

2019

ECER 2019 Aerial Robotics Tournament

Practical Robotics Institute Austria inspired by KISS Institute for Practical Robotics



Document Version 1.3

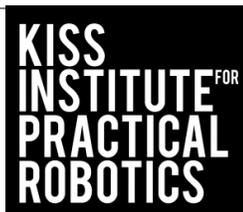


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Revision History

- Version 1.0:
 - Initial game design
- Version 1.1:
 - Added scoring
 - Added more explanations
 - Cleanup
- Version 1.2
 - Specified dimensions of base zone
 - Updated scoring rules for supplies on the peak
 - Updated supply construction rules
 - Added rule for supplies before the beginning of the game
 - Updated color and material of the default supplies
 - Color splashes on the game board will not be red, green or brown
- Version 1.3
 - New scoring rule for multiple drones added
 - Updated minimum net height

ECER 2019 Aerial Robotics Tournament

This year's Aerial Tournament is inspired by the KIPR Autonomous Aerial Robot Tournament. PRIA has adapted it for the European Region.

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. 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>.

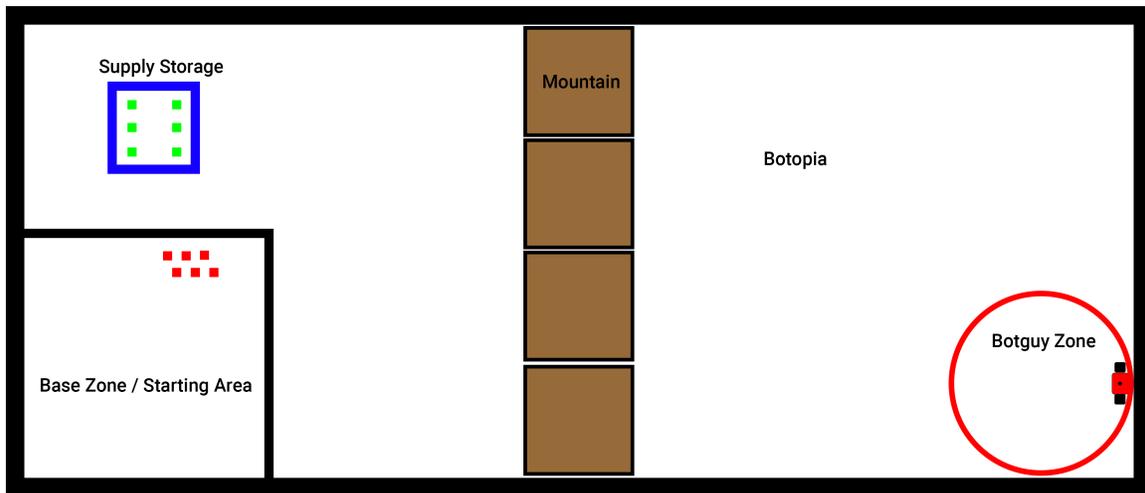
This Year's Game

In this year's game, you need to conduct a Search and Rescue mission to rescue Botguy. Botopia is on the other side of the mountains and you must fly over there to make contact with him. You will have some supplies to bring to him that are located in your starting box or Supply Storage. Teams will have to deal with the recent seismic activity that has reconfigured the landscape, but luckily ground teams have put markers on them already to identify the peaks. Teams will have to make the hazardous trip over or through the mountains to reach Botguy. He has placed some indicator markings around him to help identify his location. Teams will be able to see a bright red ring around him.

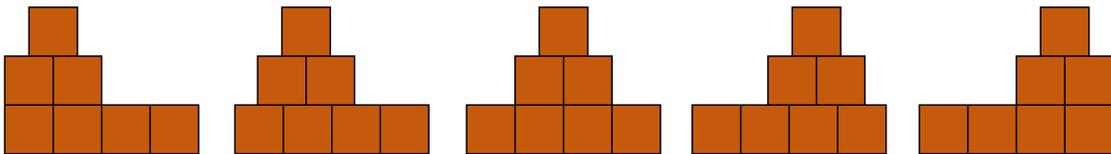
The Board

The PRIA Aerial Challenge Game Board is 245cm by 600cm. A (probably wooden) frame surrounds the entire board. In the middle of the game board there is a mountain which divides the board into Botopia and the other side.

Top view



Side views of the Mountain



Zone definitions

- Botopia is confined by the inner edges of the frame and the mountain.
- The Botguy Zone is confined by the inner edge of the Hula Hoop ring.
- The Supply Storage is confined by the inner edge of the blue tape.
- The Base Zone is confined by the inner edge of the frame and the inner edge of the black tape.
- The Peak is the topmost box of the mountain.

Note that the diagrams in this document are meant for illustrative and descriptive purposes, rather than for accuracy.

Mountain

Each part of the mountain will be a 60cm x 60cm x 60cm cardboard box. On top of the peak box will be a Velcro X-shaped pattern (hook side) that a Target Marker can attach to. The base of the mountain is comprised of four boxes. On top, the remaining three boxes, set up in a triangle formation, the formation will be placed randomly in one of the five positions (see Side View of the Mountain). The mountain will be placed in the middle of the game board so at approximately 300 cm.

Supply Storage

The Supply Storage holds some of the Supplies it will be located at the approximate position as shown in the Top View. The exact place and dimension will be available to you only at the tournament, so prepare accordingly so you can adapt your setup.

Botopia

Botopia starts on the other side of the mountain and is approximately 270 cm x 245cm.

Botguy Zone

The Botguy Zone (Hula Hoop ring with 100cm diameter) will be placed in one of the two corners at the end of the game board. Botguy will be placed inside the ring touching the edge of it, so you can land inside the Botguy Zone without landing on Botguy.

Base Zone / Starting Box

The Base Zone is located at the position as shown in the Top View. The dimensions of the zone will be 140 cm x 140 cm.

The virtual height of the Starting Box is 38cm.

Supplies

The supplies are made of PLA printed cubes (approximately 5cm x 5cm x 5cm) in two different colors (red and green), for a picture and the 3D model of the cubes see the [ECER 2019 Forum](#). The red cubes will be placed in the Base Zone and Teams are allowed to attach them on their drones before the game starts. The green cubes are placed in the Supply Storage, teams are allowed to place them as they would like within the boundaries of the Supply Storage before the beginning of the game. Both in the Base Zone and the Supply Storage supplies are not allowed to touch each other and must be at least 2mm apart at the beginning of the game.

Teams are allowed to bring their own Supplies to the tournament. If you choose to do so make sure you have two sets of Supplies in different colors so one can distinguish between Supplies from the Base Zone and the Supply Storage. Also make sure you have 6 Supplies of each color, you are not allowed to use more or less supplies. For details on how to construct the Supplies please refer to the Supply Construction Rules. If unsure if something is permitted, then ask aerial@pria.at.

Supplies that fail these requirements are not permitted to be used during the competition. Judges reserve the right to thoroughly inspect the supplies at any point during the competition.

Target Marker

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 aerial@pria.at.

The thickness of the Target Marker may not exceed 5 cm and may not extend outside of the target surface (the peak of the mountain). The weight of the marker may not exceed 1,5 kg. Also, the top surface of the marker must be flat.

For further rules regarding markers refer to the Marker Construction Rules section.

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.

Game Rules & Scoring

Scoring is divided into actions that are scored when they happen and into states that are scored when the game ends (3 minutes after the game starts):

Actions scored when they happen	Points scored
Drone lands on the Peak:	30 (only counted once)
Drone lands in Botguy Zone:	30 (only counted once)

States scored when game ends	Points scored
Supply in Botopia but outside the Botguy Zone:	10 per supply
Base Zone supply in Botguy Zone:	50 per supply
Base Zone supply on the Peak:	70 per supply
Storage supply in Botguy Zone:	points scored in this zone by Base Zone supplies are multiplied by (2 * number of Storage supplies in this zone)
Storage supply on Peak:	points scored in this zone by Base Zone supplies are multiplied by (2 * number of Storage supplies in this zone)
Drone landed anywhere but the base zone:	50
Drone landed in the base zone	100

Penalties scored when they happen	Points deducted
Drone touches the side of the mountain:	50 (only subtracted once)
Drone touches Botguy	15 (only subtracted once)

For scoring on the ground, scoring items (drone, supplies) have to be fully inside the vertical projection of the scoring zone (Botopia, Botguy Zone, Base Zone) and touch the ground either directly or via other items (drone, supplies).

For scoring on the peak, scoring items (drone and supplies) have to be inside or break the vertical projection of the scoring zone (Peak) and touch the top surface of the peak (or the target maker which you may place on the peak) either directly or via other items (drone, supplies).

The drone counts as landed when it has not been moving (including propellers spinning) for at least 5s.

If you use multiple drones in order to be rewarded points for landing in the Base Zone all of your drones must land in the Base Zone. Also, to be rewarded points for landing anywhere but the Base Zone all drones must land, if one does not land at all you won't be rewarded points.

Judges may use some sort of technical support (e.g. photos or videos) to document the state of the game board when the game ends (3 minutes after the game starts)

Spirit of the Game

If your team has come up with a creative technique to take advantage of a loophole in the rules, then contact us aerial@pria.at. 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. 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).

Marker Construction Rules

The following rules apply to the landing markers which you are allowed to bring to the tournament:

1. The marker does not have to encompass the complete peak.
2. The marker must not exceed the vertical projection of the peak.
(marker \leq peak)
3. The marker must not be higher than 5cm.
4. The marker must not weigh more than 1,5kg.
5. The marker is allowed to transmit signals like IR or ultrasonic
6. The marker must not be a robot. For the purpose of this tournament a robot is defined as a thing which actively moves or consist of a grapping arm or something similar.
7. Markers are not counted as independent structure.
8. Markers 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.
9. The rules 2, 3, 4, 6, 7, 8 from the robots construction rules also apply for the markers.

Supply Construction Rules

1. If you choose to bring your own Supplies to the Tournament you must provide two sets of Supplies with different colors consisting of exactly 6 Supplies per color.
2. One Supply must weight no more than 100g.
3. The supplies must be recognizable as cuboids and have a size between 4cm x 4cm x 4cm and 7 cm x 7 cm x 7cm.
4. All supplies must be recognizable as a cuboid, which means it must at least consist of edges and corners which coincide with a cuboid with a margin of error of +/- 0.2cm.
5. You are allowed to attach things (e.g non slip pads) outside of the volume of the cuboid as long as the supply remains recognizable as cuboid and the things do not stick out more than 5mm.
6. What is inside of the volume is not restricted as long as it complies with the other construction rules. Also, the cuboid is not required to be completely filled.
7. You are allowed to bring supplies which are modified and have electronic components in it as long as they comply with the construction rules.
8. The supply is allowed to transmit signals like WiFi, Bluetooth, IR or ultrasonic.
9. The supply must not be a robot. For the purpose of this tournament a robot is defined as a thing which actively moves or consist of a grapping arm or something similar.
10. Supplies are not counted as independent structure.
11. Supplies 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.
12. The rules 2, 3, 4, 6, 7, 8 from the robots construction rules also apply for the supplies.

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.
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 frame bordering the starting box).
6. The team's entry may not contain or release pressurized materials at greater than 7 bar.
7. The team's entry may not release any liquids during the game, or before or after the game while the robots are 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 or above 50°C.
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.
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, marker or supply violates the construction rules, whether or not a challenge has been made, that robot, marker or supply 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 be a little bit bigger than the game board and at least 2.6m high. 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 frame of the 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. Game duration is 180 seconds.
10. Lights will remain on for 175 seconds and flash the last 5 seconds unless the judges stop the game.
11. Once the starting lights are turned on, the round counts unless a judge rules outside interference.
12. There are no instant replays and attempts to use videos to question a decision will not be considered.
13. 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.
14. 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.
15. 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.

Robot and Human Safety

Only approved drones are allowed to fly in the competition. Appendix A has a list of already approved drones.

Drones that are not listed are required to submit the information found in Appendix B to aerial@pria.at. PRIA has up to 5 business days to review the robot to approve or deny with justification.

Prior to the competition, teams must demonstrate to the Head Judge that the robot is safe to land by demonstrating a kill switch feature.

All teams must have a physical button switch attached to the computer that will safely land the drone. Without this switch, drones will not be permitted to operate. Teams will not be allowed to type something into their computer to get the robot to land.

Interference

PRIA will be monitoring the wireless network traffic. Our objective is to detect when teams maliciously interfere with the Wi-Fi communication link. If this is detected, then the Head Judge reserves the right to act swiftly and disqualify the offending team. If someone in the audience is detected as interfering, then the team they are affiliated with will be disqualified. Teams are also required to cooperate with Judges and PRIA staff during the investigation of Wi-Fi issues and attack reconnaissance. Any other disruption, or the denial of cooperation may result in your team being disqualified.

Furthermore, we want to point out that the usage of Wi-Fi interference and jamming devices is illegal in the European Union. PRIA reserves the right to evaluate legal options if there is evidence of a participant maliciously causing interferences.

Teams should embrace the Spirit of Botball. Teams choosing to break this rule will be banned from ever participating in another event organized by PRIA again.

TL;DR: don't cheat. It won't be tolerated.

Game Materials

The game surface is 245cm x 600cm.

The surface will be white with some color splashes (the color splashes will not be red, green or brown) on it.

Game Board Setup

- A team's entry must be completely within their starting box (140cm wide and 140 cm long) at game start. Also no cables will be allowed to break the boundaries of the starting box.
- 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 38 cm.
- There will be one 3-way power distributor inside the starting box to plug in a Laptop or something similar.
- All measurements on official boards, whose uncertainty is not otherwise specified will be as specified within 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!

If you have any questions, please ask them in the [ECER 2019 Forum](#)

Good Luck!

Appendix A – Approved Drones

- Parrot AR Drone 2.0
- Parrot Bebop 1
- Parrot Bebop 2
- Parrot Mambo
- Parrot Anafi
- Intel Aero RTF
- DJI Spark

Appendix B – Drone Information

- Team Name
- Web link to drone
- Rough dimensions of the drone
- Any safety features of the drone

If you already own the drone, then please provide clear photos (minimum 2) of the drone.

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