fixed-wings, flapping-wings, aerial swarms, perching, collision resilience, search & rescue, and flight testing. There will be two hands-on projects, the first will consist of searching a space for a safe landing point with a crazyflie quadcopter, and the second will be navigation of a narrow passage with a fixed-wing robot. At the end of the class, the students will be able to critically evaluate aerial robotic systems, conceive new systems, and implement functional prototype vehicles.

**Instructor Information:**

**Instructor name:** William Stewart

**Instructor's Stony Brook email:** william.stewart@stonybrook.edu

**Instructor's phone number:** 631-632-8342

**Office location and hours:** Heavy Engineering 214 Tuesdays and Thursdays 1:30-3:00pm

**Classroom Expectations and Information:**

- **Class attendance:** Attending class regularly will help you succeed in this course. You are expected to attend all classes. If you are unable to attend due to illness

or emergency, please contact me ahead of time to let me know (if possible) and be sure you get any important information you missed from me or a classmate.

- **Class cancellation or delay:** In the event that our class is cancelled, you will be notified via Brightspace Announcements and/or by your stonybrook.edu email. In the event of inclement weather, you can check [www.stonybrook.edu](http://www.stonybrook.edu) for updates on weather related delays or cancellations.
- **Classroom environment:** It is important for everyone that we maintain a positive and respectful learning environment both in class and online. We treat others and their ideas and experiences with respect and tolerance. If you have concerns about the material or class discussions, please contact me.
- **Instructor email and office hours:** I am accessible via email and will make every effort to respond as quickly as I can. When sending emails please include the course number in the subject line. If you would like to speak to me, you may come to my office hours or schedule an in-person or virtual (Zoom) meeting.

Review some [Academic Success Strategies](#) and visit the [Student Resources](#) page to ensure that you are successful in this course.

### **Technical Requirements:**

Having a reliable computer and Internet connection throughout the term will benefit you. **Caution!** It may not be possible to submit the files required for your assignments using a smartphone or tablet. If you need to borrow a laptop, please visit [SBU's Laptop Loan Program](#).

### **Technical Assistance:**

We are using Brightspace, a digital learning environment, for this course. To learn more and for SUNY Online helpdesk information, visit: <https://brightspace.stonybrook.edu>. If you would like, you can add a link to Brightspace in your Blackboard "My Courses" list to easily move between the LMS's during this transition. Information can be found: <https://it.stonybrook.edu/help/kb/adding-brightspace-course-to-bb-course-list>

If you need technical assistance at any time during the course or to report a problem with Brightspace you can:

- Phone: 631-632-9800 M-F 9:00-5:00 (device support, Wi-Fi, software, hardware, logins)
- Submit a help request ticket: <https://it.stonybrook.edu/services/itsm>

### Part 2: Course Learning Outcomes

The following topics will be covered in this course:

- Robot configurations – Multicopter, fixed wing, and flapping wing UAVs
- Control theory – Dubins path, visual servoing, and cascade control
- Hardware – Crazyflie aerial search, fixed wing corridor navigation
- Related aspects – Swarms, collision resilience, perching, and multimodality

These are your course level learning outcomes, or broad goals you will achieve in this course. Upon completion of the course, students will be able to:

1. Describe in a broad and practical way many aspects specific to the field of aerial robotics
2. Implement in hardware, an aerial robotic system
3. Analyze practical and technical aspects of aerial robotic systems
4. Discuss and present the state of the art in research and industry in a technical manner

### Part 3: Course Schedule

The possibility exists that unforeseen events will make schedule changes necessary. Any changes will be clearly noted in course Announcements and/or through Stony Brook email.

Week	Topics	Activities	Due Dates
1	Can UAVs deliver? Applications, and Multicopter UAVs	Lectures	N/A
2	Fixed-wing UAVs and UAV Hardware	Lectures and Quiz 1	Aug. 30 <sup>th</sup>
3	Flight testing and Introduction to Multicopter Practical	Lectures and Quiz 2	Sept. 6 <sup>th</sup>
4	Multicopter practice and Journal Presentations	Project Work and Journal Presentation 1	Sept 15 <sup>th</sup>
5	Cascade Control and Visual Servoing, Multicopter practice	Project Work and Lectures	N/A
6	Multicopter practice and Dubins path	Project Work and Lectures and Quiz 3	Sept. 29 <sup>th</sup>
7	Multicopter practice and demonstrations	Project Work and Demonstrations	Oct. 6 <sup>th</sup>
8	Aircraft Performance	Lectures	N/A

<b>Week</b>	<b>Topics</b>	<b>Activities</b>	<b>Due Dates</b>
9	Swarms and Introduction to fixed-wing practical	Lectures and Quiz 4	Oct. 20 <sup>th</sup>
10	Fixed-wing practice	Project Work	N/A
11	Flapping wing MAVs, Rescue robotics, and journal presentations	Lectures and Journal Presentation 2	Oct. 3 <sup>rd</sup>
12	Fixed-wing practice, soft aerial robotics, and multimodal UAVs	Project Work and Lectures	
13	Fixed-wing practice, collision resilience, and perching	Project Work and Lectures and Quiz 5	Nov. 17 <sup>th</sup>
14	Fixed-wing practice	Project Work	N/A
15	Fixed-wing practice and demonstrations	Project Work and Demonstrations	Dec. 1 <sup>st</sup>

<b>Part 4: Grading and Late Work Policies</b>
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**Assessment and Grading:**

Points and feedback for graded activities will be posted to Brightspace. In this course, you will be assessed on the following:

Activity/Assignment	Points	Due Date
Multicopter Hardware Practical	30	Oct 6 <sup>th</sup>
Journal Presentations	30	Sept 15 <sup>th</sup> and Nov 3 <sup>rd</sup>
Fixed-wing Hardware Practical	30	Dec 1 <sup>st</sup>
Quizzes	10	Aug 30 <sup>th</sup> , Sept 6 <sup>th</sup> , Sept. 29 <sup>th</sup> , Oct 20 <sup>th</sup> , Nov 17 <sup>th</sup>
Total	100	

**Letter Grades:**

Letter Grade	GPA Points
A	4.0
A-	3.7
B+	3.3
B	3.0
B-	2.7
C+	2.3
C	2.0
C-	1.7
D+	1.3
D	1.0
F	0.0

- Additional information: [Graduate Grading System](#)

**Late Work/Retake Policy:**

The assignments in this course require demonstrations using hardware in experimental setups as well as presentations to the class, as such, late work cannot be accepted.

The same policy applies to the quizzes. Excused absences will be handled on a case-by-case basis.

### **Assessment and Grading:**

The hardware practical grades will be assigned based on the tasks completed during the final demonstration. Each team will be allowed up to three flights, with the highest performing flight counting for the grade. The nature of flight tests and demonstrations is fickle. As a result, on a case-by-case basis, the submitted video of practice flights can be counted as a back-up flight.

#### **Multicopter Hardware Practical Grading Rubric**

<b>Points</b>	<b>Accomplished Tasks</b>
5	Return to original take off pad.
5	Locate and land on the landing pad
5	Avoid obstacles in the way
5	Take off and move according to a search pattern
10	Presentation and video of working algorithm

#### **Fixed-Wing Hardware Practical Grading Rubric**

<b>Points</b>	<b>Accomplished Tasks</b>
5	Avoid contact with walls
5	Land within correct region
5	Take off and fly
15	Presentation and video of working flight

#### **Journal Club Presentation Grading Rubric**

<b>Points</b>	<b>Accomplished Tasks</b>
5	Presenter clearly understood the paper
5	Presentation slides were clear
5	Presenter spoke clearly

**Part 5: University and Course Policies****University Policies:****Student Accessibility Support Center Statement:**

If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact the Student Accessibility Support Center, Stony Brook Union Suite 107, (631) 632-6748, or at [sasc@stonybrook.edu](mailto:sasc@stonybrook.edu). They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and the Student Accessibility Support Center.

For procedures and information go to the following website:

<https://ehs.stonybrook.edu/programs/fire-safety/emergency-evacuation/evacuation-guide-people-physical-disabilities> and search Fire Safety and Evacuation and Disabilities.

**Academic Integrity Statement:**

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty please refer to the academic judiciary website at

[http://www.stonybrook.edu/commcms/academic\\_integrity/index.html](http://www.stonybrook.edu/commcms/academic_integrity/index.html)

**Important Note:** Any form of academic dishonesty, including cheating and plagiarism, will be reported to the Academic Judiciary.

**Critical Incident Management:**

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of University Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures. Further information about most academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook.

**Course Policies:**



**Understand When You May Drop This Course:**

If you need to drop or withdraw from the course, it is your responsibility to be aware of the tuition liability deadlines listed on the registrar's [Academic Calendar](#). Before making the decision to drop/withdraw you may want to [contact me or] refer to the University's policies:

- [Undergraduate Course Load and Course Withdrawal Policy](#)
- [Graduate Course Changes Policy](#)

**Incomplete Policy:**

Under emergency/special circumstances, students may petition for an incomplete grade. Circumstances must be documented and significant enough to merit an incomplete. If you need to request an incomplete for this course, contact me for approval as far in advance as possible. You should also read the University's policies that apply to you:

[Undergraduate Bulletin](#)

[Graduate Bulletin](#)

**Course Materials and Copyright Statement:**

Course material accessed from Brightspace, Zoom, Echo 360, VoiceThread, etc. is for the exclusive use of students who are currently enrolled in the course. Content from these systems cannot be reused or distributed without written permission of the instructor and/or the copyright holder. Duplication of materials protected by copyright, without permission of the copyright holder is a violation of the Federal copyright law, as well as a violation of Stony Brook's Academic Integrity.