



UAV Technology- Drone Quadcopter Challenge 2020

OVERVIEW

The Drone Technology Quadcopter Challenge: Drone skills, enables students to enter a wide range of industries using this new field of technology. Drones are cost-effective, safer, faster and more accurate than traditional methods of aerial data acquisition. Additionally, with the pending integration of drones into the national airspace, this platform, helps multiple industries leverage autonomous drone operations and redefines their business models.

PARTICIPATION REQUIREMENTS

ELIGIBILITY

- A. Event participants are limited to three (3) teams per chapter 2-3 individuals per team.
- B. AMA youth membership with AMA ID number.
- C. Liability and photo release form
- D. FAA Registration for drones weighting in excess of .55lbs

ATTIRE

Competition attire, as described in the Idaho TSA dress code is required for this event.

SAFETY

FLIGHT SAFETY DURING COMPETITION

- A. A Pilots briefing may be called at any time during the contest. All Pilots are required to attend.
- B. Participants are required to wear safety–approved eyewear during the on-site phase of this event.
- C. Pilots may not fly in an intentionally dangerous manner
- D. Pilots may only fly their aircraft within the hot zone of the practice and or competition field
- E. Pilots will be asked to crash land or ground their aircraft if its flight course poses a threat to any individuals or rule violations.
- F. Drone teams will adhere to all safety rules and directions of game officials.

HOT AND COLD TABLES

- A. At times the contest area will have a hot and cold table. These tables are used for the safety of teams and spectators, allowing them to discern whether or not a team can power their aircraft.
- B. The Cold Table: The cold table is the table on which teams and field officials may place any equipment needed for competition and scoring. At this table teams may handle their drones WITHOUT a battery connected.
- C. The Hot Table: The hot table is the table specifically for a competing team’s aircraft, transmitter, or any other items needed only during the flight competition itself. The hot table is the only place a team may connect their battery unless specified for some other reason by a competition official.

FAA REGULATIONS AND AMA GUIDELINES:

- A. The FAA Advisory Circular 91-57A is extremely pertinent to the outdoor operation UAVs. Please take the time for your team to read this document and abide by its rules during outdoor operation.

http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_91-57A.pdf

On October 5, 2018, the President signed the [FAA Reauthorization Act of 2018](#)(PDF). The Act establishes new conditions for recreational use of drones and immediately repeals the Special Rule for Model Aircraft. The agency is evaluating the impacts of this change in the law and how implementation will proceed. In the interim, please continue to follow all current policies and guidance with respect to recreational use of drones.

- B. When you fly outside, you fly in public airspace which means that no matter the situation, you must ALWAYS GIVE WAY TO THE LARGER MANNED AIRCRAFT. This rule is imperative to the safety of those in the air and the continuation of the UAV hobby in general.
- C. Abide by the Academy of Model Aeronautics National Aircraft Safety Code:
<https://www.modelaircraft.org/files/105.pdf>
- D. Abide by the Academy of Model Aeronautics National Aircraft UAS Safety Guide:
http://suas.modelaircraft.org/ama/images/sUAS_Safety_Program_web.pdf

DRONES AND PEOPLE

- A. Aircraft may not be armed when being held by an individual.
- B. When configuring an aircraft using the INAV or any other software, it is imperative that no propellers be attached to said aircraft's motors.
- C. Team members may not fly their aircraft over or near other individuals.

BATTERY SAFETY

- A. Team members should always be present during the charging of a lithium polymer battery.
- B. Follow good LiPo treatment practices:
 - a. Do not discharge batteries below 30%.
 - b. Do not charge batteries above 90%.
 - c. Always Charge and store batteries inside fireproof containers
 - d. Never charge a battery that is puffy or punctured
 - e. Never charge faster than 1C
 - f. Stop Charging immediately if a battery heats up
- C. Lithium Polymer battery fires are chemical fires that do not require oxygen to burn, so if a battery ignites:
 - a. DO NOT POUR WATER ON THE BATTERY. Doing so only makes the fire worse?
 - b. DO NOT PLACE THE BATTERY IN A SEALED CONTAINER TO SMOTHER THE FIRE.
 - c. DO NOT USE A STANDARD HOUSEHOLD FIRE EXTINGUISHER.
- D. If a battery ignites:
 - a. PLACE THE BATTERY IN A BUCKET OF SAND.
 - b. THEN COVER THE BATTERY WITH AN ADDITIONAL LAYER OF SAND.
 - c. PLACE A PLASTIC BAG FULL OF SAND OVER THE BATTERY.

DRONE REGULATIONS

DRONE SPECIFICATION

A. Participants are required to provide their quadcopter drone fitting one of the specifications below:

Class	Frame	Prop Size	Battery (Max)
Tiny Whoop	No Limit	126 mm or less	1s Lipo
Micro	No Limit	150 mm or less	2s Lipo
Macro	No Limit	151 mm or larger	3s Lipo
RubiQ	No Limit	No limit	3s Lipo

B. The following is a suggested list of drone and tool box items.

- i. Extra blades
- ii. Batteries Charged
- iii. Drone controller with batteries
- iv. Power strip for battery charger
- v. Tools required for working on drone
- vi. FPV Goggles
- vii. Extra blades
- viii. LiPo-safe storage bag
- ix. LiPo battery charger with balance, charge, discharge and storage functions
- x. Safety glasses

DRONE OPERATION

- A. Team number must be displayed on each drone.
 - a. No bare electrical wiring is allowed.

DOCUMENTATION

PORTFOLIO REQUIREMENTS

- A. The portfolio must have a clear front report cover. The portfolio must include the following single-sided, 8 ½" x 11" pages, in this order.
- B. Title page with contest listed, conference city and state, and year. One (1) page.
- C. Table of contents as needed.
- D. The drones specifications (i.e., engine power, size).
- E. A description and identification of parts.
- F. Flight log.
- G. Rules and Regulations for drones with the FAA registering information and fees.
- H. AMA Registration
- I. Documentation of problem-solving challenging to include the following (see Problem-solving challenging for additional information).
 - a. Problem statement
 - b. Research
 - c. Solution
- J. LEAP Resume

FLIGHT LOG

Participant ID#				
Flight #	Date	Flight Time	Drone adjustments	Advisor Sign off
#1				
#2				
#3				
#4				
#5				
#6				
#7				
#8				
#9				
#10				

CONTEST PROCEDURE

WRITTEN EXAM

- A. Online exam to be taken before the skills event. All teams’ members are required to take the exam.
- B. Failure to take the exam will result in disqualification of the team from the skills and racing parts of the contest.
- C. The exam will consist of a multiple choice question test that will cover: Rules and Regulations, safety, and terminology.

PROBLEM-SOLVING CHALLENGE

- A. Each Team will identify a problem in their state and develop a conceptual solution that positively utilizes drone technologies.
- B. Teams will present their project to a panel of judges for evaluation and feedback. Each presentation will last a maximum of ten (10) minutes, including Q&A.
- C. Teams may produce prototypes and of visual aids such as displays boards. Teams may present a video or PowerPoint presentation but must provide their computer and projector.
- D. Evaluated on the quality of the team’s research, the level of innovation demonstrated, and the quality of the presentation itself. See the Rubric for specific aspects of judging.
- E. Only student team members may present to the judges.

FLIGHT CHALLENGE GENERAL RULES

- A. Participants report to the event coordinator at the time and place stated in the conference program to sign up for the flight times.

- B. Teams must pass the written exam to be eligible for the semifinalist skills/racing portions of the contest.
- C. Once you start a flight, you may NOT touch your drone nor change batteries. If you crash or the drone can no longer fly the runtime will be recorded for that flight.
- D. Each team will work from a designated area or command center (hot table) to remotely operate the drone. You will place the drone at the starting position as directed by the judge.
- E. Take-off and landing: Teams must be capable of executing take-off and landing
- F. Conduct of the UAV Pilot
 - a. The UAV Pilot is responsible for launching and recovering the aircraft and the safe piloting of the aircraft once it is airborne. At all times while the aircraft is airborne the UAV Pilot must have a handheld radio control transmitter for the aircraft and be able to activate flight termination mode.
 - b. The UAV Pilot must control the aircraft such that it remains in the flying zone. Spotters on the course will determine if the aircraft flies outside the flying zone.
- G. Airspace incursion procedures:
 - a. The UAV Controller must adhere to the flight circuit procedures provided at the competition.
 - b. Safety Inspections
 - i. Static safety inspections will include (but not be limited to) the following:
 1. Structural verification of the aircraft to ensure structural integrity including
 2. Components adequately secured and fasteners tightened
 3. Propeller structure and attachment integrity
 4. Inspection of all wiring
 5. Controls move as expected
 6. Radio range checks with motor/s off and on;
 7. Flight termination behavior tested (transmitter switched off)

SKILLED FLIGHT CHALLENGES

The 2019 Idaho TSA challenge will focus on two different precision flight events, including a Manual Flight Challenge and a Relay Race Challenge. Additionally, we are providing an optional contest called Computational Thinking Challenge which will be available to all drone classes. Each skill challenge is required to be completed by a different pilot.

Manual flight (All Drone Classes) leverages the UAV's capability to maneuver around an obstacle course. Students will fly their drone through various obstacles as quickly as possible

The Relay Race challenges (Micro, Macro, RubiQ Classes) Students to design a mechanism to retrieve and deliver a baton, and demonstrate their flying skills with moving the baton around the field. Students are to move batons as outlined in the Relay Race Section as many times as possible in one minute, fifteen seconds.

DRONE FPV EXHIBITION RACE (OPTIONAL)

- A. Teams that qualify for the skilled flight challenge have the opportunity to test their skills on an indoor race course consisting of flag and gates placed inside the netted flight area.
 - a. Teams will fly an individually timed race.
 - b. Each team will be given three opportunities to complete the course and record the fastest time possible.
 - c. The course will be comprised of multiple gates and flags to maneuver around. A course layout will be provided prior to the event.
 - d. Winners will be celebrated at Closing Ceremonies
 - e. Please review the safety section on pg. 1, as hot table and cold tables will be utilized for this contest.

AWARDS

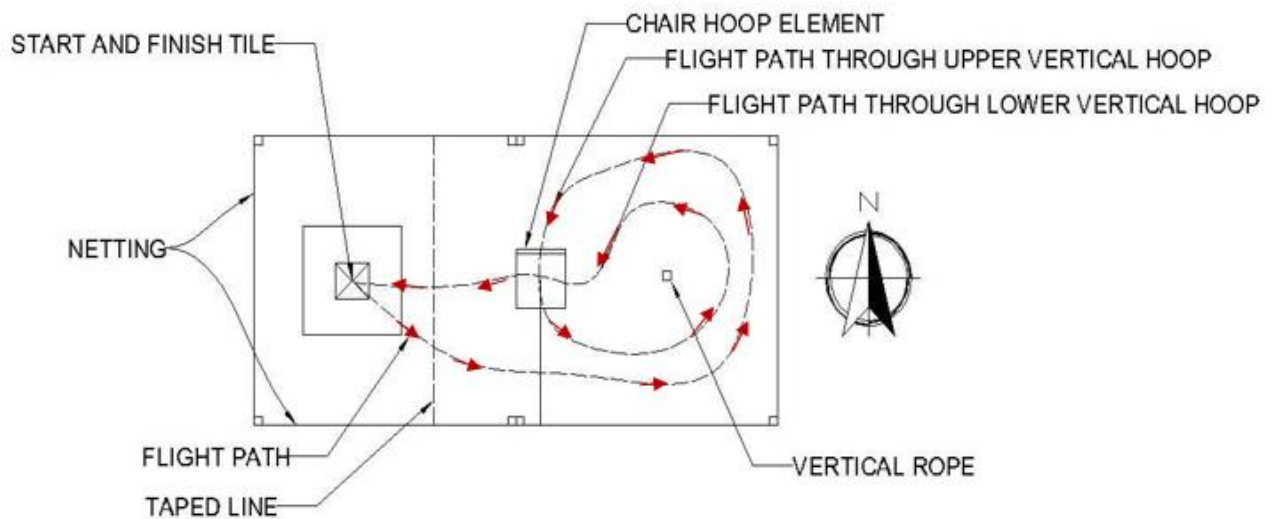
- A. **Problem-Solving & Research Award:** The team that best demonstrated the fulfillment of the Problem-solving Project criteria described in Section 5 as determined by the judges.
- B. **Skilled Flight Award:** The team with the highest score in the skilled flight challenges among all teams. Awards will be given by Drone Classes.
- C. **Champion's Award:** The top three overall teams overall. (Medals)

MANUAL FLIGHT

Each team will set their quadcopter on the starting/finishing tile (2' X 2') at one end of the field. After the start of the match, teams will fly around the vertical rope at the other end of the field. After flying around the vertical rope, teams will fly through the upper vertical portion of the [PVC chair hoop](#) in the North to South direction and then back around the vertical rope. After flying around the vertical rope the second time, teams must then fly through the lower portion of the [PVC chair hoop](#) in the East to West direction, then land on the starting/finishing tile (2' X 2') (see figure). Pilots may choose to compete using FPV or flying line of sight.

- A. The race will begin with a countdown (“3, 2, 1, go”) and end when the quadcopter comes to rest on the finish tile.
- B. To be considered a good run, the quadcopter must be in contact with the starting/finishing tile when the word “go” is announced. In other words, quadcopters cannot take off till a referee announces ‘go.’
- C. Challenge clock will stop when the quadcopter comes to rest and some portion is touching the start/finish tile.
- D. Teams will have 1 - 3 attempts to achieve their best score based on the discretion of the competition manager.
- E. **Scoring:** Winning team will be based on the team that completes the course in the least amount of time. Teams will be ranked on their flight times, lowest flight time wins.

MANUAL FLIGHT COURSE LAYOUTS (MICRO, MACRO, RUBIQ CLASSES)



THE RELAY RACE CHALLENGES (MICRO, MACRO, RUBIQ CLASSES)

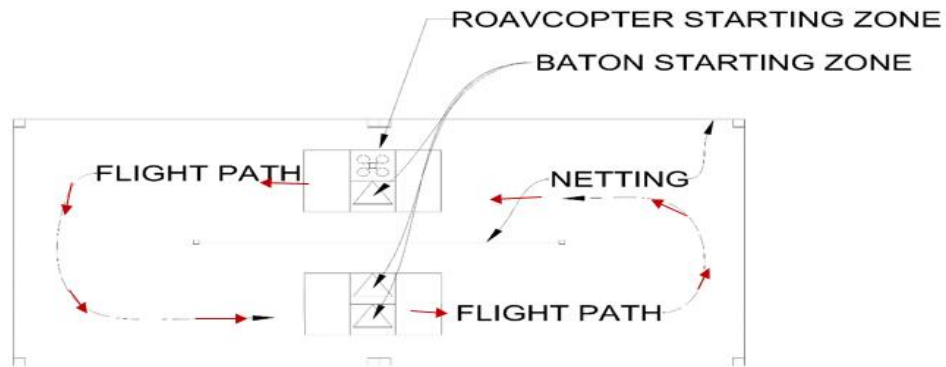
Field configuration is a net with an 8' opening at each end, hung down the center of the field, forming an oval race course. Pilots will fly using line of sight.

- A. Teams will only have one minute fifteen seconds to move the batons as many times as possible.
- B. Teams will set their quadcopter on the side of the field with only one baton.
- C. Teams will set their quadcopter on the side of the field with only one baton.
- D. During the relay race batons will be flown in a counter clockwise rotation
- E. At the start of the race, the quadcopter will take off, fly half a lap around the race oval, pick up a baton, and place the baton on the quadcopter's starting location. The quadcopter will then pick up the baton that the quadcopter initially started out next to. This baton is then dropped off at the opposing side of the oval, where the first baton was removed. The remaining baton is then picked up, and moved to the opposing side of the field. This process is continued until one minute has elapsed.
- F. Batons need to be placed on the opposite side of the oval from which it was picked in order to be counted for points.
- G. For a visual representation of the race flight plan, see figure below.
- H. **Scoring for the Relay Race Challenge:** For each successful translocation of a baton, a team will be awarded points. For every baton moved and successfully placed on an open 2' X 2' tile, 3 points will be awarded. For every baton moved and successfully placed on any 6' X 6' tile, 2 points are awarded. For every baton moved and successfully placed on the required side of the course, one point is awarded. The team with the highest number of points is considered the winner of this challenge.

The Baton is made up of 1/4" dowels and 3D printed connectors.

Detailed drawing and STL file for 3D printing is available to download here,
<HTTPS://ROAVCOPTERS.USU.EDU/FILES/BATON%20WORKING%20DRAWING%206-26-17.PDF>





PLAN VIEW

DRONE FPV EXHIBITION RACE (OPTIONAL)

- B. Teams that qualify for the skilled flight challenge have the opportunity to test their skills on an indoor race course consisting of flag and gates placed inside the netted flight area.
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 - b. Each team will be given three opportunities to complete the course and record the fastest time possible.
 - c. The course will be comprised of multiple gates and flags to maneuver around. A course layout will be provided prior to the event.
 - d. Winners will be celebrated at Closing Ceremonies
 - e. Please review the safety section on pg. 1, as hot table and cold tables will be utilized for this contest.

Participant ID#1 _____ ID#2 _____ ID#3 _____

Drone Technology Rubric		
2020 & 2021 Official Rating Form		High School
Team Written Test (50 points)		
Record the scores of the three (3) team members in the boxes below. Calculate the average of their scores. Divide the average by three (3) for the score that the team will receive out of the fifty (50) points. Record the score in the column space to the right.		
#1	#2	#3
SUBTOTAL (50 points)		

Record scores in the column spaces below.

Documentation (100 points)			
CRITERIA	Minimal performance 1-4 points	Adequate performance 5-8 points	Exemplary performance 9-10 points
Evaluations: Using Minimal (1-4 points), adequate (5-8 points), or exemplary (9-10) performance levels as a guideline. Record the scores earned for the event criteria in the column spaces to the right. The X1 or X2 notation in the criteria column is a multiplier factor for determining the points earned. Example: an "adequate" score of 7 for an X criteria = 7 points; an "adequate" of 7 for a X2 criteria = 14 points. A score of zero (0) is acceptable if the minimal performance for any criterion is not met.)			
Portfolio components (X1)	The portfolio is unorganized and is missing three or more components.	Portfolio has most components and is organized; It has sufficient content	All components are included in the portfolio; content and organization are excellent
Technical data (x1)			
Description and identification of parts (x1)			
Flight log (x1)			
Rules and Regulations (x1)			
AMA Registration (x1)			
Problem Solving Challenge –			

Record scores in the column spaces below.

Problem Statement (x1)				
Problem Solving Challenge – Research (x1)				
Problem Solving Challenge – Solution (x1)				
SUBTOTAL (100 points)				

Problem-Solving Challenge (70 points)				
CRITERIA	Minimal performance 1-4 points	Adequate performance 5-8 points	Exemplary performance 9-10 points	
Problem statement (x1)	The portfolio is unorganized and is missing three or more components.	Portfolio has most components and is organized; It has sufficient content	All components are included in the portfolio; content and organization are excellent	
Effectiveness of Design (x1)				
Aesthetic appeal (x1)				
Creativity and innovation (x1)				
Research (x2)				
SUBTOTAL (60 points)				

Presentation (80 points)				
CRITERIA	Minimal performance 1-4 points	Adequate performance 5-8 points	Exemplary performance 9-10 points	
Organization (X1)				
Knowledge (X2)				
Articulation (X1)				
Delivery (X1)				
Team participation (X1)				

LEAP Leadership Resume/Interview See Regulation E and instructions on TSA website (X2)										
SUBTOTAL (80 points)										
Flight Challenge Flight times recorded to the nearest tenth (.1) of a second										
Drone Classification		Whoop		Micro		Macro		RubiQ		
Manual Flight Race Placement (55 points)										
1 st	2 nd	3 rd	4 th	5 th & 6 th	7 th & 8 th	9 th - 12 th	13 th -16 th			
55 points	50 points	45 points	40 points	35 points	30 points	25 points	15 points			
					Time	Place				
Relay Race Flight										
Perfect placement =3 pts, Partial= 2pts Moved= 1 pts			Perfect 3 x _____		Partial 2 x _____		Moved 1 x _____			
SUBTOTAL										

Total

Exhibition FPV Flight Time 1 _____ 2 _____ 3 _____ Placement _____
