2010 IARC (Indoor Aerial Robotics Competition)

This year's annual Indoor Aerial Robotics Competition sponsored by the Drexel Autonomous Systems Lab (DASL), hosted by Rowan University, will focus on unmanned equipment pickup/drop off and target tracking as it has to do with UAVs (Unmanned Aerial Vehicles). The competition will consist of the three parts listed in the *Rules* section below. Note: This competition is similar to IARC 2009 with the main difference being the requirement to only use autonomous control for the vehicles. Please read the competition rules carefully and contact Daniel M. Lofaro, dml46@drexel.edu, with any questions you may have.

1. Rules:
1.1 Part 1 – Pickup/Drop off:

In this section each team will have to locate, pickup, and drop off dropped cargo in the area described in Section 3.7. Each piece of cargo will be simulated by a small box as described in Section 3.8. Each piece of cargo will have to be located, picked up, and dropped off at the home base, which will be simulated by a 12"x12"x12" cardboard box with the top open. Each piece of cargo has to placed in the home base and remain inside until the end of the run in order for it to count. There will be six pieces of cargo in groupings of one to three. The maximum amount of points allotted for this section is 360. The maximum time allotted for this portion of the competition is two minutes. Each team gets two separate attempts with the highest score being taken. The score for this round can be calculated by the equation listed below.

$$Score_{Part\ 1} = \frac{120}{t}(N \bullet 20) \bullet M$$

Note: N is the boxes successfully placed in the home base. t is the amount of time taken to complete the objective, this is measured in seconds. M is the control method multiplier.

1.2 Part 2 – Target Tracking:

In this section each team will have to locate and activate six targets in the area described in Section 3.7. Each target will be no smaller than a 3" in diameter, each object will be sphere-like, and colored in the red spectrum. Each target will be a standard red latex balloon filled to different capacities with helium. Each balloon will be held down by a string attached to a weight. Each balloon will be at altitudes ranging from 12' off the ground to 0', i.e. touching the ground. Each target has a point value associated with it which is a function of how difficult it is to track. The target is deemed activated when the target balloon is popped. Only targets that are activated before time has expired will count towards the score. The maximum amount of points allotted for this section is 360. The maximum time allotted for this portion of the competition is two minutes. Each team gets two separate attempts with the highest score being taken. The score for this round can be calculated by the equation listed below.

$$Score_{Part\ 2} = \frac{120}{t}\left(\sum(Achieved\ Target\ Points)\right) \bullet 2M$$

Note: t is the amount of time taken to complete the objective, this is measured in seconds.   M is the
     control method multiplier.

2. Scoring:

2.1 Each round is scored based on its given score equation. This equation includes a variable M which
     stands for the control method. The multiplier is used to adjust the achieved score for the difficulty
     of the control method used.

- M=0.0   Remote Control/Human Control (see section 3.1 for definition)
- M=0.0   Partially Autonomous Control (see section 3.2 for definition)
- M=1.0   Fully Autonomous Control (see section 3.3 for definition)

2.2 Judge's Choice: In addition the judges will score each device based on a how well it performs to *their
     opinion*. This section will be worth a maximum of 280 points. The factors that the judges will look at
     are:

- Smoothness of movements, the smoother the better (40 points max)
- Reliability, does the device start on its first try without any issues (50 points max)
- Simplicity, is it simple to use, does it take a long time to set up (50 points max)
- Build Quality, does the device look clean, neat, and organized, does it look professional (50
     points max)
- Volume, how loud is the device when it is running. The quieter the better (40 points max)
- Over all likeability, personal preference (50 points Max)

The total score will be calculated by summing up the scores from *Part 1*, *Part 2*, and the *Judge's
Choice.* The highest overall score wins. The maximum combined score for the competition is 1000
points.

3. Vehicle, Terrain, and User Interface Restrictions:

3.1 All events where the device is remote controlled/non-autonomous will be done from a remote
     location such that the operator cannot see the device during operation. This is done to simulate a
     real UAV mission. All communication between the device and the operator/computer must be
     wireless while the device is in use.

3.2 All events where the device is partially autonomous will be done from a remote location such that
     the operator cannot see the device during operation. This is done to simulate a real UAV mission.
     Partially autonomous is defined for this document as: A device that receives high level commands,
     such as "pick X up" or "go to (x,y,z)," and then complete that task without any further operator
     interaction. The command "go forward," or other such commands, would not be considered a

partially autonomous command. All communication between the device and the operator/computer must be wireless while the device is in use.

3.3 All events where the device is fully autonomous the operator can be in the same room.   For the device to be counted as fully autonomous the operator can only do two actions. (1) Turn the device on and (2) press the equivalent of a "go" or "start" button. All communication between the device and any computer must be wireless while the device is in use however the user is can press a physical button on the device to turn it on as well as press the equivalent of a "go" or "start" button.

3.4 For all events the starting orientation of the device will be magnetic North at an altitude of 3 feet directly above a randomly chosen starting position which will be the same for each team.

3.5 All devices must be able to maintain stable flight for a minimum of 2 consecutive minutes as well as not have any piece of the device larger than a 4"x4"x4" cube move faster than 10 mph. The entire device must fit inside a 5'x5'x5' box. The device must be electrically powered. No gas, nitro, or like energy sources may be used.

3.6 At no time may any device have a piece that it started with it detach from its body or extend more than 5' away from the center of gravity of the device.

3.7 The area for competition will consist of an area win minimum LxWxH dimensions of 20'x20'x10'. The area may or may not include multiple easily accessible levels as well as inclines or stairs. The area may also include hall ways or passageways as narrow as 5' wide and as tall as 8' tall. In addition the floor and the majority of the walls will be covered with white paper.

3.8 The simulated cargo will be a small box weighting no more than 20g each and a maximum length with and height of 4". Each piece of cargo will have a piece of faradic metal attached to the highest point. The weight of the faradic metal is included in the 20g weight limit.