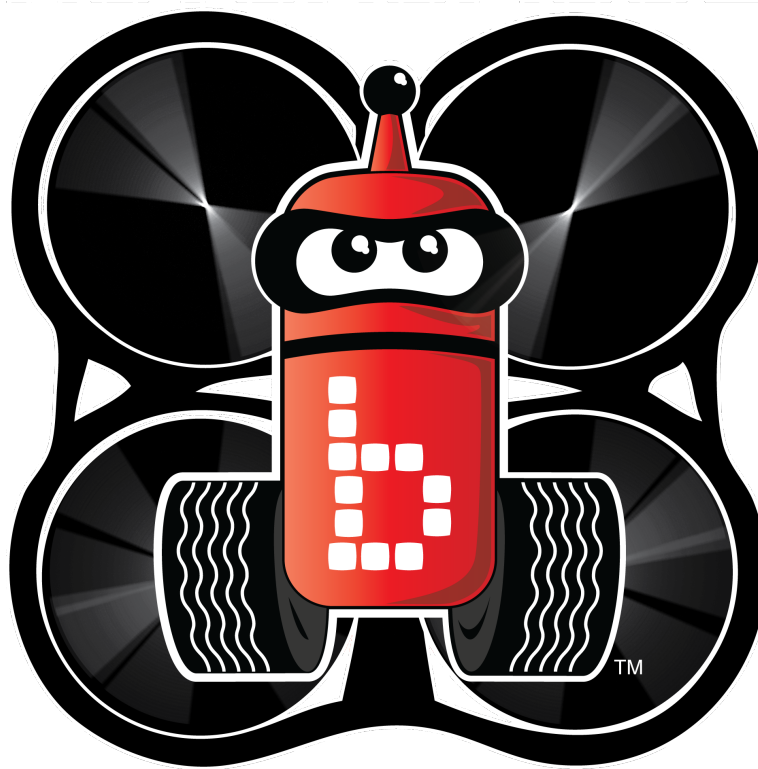


2017

Autonomous Aerial Robot Tournament

KISS Institute for Practical Robotics



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KIPR / Botball / GCER Sponsors



Change Log

Ver	Date	Description
1.1	March 9 th , 2017	Minor modifications to original.
1.2	June 5 th , 2017	Added section regarding the use of Target Markers. In addition, provided clarification on the movement of the Targets.

KIPR Autonomous Aerial Robot Tournament

KIPR produces the KIPR **Autonomous Aerial Robot Tournament** each year at the Global Conference on Educational Robotics. The current game will continue to be revised and used until a team is able to successfully complete all challenges repeatedly.

KIPR Autonomous Aerial Robot Tournament Game

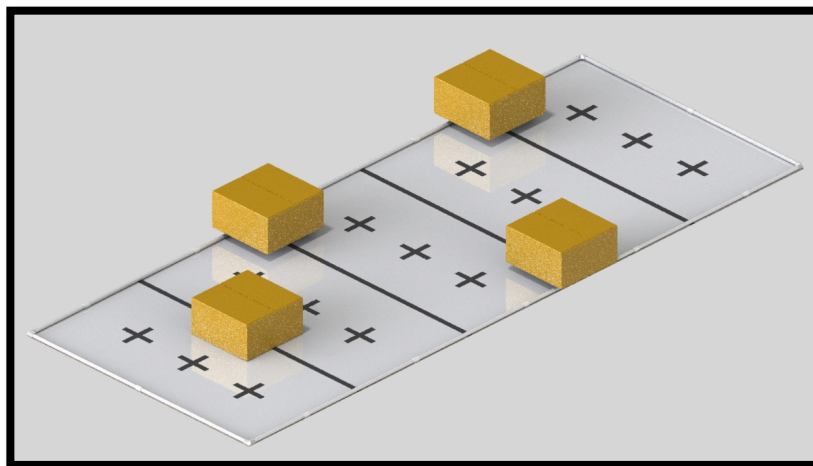
The KIPR Autonomous Aerial Robot Tournament Game is an autonomous robotics challenge designed and distributed each year by the KISS Institute for Practical Robotics (KIPR) to encourage autonomous robotics education. This document presents the official game rules for the KIPR Autonomous Aerial Robot Tournament Game. These game rules are free for educational use and are used in college courses and robotics events throughout the country. For the latest information on the KIPR Autonomous Aerial Robot Tournament, please visit <http://www.kipr.org/aerial-robot>.

For information on KIPR's Botball Educational Robotics Program for students in middle school and high school visit <http://www.botball.org>.

This Year's Game

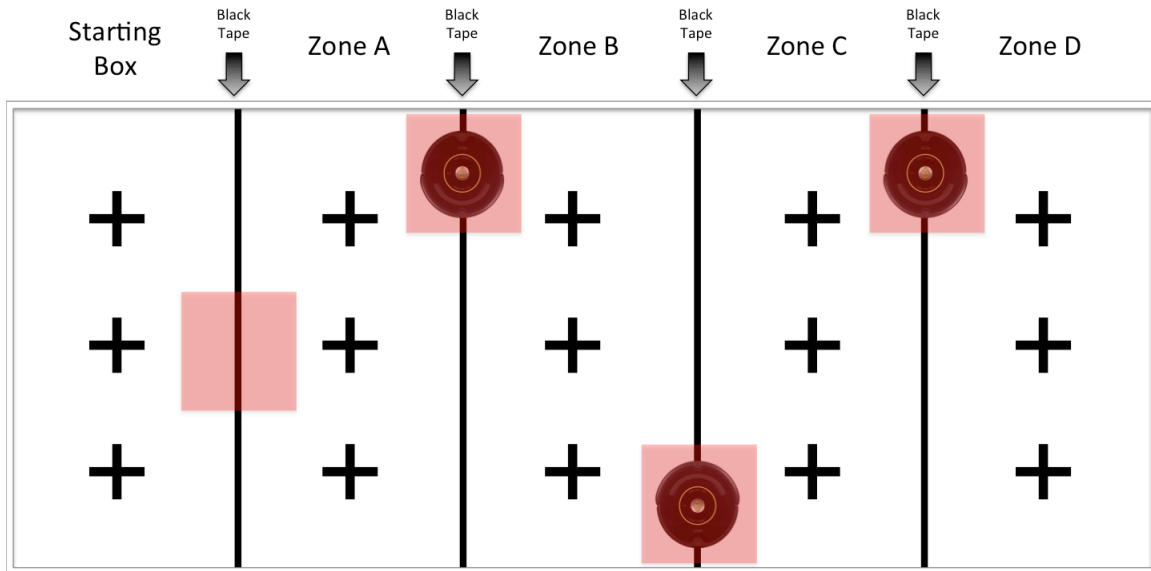
This year the focus will be a simple yet complex task: landing. SpaceX has made a historic leap forward this past year with being able to land their reusable Falcon 9 rocket boosters on a predetermined landing zone. This was an incredible engineering feat, and we are going to try to tackle it with this year's game.

In front of you are four landing pads. The first is fixed and stationary, however the next three are moving. You will need to successfully land on multiple pads in order to win this year's challenge. The further away the pad, the faster it moves. Pads will move in a predictable manner where your robot will be able to calculate the appropriate trajectory to land. To aid in the landing process, teams can place their own landing markers on the pads.



The Board

The KIPR Aerial Challenge Game Board is 8 feet by 20 feet, and divided into 5 equal zones as delineated by black tape. 1-inch PVC pipe surrounds the entire board. On the board is one stationary target in Zone A, followed by three moving target on top of Creates.



Note that the diagrams in this document are meant for illustrative and descriptive purposes, rather than for accuracy. Please consult the construction guide for details on construction.

Zones

All Zones will have a black line dividing them, equally covering both panels. The line will be composed of 1.875-inch Duck Brand Duct Tape.

Target

Each target will be a 2'x2'x1' cardboard box. On top of the box will be a Velcro X-shaped pattern (hook side) that a Target Marker can attach to. The target in Zone A will be placed on the ground on the line that separates the Starting Box and Zone A, however it will be referred to the Zone A target. This naming convention will apply for the Zone B target, which runs the line between Zone A and Zone B. This same style applies for Zones C and D's targets. The targets in the rest of the zones will be on top of Creates programmed to drive in a predetermined pattern.

Target Markers

The Target Marker may contain electronics that involve the use of LEDs to passively emit a light, visible or invisible to humans. This mainly pertains to the use of infrared LEDs to provide navigation points to a drone. Microcontrollers, microprocessors, motors, servos, or any other similar device, may not be used. The Target Marker does not count against your independent structure count. If unsure if something is permitted, then ask the FAQ.

The thickness of the Target Marker may not exceed 1-inch and may not extend outside of the target surface. The weight of the marker may not exceed 3 pounds.

A Target Marker that fails these requirements is not permitted to be used during the competition. Judges reserve the right to thoroughly inspect the marker at any point during the competition.

Target Velocity

Zones B, C, and D each have kinetic targets. They will start out as shown in the board diagram. Each will line-follow along the black tape until it senses a bump, in which case it will stop, reverse direction, and continue the line-following algorithm. It is not guaranteed that the robots will continue following the line throughout the duration of the game due to wheel slippage, disabled robots, etc. The targets may venture out of their zone, but their point value does not change.

	Speed
Zone B Target	3 cm/s
Zone C Target	6 cm/s
Zone D Target	10 cm/s

Navigation Markers

Navigation markers appear in each zone and in the Starting Box. They are composed of two 1-foot strips of black 1.875-inch Duck Brand Duct Tape arranged into a cross shape. They are located in the center of the zone, and then at the center of the two 4'x4' sections within the zone.

Game Rules

Landing to Score

In order for a robot to score on a target, the robot must land successfully and come to rest (propellers can be spinning) on top of the box for at least five seconds. Each box can only be scored on a maximum of ten times. The aerial robot must descend onto the target without gravity being the only source driving the robot downwards.

Teams may land on the same box multiple times, but not consecutively. For example, a team can land on Zone A's box, stay for 5 seconds, and take off. In order to score on Zone A's target again, they must make a landing attempt onto another zone's target. If a team makes a landing attempt into another zone and misses, then the drone must be stationary for at least 5 seconds on the ground before being eligible to score on Zone A's target again. Teams that appear to be intentionally landing on the ground and not making an attempt at landing in order to score repeatedly on the same target may not be awarded points at the judge's discretion.

Consecutive landings on the same target will not disqualify a team, but it will only count for the first landing.

Touching to Score

If a team attempts to land and misses, but makes contact with the target in the process, then points will be awarded according to the score sheet. However, this rule is intended to provide teams with points for making an attempt as determined by the judge. Teams who try to sweep through the field of play to make contact with boxes will not be awarded points. Teams can only earn these touch points once in the round.

Team Membership

Teams can be comprised of K-12 aged students, college students, professional engineers, hobbyists, poets, and anyone else fulfilling the criteria above are all encouraged to participate.

Target Visual Identifiers

The boxes will have a Velcro X-shaped pattern on top of them. The marker that your team provides does not have to encompass the 2'x2' target area. It can be anything to aid your navigation, or be something that looks fun.

Spirit of the Game

If your team has come up with a creative technique to take advantage of a loophole in the rules, then ask it on the FAQ. Teams that show up to the competition that take advantage of the rules in a way that defeats the spirit of the game may result in their runs not being awarded points.

Competition Rounds

1. The aerial robot(s) may not leave the starting box until the starting light has turned on.
2. The light will turn on at the judge's command (at a time of their choosing) and the game timer will start at that point – the robots must be able to autonomously sense when the game has started.
3. Teams whose aerial robots leave the start box after the team indicates that they are ready but before the lights turn on will receive a fault.
4. Two faults in a row will cause the team to receive a score of 0 for that round.
5. All aerial robots must power down their mobility system within 180 seconds of the start lights turning on (aerial robots should be on the ground).
6. Each team will have at least three competition rounds (the judges may increase the number for all teams, if they feel it is warranted and time is available).

Scoring

The following is what judges will be using for scoring at the tournament. Teams will have their two highest runs averaged together. This will determine the standings. If there is a tie, then refer to the Tie Breaker list.

Task	Pts	Complete	Running Total
Zone A Target Landed On	10	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
Zone B Target Landed On	20	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
Zone C Target Landed On	40	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
Zone D Target Landed On	80	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
Zone A Target Touched	1	<input type="checkbox"/>	
Zone B Target Touched	2	<input type="checkbox"/>	
Zone C Target Touched	3	<input type="checkbox"/>	
Zone D Target Touched	4	<input type="checkbox"/>	

Team Score

Once the sheet is signed, TEAM SCORE cannot be challenged. Teams, ask to see Head Judge before initialing if there are any questions.

Tie Breaking

1. Team landed on the Zone D target
2. Team landed on the Zone C target
3. Team landed on the Zone B target
4. Team landed on the Zone A target
5. Team scoring the most times on the Zone D target
6. Team scoring the most times on the Zone C target
7. Team scoring the most times on the Zone B target
8. Team scoring the most times on the Zone A target
9. Team touched the Zone D target
10. Team touched the Zone C target
11. Team touched the Zone B target
12. Team touched the Zone A target

Robot Construction Rules

The following rules apply to all robots to be entered in the KIPR Autonomous Aerial Robot Tournament Game:

1. For purposes of this competition, an aerial robot is any self-powered aerial vehicle that is under autonomous computer control. The control computer can be on the aerial robot, or elsewhere on the team's entry.
2. No ground-based robots are permitted in this year's game.
3. Ballistic entries are not allowed -- nor are others which use high pressure or chemical rocket propellant.
4. A team's entry (all materials placed on the game-board) must mass less than 10kg (22 pounds).
5. A team's entry (all materials placed on the game-board) must fit within their (virtual) starting boxes without restraint (other than pressing against interior edge of any game board PVC bordering the starting box).
6. The team's entry may not contain or release pressurized materials at greater than 7 bar (100 psi).
7. The team's entry may not release any liquids during the game, or before, during, or after the game while the team is at the game table.
8. The team's entry may not release any gasses while at the game table that are considered hazardous by the judges, or are at a temperature below 0°C (32°F) or above 50°C (122°F).
9. Robots may not contain features (manipulators, protrusions, or materials) that are designed to, or are deemed by the judges likely to, cause damage or destruction to the game board, or to game pieces. Propellers should be shielded so as to be unlikely to damage the hoops.
10. Robots must operate autonomously. No external power or control from outside of the game board area will be allowed.
11. Each team may only have a maximum of five independent structures on the game board at a time.
12. A team's entry may be made out of any materials or parts (including Botball and non-Botball kits) as long as the entry conforms to the construction rules above.
13. Each robot must have a name suitable for broadcast over a public address system.

Tournament Logistics

1. If the judges determine that a robot violates the construction rules, whether or not a challenge has been made, that robot will not be allowed to run until it has been modified to meet the rules.
2. All competition rounds will take place inside a netted arena. The netting will have a 10-ft by 20-ft ground footprint. So prepare accordingly.
3. Construction rules apply only to what is brought to the Game Table.
4. During setup teams may adjust starting lights.
5. Starting lights must be attached to the PVC pipe for a starting box
6. Starting lights may not be in physical contact with any robot
7. During setup, teams may perform any necessary calibrations needed by their robots.
8. Setup time should be two minutes or less.
9. For each minute or fraction thereof in excess of 2 minutes the team's score will be reduced by 20%.
10. Game duration is 180 seconds or until team completes the challenge.
11. Lights will remain on for 175 seconds, and flash the last 5 seconds unless the judges stop the game because a robot has reached the opposite end zone.
12. Once the starting lights are turned on, the round counts unless a judge rules outside interference.
13. Robots must cut power to their motors and turn off or stop issuing motion commands to servos after 180 seconds or risk forfeiting the round.
14. There are no instant replays, and attempts to use videos to question a decision will not be considered.
15. If a team is unhappy with the judges' decision, then they should challenge it then and there. Once the score sheet is signed, there is no further challenging.
16. Challenges to scoring after the teams have left the table will not be considered.
17. Teams cannot touch, borrow equipment, modify robots or computers, or transmit commands to another team's equipment (including their pit table) without the permission and presence of a member of that team.
18. The visual properties and RF properties around the arena are unknown. The judges will attempt to remove any issues, but might be limited by resources and building rules. Please plan accordingly.

Game Materials

The game surface is 8' x 20'

- 5 pieces of 4x8' MDF (122cm x 244cm) or some other underlay to screw into
- 5 pieces of 4x8' white 1/8" Masonite (122cm x 244cm)
- 90' of Schedule 40 1" PVC pipe

Game Board Setup

- A team's entry must be completely within their starting box (45.5" wide and 93" long) at game start.
- The base of each starting box is defined by the boundaries given by the interior edge of the PVC and tape delineating it.
- The (virtual) height of the starting box is 15" (38 cm).
- After teams have set up and are ready to start, the judges will place Zone A and B walls at random locations.
- All measurements on official boards, whose uncertainty is not otherwise specified will be as specified within +/- 1/2 inch (12mm) or 1%, whichever is greater.

Advice for Tournament Participants

Test your robots from start to end:

1. Go through the entire starting sequence
2. Make sure you can calibrate to the starting light
3. Make sure the robots stop when they are supposed to: verify with a stopwatch!
4. Does the starting sequence work with very bright or uncertain overhead lights? (tournament will be held in a net containment on open flooring)
5. Test the shielding of your sensors!

Check <http://www.kipr.org/aerial-robot> regularly for rules updates.

Check out the KIPR Open and Aerial Robot Tournament discussion and FAQ at <http://community.botball.org>

Good Luck!

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