SPRING COMPETITION OVERVIEW

MODULE 11

LOGISTICS

SPRING 2023 SEASON SCHEDULE

Date	Milestone
Nov 1 – Dec 21, 2022	Registration
January 2023	Regional Kickoff Events*
May 2023	Regional Competitions*

Table 1. Spring 2023 Season Schedule

*Specific dates are determined by region. Contact your regional coordinator for more details about your kickoff and competition.

COMPETITION LAYOUT

- **In-Person Components:**
  - Autonomous Mission: loiter/deliver at waypoints
    - Must complete Milestone 5 to compete (1 week before)
  - Semi-Autonomous Mission: drone basketball vs another team
    - Must complete Time Trial to compete (competition day)
  - Presentation: present technical slides to judging panel
    - Must submit slides to compete (1 week before)
- **Virtual Components:**
  - Milestones
    - Submission Form
  - Presentation Slides
    - Submission Form

REQUIREMENTS

- **Hardware**
  - Must:
    - Have 4 motors with 1 propeller each
    - Be registered with FAA and have visible registration number
    - Use lithium polymer battery
      - 4 cells or less
      - Commercially available (not homemade)
  - Must not:
    - Have any lifting surfaces other than the 4 propellers
    - Have propellers > 12 inches in diameter
    - Have base plate > 7 inches from ground
- **Software**
  - Must:
    - Use a securely-mounted GPS sensor

TASK DETAILS

MISSION: AUTONOMOUS

- **Autonomous Fly-Off:**
  - Read coordinates from file
  - Hover at 3 loiter waypoints for 10 seconds each
  - Deliver medical supplies at 1 waypoint
    - Must drop from 20 ft above ground
    - Medical supply is 1 egg in a team-designed protective case
    - Must be delivered without damage
    - Must be dropped autonomously
  - Successful flight is defined by:
    - Vehicle taking off autonomously
    - Vehicle landing (autonomously or manually)
  - Must complete mission in 10 mins or less to be scored
    - Timer starts when team is given waypoint file
- **Eligibility:**
  - Must submit Milestone 5 at least 1 week before competition

MISSION: AUTONOMOUS

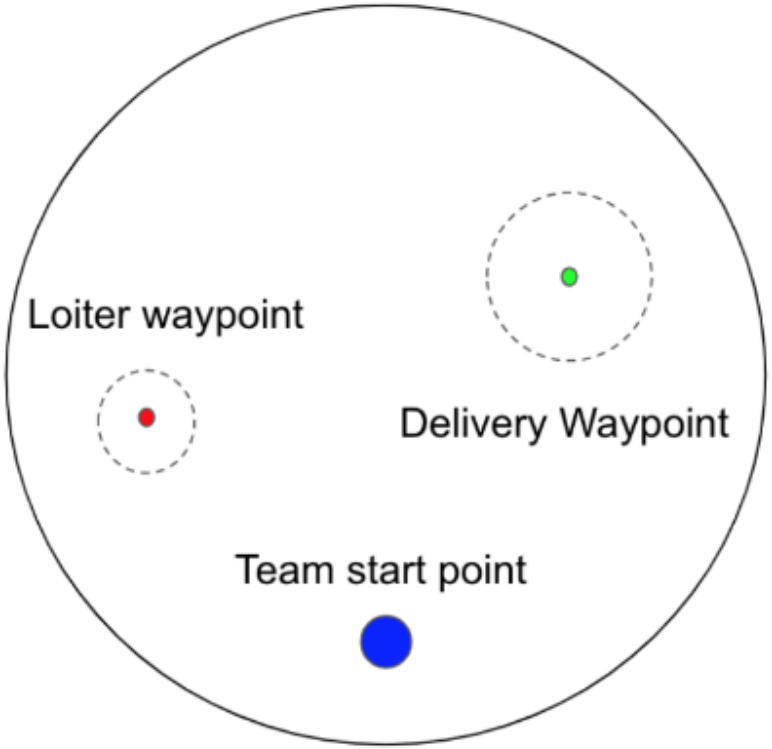

Figure 1. Example Field Layout
Autonomous

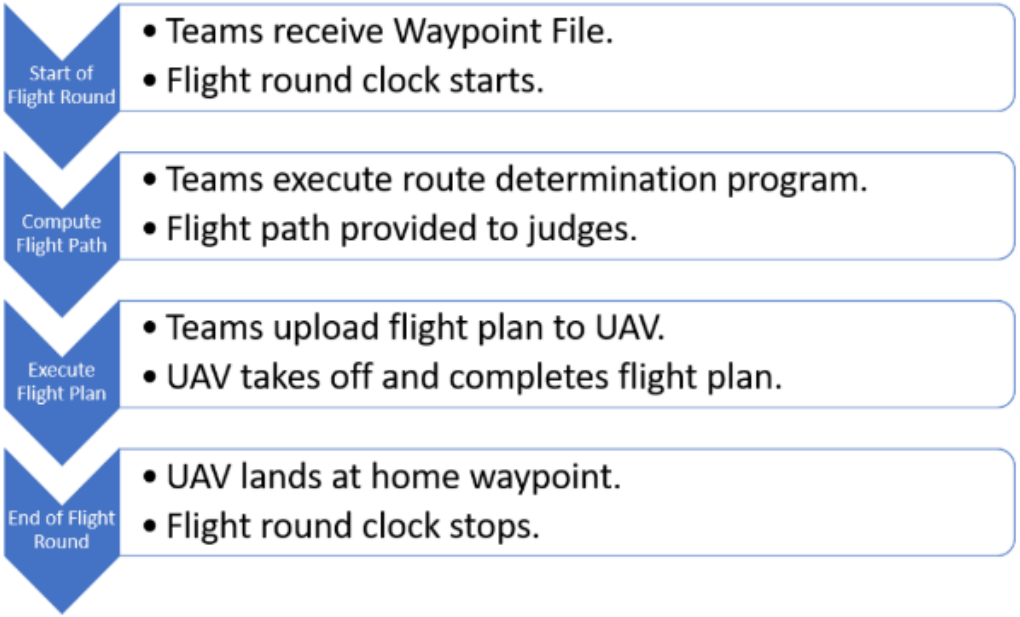

Figure 2. Flight Procedure
Autonomous

MISSION: SEMI-AUTONOMOUS

- **Head-to-Head Drone Basketball:**
  - Retrieve tennis balls from queue and drop through hoops
  - Hoops have varying sizes and point values
  - Each team has 5 tennis balls available
    - May not steal from opponent's queue
    - May only carry one at a time
  - 5-minute time limit
  - Teams causing a collision with opponent's drone will be disqualified
- **Eligibility:**
  - Must participate in time trial (complete drone basketball challenge alone before competing head-to-head)

MISSION: SEMI-AUTONOMOUS

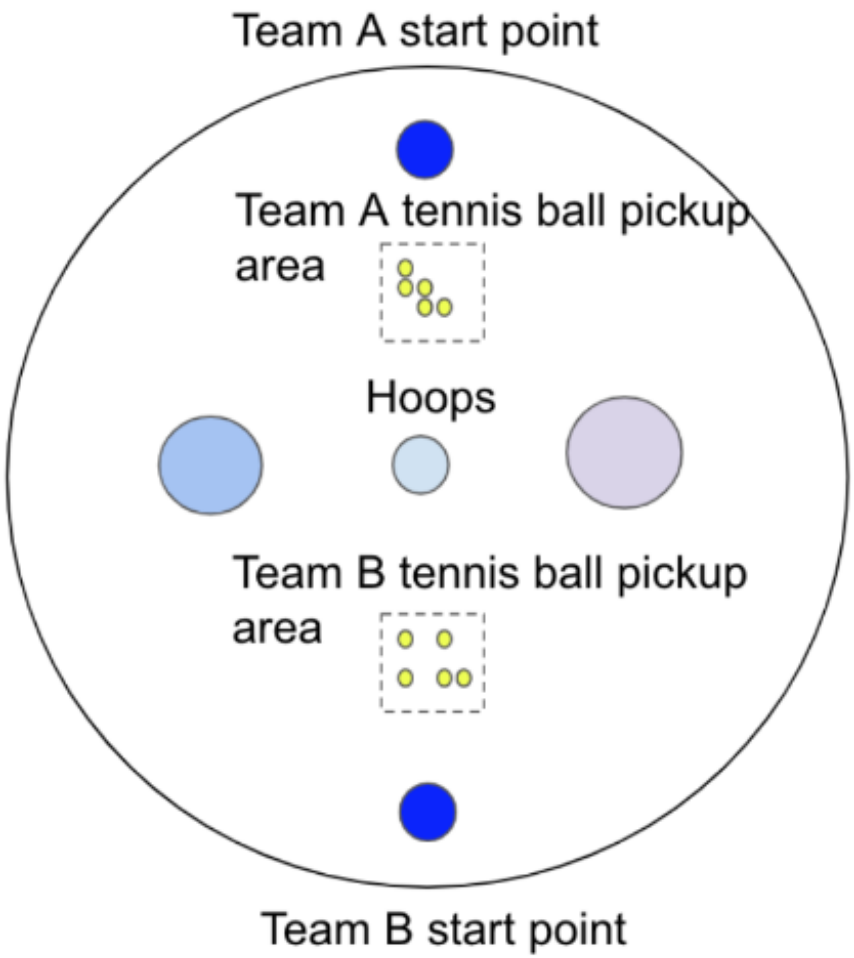

Figure 3. Field Layout
Semi-Autonomous

MISSION: MILESTONES

- **Requirements:**
  - Virtual tasks for points
  - Must be submitted prior to the competition event date
  - Task 5 must be submitted at least 1 week before competition

Task #	Task Name	Description	Points
0	**Pass TRUST Exam**	Students must complete the short course and successfully pass the FAA TRUST Exam (in order to begin flying recreationally). Each team member on the roster must submit the TRUST exam confirmation.	5
1	**Learn to Fly**	Fly semi-autonomously (student-piloted) for 1 minute. No requirements for flight beyond successful takeoff and landing; flight time may be spent hovering or maneuvering. Provide a video to ARC to show completion.	10
2	**Takeoff/ Landing**	Autonomously have the drone takeoff and land. Provide a video to ARC to show completion.	20
3	**Hover**	Hover the drone without pilot intervention (autonomously) for 30 seconds. Provide a video to ARC to show completion.	20
4	**Mechanism Test**	Hover the drone and drop a tennis ball. Provide a video to ARC to show completion.	20
5	**Waypoint Flight***	Plug in waypoints to your drone and fly autonomously. Provide a map of the waypoints and a video of your drone flying to the waypoints. ***Must complete to compete in autonomous fly-off competition.**	25

Table 2. Milestones

MISSION: PRESENTATION

- **Requirements:**
  - Teams must submit slides at least 7 days before competition
  - Presentation is 10 minutes, followed by 5 minutes of questions

Component	Task	Max Points
Content	**Team Organization and Dynamics**	**2.5**
	Team Schedule for Project Completion	**5**
	Financial Strategy/Budget	**10**
	Programming Methodology and Process	**15**
	Mission Overview and Strategy Why is your team and UAV use a good choice for disaster response? How does your team plan to succeed (in either/both missions)?	**20**
	Vehicle Overview	**10**
	Mechanism and Protection System Design	**10**
	Flight Testing Procedure and Results	**20**
	View of Entire System (front, top, side) with Primary Dimensions (height, width, length) Please label important dimensions in the picture	**5**
	List of Parts/Materials Used	**2.5**
Presentation Style	**Slides are Legible**	**10**
	Presenter Speaks Clearly and Audibly	**10**
	Presenter Speaks Profession and is Well-Prepared Minimal mannerisms such as "you know"	**10**
	Photos/Models/Videos are Present	**10**
	Presenter Speaks to the Room Not to their slides/facing the screen	**10**

Table 3. Presentation Scoring Rubric

JUDGING & SCORING

JUDGING

- **Autonomous: 3 referees + 1 flight manager**
  - Flight Manager: monitor entire playing field
  - 1 Referee: monitor clock and ground station
  - 2 Referees: monitor loiter waypoints
- **Semi-Autonomous: 2 referees + 1 flight manager**
  - Flight Manager: monitor entire playing field
  - 2 Referees: each assigned to monitor 1 team
- **Pre-Competition Challenges: 2 judges**
  - 2 Judges: approve/reject submissions
- **Presentation: 6 judges**
  - 3 Judges: grade presentation content (prior to competition)
  - 3 Judges: grade presentation style (during competition)

SCORING: AUTONOMOUS, TIME TRIAL

- **Placement is based on the following (in order):**
  - Score
  - Number of tennis balls delivered into hoops
  - Number of times tennis ball picked up
  - Time
- **Requirements:**
  - If multiple teams have same score, tie-breakers will be given based on the above ordering of team performance
  - Teams must take off and land to qualify for time trial points

Placement	Points
1st	50
2nd	45
3rd	40
4th	35
5th	30
6th	25
7th	20
8th	15
9th and beyond	10
No flight	0

Table 4. Time Trial Scoring

SCORING: AUTONOMOUS, FLIGHT ROUND

- **Use the following equation to calculate scoring:**

$$F = \frac{E + L}{A} - P$$

Variable	Meaning	Value	Stipulation
E	Egg Drop Points	100	Egg is released, lands within 20ft of target, and is unharmed
		50	Egg is released, lands within 20ft of target, but is damaged
		10	Egg is released, does not land within 20ft of target
		0	Egg is not released
L	Loiter Waypoint Points	50	Drone successfully loiters within 10ft of loiter waypoint for more than 10 seconds
		0	Drone does not loiter at waypoint
A	Trigger Autonomy	1	Autonomous trigger
		2	Manual Trigger
P	Penalty Deductions		

Table 5. Autonomous Flight Round Scoring Variables

SCORING: MILESTONES

Task #	Task Name	Description	Points
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1	Learn to Fly	Fly semi-autonomously (student-piloted) for 1 minute. No requirements for flight beyond successful takeoff and landing; flight time may be spent hovering or maneuvering. Provide a video to ARC to show completion.	10
2	Takeoff/ Landing	Autonomously have the drone takeoff and land. Provide a video to ARC to show completion.	20
3	Hover	Hover the drone without pilot intervention (autonomously) for 30 seconds. Provide a video to ARC to show completion.	20
4	Mechanism Test	Hover the drone and drop a tennis ball. Provide a video to ARC to show completion.	20
5	Waypoint Flight*	Plug in waypoints to your drone and fly autonomously. Provide a map of the waypoints and a video of your drone flying to the waypoints. ***Must complete to compete in autonomous fly-off competition.**	25

Table 6. Milestone Scoring

SCORING: SEMI-AUTONOMOUS

- **Use the following equation to calculate scoring:**

$$S = avg\ (Round\ Score)$$

$$Round\ Score = min(T, 5)x\ 10 + B - P$$

$$T = \#\ of\ successful\ tennis\ ball\ pickups$$

$$P = Penalty$$

Variable	Value	Meaning
B_x	20	Largest hoop (20" inner diam)
B_y	35	Middle hoop (16" inner diam)
B_z	50	Smallest hoop (12" inner diam)
N_1	Number scored	Tennis balls in largest hoop
N_2	Number scored	Tennis balls in middle hoop
N_3	Number scored	Tennis balls in smallest hoop

Table 7. Semi-Autonomous Scoring Variables

SCORING: PRESENTATION

- **Use the following equation to calculate scoring:**

$$\boldsymbol{S = Content + Presentation}$$

S = score
Content = scoring of content (see rubric)
Presentation = scoring of delivery (see rubric and below list)

Presentation Requirements:
i. Presentation flow
ii. Presentation mannerisms
iii. Presentation clarity

PRIZES

Rank	Prize Money
1st	$2000
2nd	$1000
3rd	$500

Table 8. Competition Prizes

*Must be 3 or more teams participating. Prizes are halved if 10 or fewer teams participate. Full prizes are awarded when over 10 teams participate.

SAFETY REQUIREMENTS

BATTERY CARE

- **Charger:**
  - Remove battery as soon as charging is complete
- **Storage:**
  - Store in LiPo bag
  - Do not leave in car, near heat vent, etc.
- **In Case of Emergency:**
  - If drone crashes, wait at a distance before retrieving
  - If battery puffs, set in a plastic bin and do not touch
  - Do not dispose of batteries in trash can (must take to authorized recycling facility)

Battery Charger

LiPo Bag

TESTING/FLIGHT ETIQUETTE

- **E-stop:**
  - Program a button (escape key on computer, switch on transmitter) that will immediately ground drone
- **Tether:**
  - Do not fly until drone is securely tethered
  - All personnel must stay out of tether range during flight
- **Carrying Drone:**
  - Keep hands away from propellors at all times
  - Lift from below and aimed away from face
- **Arming:**
  - Program drone to not fly until arming switch/buzzer are set