



**Monroe Community College**

STATE UNIVERSITY OF NEW YORK

## **Monroe Community College Mini UAV Competition**

Saturday, May 2, 2015

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### ***The Task***

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Small teams of sophomore and freshman students will design, build, and pilot a mini Unmanned Aerial Vehicle (UAV) to carry a payload through a series of obstacles, and return to the starting point. The UAV must be able to maneuver around and through obstacles, change altitude, carry various payloads, and pass sizing specifications. Size, cost, and part constraints are provided to ensure a level playing field. You cannot purchase and modify an existing commercially available vehicle. Participants are permitted to purchase a frame kit and propulsion and control system for their UAV. However, participants are encouraged to engage in research and design a frame for their UAV. In addition, it is expected that participants will become fairly adept to line of sight piloting in preparation for the competition.

The task is designed to simulate a cargo/supply delivery where human navigation is difficult or dangerous. With the expanding industry, growing market, and advancing technology, we expect to see more problems solving using UAV's in the near future.

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### ***Time and Location***

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The competition will be held in the *PAC Field House* at Monroe Community College - Brighton Campus on May 2, 2015 at 10:00 AM. Participants should arrive and register at 9:00 AM. Directions to MCC can be found here: <http://www.monroecc.edu/depts/webmaps/>

Participating teams should report to Christopher Kumar at the MCC Engineering Department by Friday, April 17, 2015.

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## ***Vehicle Requirements***

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**The following rules will be checked on competition day for each team. Safety is of the utmost importance when flying – pilot must wear goggles.**

1. The vehicle must be powered by batteries.
2. The device must be controlled through a wireless transmitter/receiver radio link. The following requirements pertain specifically to the device controller:
  - A radio transmitter may have its own batteries (rechargeable or non-rechargeable).
  - The transmitter/receiver radio link may be any commercially available model controller.
  - During the trial, the device must be completely controlled via the radio link. No other contact, interaction or influence is permitted.
  - One team member must control the device throughout the trial.
  - All radio controllers will be impounded and shut off during the competition, except during the team's run.
3. All devices must have a readily accessible and clearly labeled master shut-off switch.
4. All fully assembled UAV (propellers included) must be capable of fitting in a 24x24x12 inch box.
5. All vehicles must adhere to the part specifications outlined on page 5. A brief bill of materials must be provided for each UAV. The bill of materials needs only to provide for parts included in the parts table below (motor, speed controllers, etc.).

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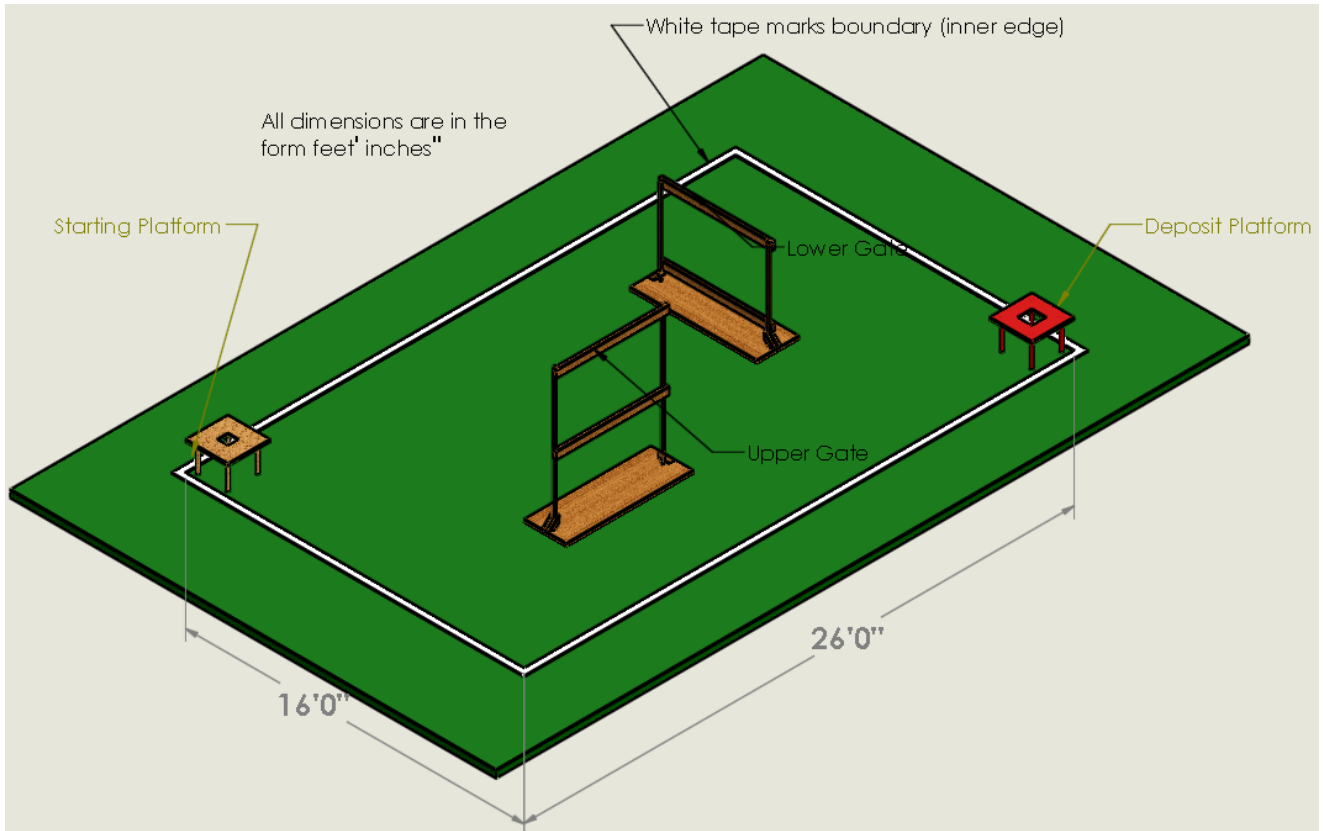
## ***Course Description and Rules***

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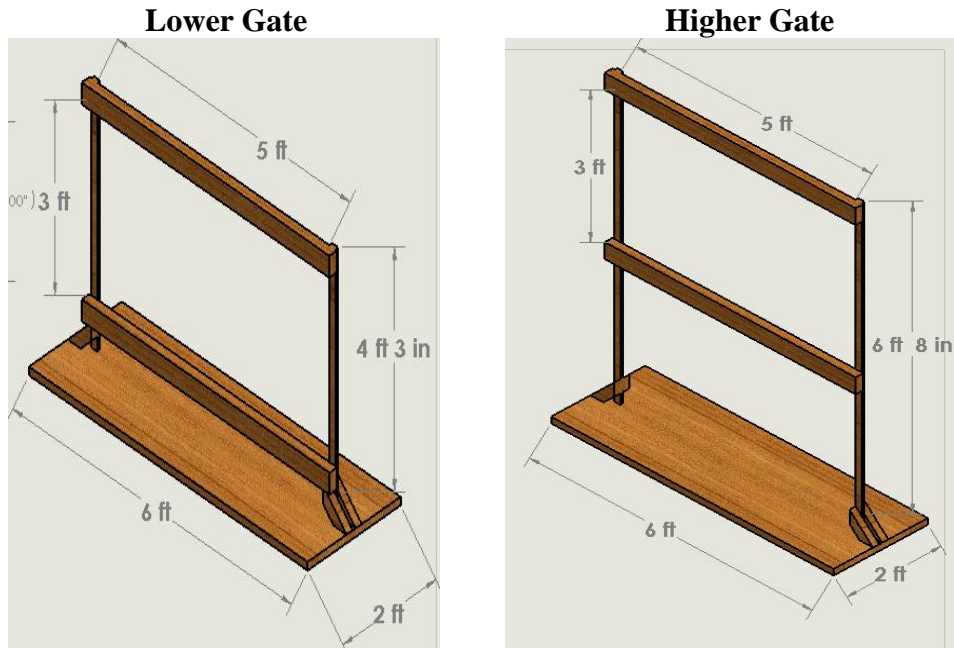
The course will consist of a flat, level section of field marked off with masking tape, and the corresponding airspace will be above the field. The rectangular course (figure 1), with the maneuver gates, will be in a space of 16 ft. by 26 ft. in size. The airspace for maneuver will be in indoor field house (MCC PAC center/ field house).

There will be no penalty for maneuvering outside the bounds of the course area. The minimum will be 6 ½ ft. between gates. The judges will determine the gate locations on the competition day. However, the starting and deposit platform (figure 3) will be located diagonally from one another as shown in figure 1.

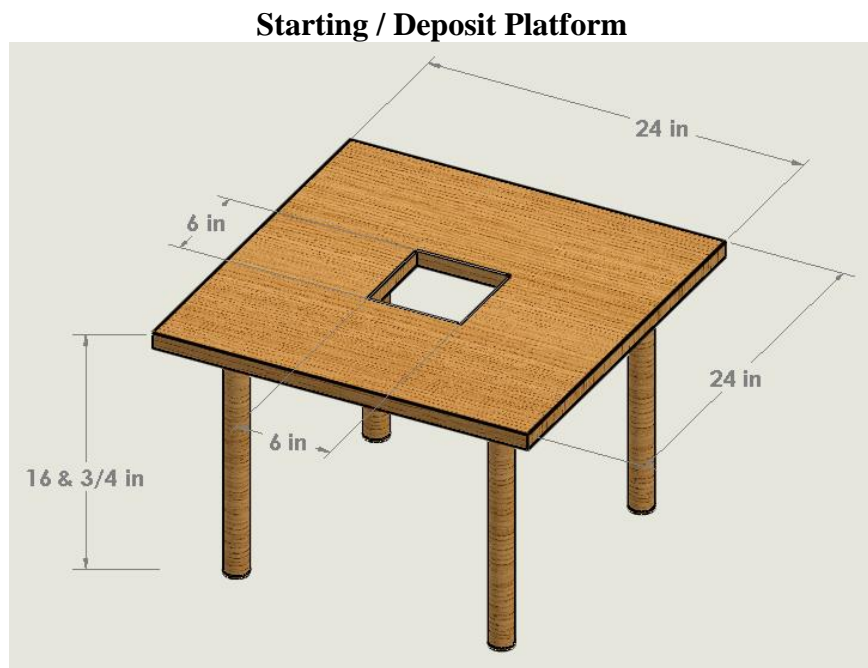
The UAV must go through two gates, physically contact the deposit platform with the payload and return to the starting point, all while carrying a payload. Extra points will be awarded for going through the same two gates on the UAV's return trip. Extra points will also be awarded for releasing the payload onto the deposit platform. The payload will be a small standard 300 gram mass. A carry and release system must be constructed to transport the payload to the platform (if the team decided to release the payload). The use of nets, blunt hooks, buckets, and the like are allowed. Adhesives may not be applied directly to the payload and no marks or scuffs may be left on the platform by the carry and release mechanism. UAV's will begin each trial with possession of the payload; no pickup mechanisms are needed. Each gate will be 5 ft. wide with a 3 ft. tall opening; however, the lower gate will have a 4 ft. 3 in. height and the higher gate will have a 6 ft. 8 in. height (figure 2). *Note:* All pilots must fly on a line of sight basis. No First Person View (FPV) cameras may be used to navigate.



**Figure 1: The isometric view of the course constructed in the indoor field house.**



**Figure 2: Schematics for lower gate and higher gate. Each gate will be 5 ft. wide with a 3 ft. tall opening.**



**Figure 3: Schematics for the starting and deposit platforms. It has a 6 in by 6 in hole in the center of each platform. This is provided for carry and release systems that occupy space beneath the vehicle.**

## ***Part Specifications and Example Build***

The following table is an example part list requirement to build a mini UAV. All vehicles that participate in this event must not have a cost exceeding \$210 (Excluding Tax). This build ends up with a net cost of approximately \$180 (not including small parts such as screws, hot glue, etc.). Students will need to devise a carry and release system for the payload in addition to the parts listed here. The carry and release system will not be considered when evaluating the budget for each UAV.

<b>Part</b>	<b>Specifications</b>	<b>Example Build</b>	<b>Qty</b>	<b>Cost per component</b>
<b>Required</b>				
Control Board	Any.	<a href="#">KK 2.0 flight controller board</a>	1	\$26
Frame	Students are encouraged to fabricate their own frames, however commercial frames are allowed.	<a href="#">F330 Glass Fiber Mini Quadcopter Frame 330mm</a>	1	\$9
Motors	Must not exceed a 20A maximum current draw or 1200 kV rating.	<a href="#">NTM 28-30 800kv</a>	4	\$16
Motor mounts	Can be fabricated or purchased.	<a href="#">NTM Prop Drive 28 Series Accessory Pack</a>	4	\$2
Speed Controllers	Must be able to handle the motor current draw at least. ESC's with integrated BEC's are allowed.	<a href="#">MultiStar 20A opto ESC</a>	4	\$8
Battery Eliminator Circuit	Any.	<a href="#">X3 PRO 3.3V 3.5A UBEC</a>	1	\$4
Propellers	Must not exceed overall drone size specifications.	<a href="#">TGS Sport 8x4E Precision propellor</a>	4	\$2
Battery	NiMH, LiPo, or NiCad allowed. No greater than 3-cells, or 12 volt rating.	<a href="#">Zippy 2200A 35 C compact motor</a>	1	\$17
Power distribution	Any.	<a href="#">Multistar ESC Power Breakout Cable</a>	1	\$4
Receiver Leads	Any.	<a href="#">JST-SH</a>	1	\$2
<b>Recommended</b>				
Battery Alarm	Any.	<a href="#">HobbyKing Low Voltage Alarm</a>	1	\$2
Battery strap	Any.	<a href="#">Turnigy Velcro Strap</a>	1	\$2
Mounting Foam/Shock absorbers	Any.	<a href="#">Gyro Mounting Pads</a>	1	\$2

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## **Scoring Guidelines**

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The final score will be the sum of scores from the three trials, including any broken rule deductions and bonuses.

Tasks to be accomplished:

1. Navigate through the gates in the fastest time.
2. Bonus: Release a payload over the deposit platform
3. Bonus: Navigate through same gates on return trip
4. Hitting or touching the gates will incur a penalty
5. Provide photographic visual evidence of the construction of your vehicle
6. Design Calculations
7. Brief Bill of Materials

### **Design Calculations:**

Each team must have at least one page of design calculations which provide the cad dimensions of major components (propellers, motors, frame, flight controller, etc.) and overall design of assembled UAV. Motor and propeller selection must be briefly explained, along with calculation for thrust and maximum payload lift.

### **Trial Score:**

200 – (Trial time) (seconds) will be awarded each trial. Each trial terminates after returning to the starting position and landing or after the vehicle is otherwise not able to progress any further. 100 points will be awarded each time a drone passes through a gate. This may only be done once per gate before and once per gate after payload delivery for a total of 400 points maximum per trial. 20 points will be awarded if the payload makes physical contact with the drop zone. 50 points will be awarded for successful release of the payload. 50 additional points will be awarded if the payload is released within the designated drop zone. To be considered within the drop zone the payload must be either on the deposit platform or underneath after having fallen through the hole in the center of the platform.

### **Deductions:**

20 Points will be deducted each time the drone or payload makes physical contact with a gate. 200 points will be deducted if the budget for the drone exceeds the \$210 limit. Note: If the budget exceeds the limit substantially, scores will be more heavily reduced or even invalidated.

**Note:** On the competition day, designated judges will interpret the rules and determine all decisions. The decision will be final and will not be negotiable. All teams must respect the decision. The purpose of this competition is to support students' interest in mathematics, engineering, science, and technology. We expect the competition to be a learning environment, and to be cordial and courteous.

**Example Trial Score:**

Event	Trial 1	Points	Trial 2	Points	Trial 3	Points
Time:	100	100	120	80	40	160
Gates:	4	400	3	300	2	200
Contact With Drop Zone:	Yes	20	Yes	20	No	0
Payload Released:	Yes	50	Yes	50	Yes	50
Payload in Drop Zone:	Yes	50	No	0	No	0
Deductions						
Contact with gate?	3	-60	0	0	1	-20
Unacceptable Budget	No	0				
Score:	1400					