

2023

ECER 2023 Aerial Robotics Tournament

Practical Robotics Institute Austria inspired by KISS Institute for Practical Robotics



Document Version 3.0

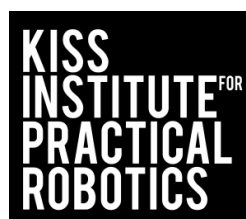


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Revision History

- Version 1.0:
 - Initial gamedesign
- Version 1.1:
 - Connection Multiplier only counts for the points scored with the Radio Masts.
 - Added definition of leaving the Starting Area to be rewarded points for the final Resting Position.
 - Removed references to Independent Structure count since it no longer exists.
 - Added definitions for the placing of the Radio Masts Base.
 - Scoring Rule for broken supplies added.
 - Added the RYZE DJI Tello as approved drone.
- Version 2.0:
 - Initial Release for ECER 2022
 - Added the Coex Clover drone as approved drone.
 - Added a picture of the default supply.
- Version: 3.0
 - Initial Release for ECER 2023

ECER 2023 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 <https://www.kipr.org/gcer/events/kipr-autonomous-aerial-robot-tournament>.

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

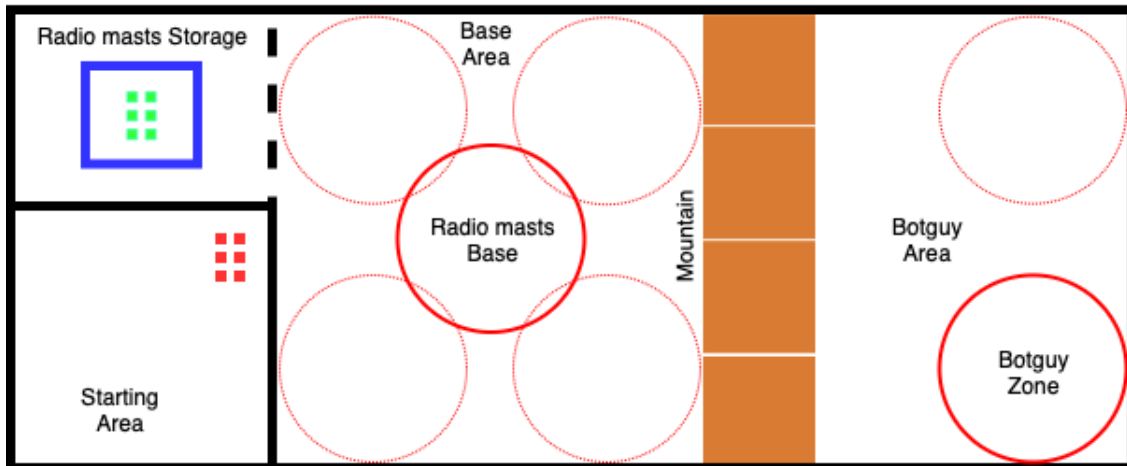
This Year's Game

In this year's game, Teams have to conduct a Search and Rescue mission to rescue Botguy. There are different ways to rescue Botguy, which is placed in the Botguy Zone on the other side of the mountains. Teams must fly between the mountain to bring the Rescue Kits (placed in the Starting Area) to Botguy. To establish a communication between Botguy and the rescue services, teams have to place the Radio Masts in the designated places. Luckily, ground teams have put markers on some of them already to identify these places. Teams will have to make the hazardous trip through the mountain 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

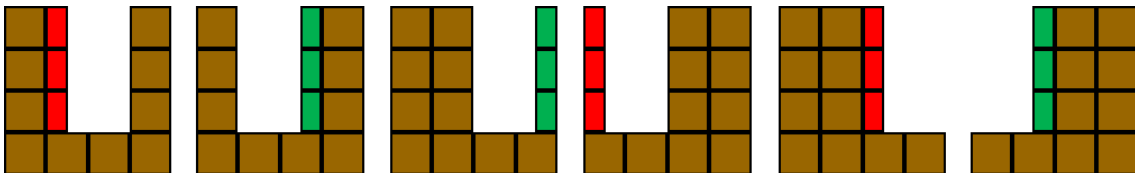
The PRIA Aerial Challenge Game Board is 245cm by 600cm. A mountain will be at about 2/3 of the game board and will divide the board into Base Area and the Botguy Area side.

Top view



The black dotted line is only for illustrative purposes to show the containment of the Base Area. There won't be any physical tape on the game board, instead the virtual extension of the Starting Area will be used. The red dotted lines represent the alternative positions of the Radio Masts base and the Botguy Zone.

Side views of the Mountain



The color of the narrow boxes (red or green) indicates on which side the gap is. Red means that the gap is on the right side of the boxes. Green means that the gap is on the left side of the boxes. On the back side, the narrow boxes have the opposite color: arrangement 2 is also how arrangement 1 looks from the back, and so on.

Zone definitions

- Botguy Area 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 Base Area is confined by the inner edges of the frame, the outer edges of the black tape around the Starting area which is virtually extended to the frame (see Top view) and the mountain.
- The Radio Masts Base is confined by the inner edge of the Hula Hoop ring.
- The Radio Masts Storage is confined by the inner edge of the blue tape.

- The Starting Area is confined by the inner edge of the frame and the inner edge of the black tape.
- The Mountain Base Zone is the area on top of the boxes in the gap (1 ½ boxes; about 90 cm) of the mountain.

Note that the diagrams in this document are meant for illustrative and descriptive purposes, rather than for accurately reflecting the board dimensions.

Mountain

Some parts of the mountain will be 60cm x 60cm x 60cm cardboard boxes, some parts will be 60cm x 30cm x 60cm cardboard boxes. In the Mountain Base Zone will be some Velcro tape (hook side) that a Target Marker can attach to. The base of the mountain is comprised of four 60cm x 60cm x 60cm boxes. From the second row on there are also boxes with a width of 30 cm. The formation will be placed randomly in one of the six positions (see Side View of the Mountain). The mountain will be placed at 2/3 of the game board so at approximately 430 cm.

Radio Masts Storage

The Radio Masts Storage holds the Radio masts and 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.

Base Area

The Base Area includes the playing field from virtual extension of the Starting Area (shown in the top view as dotted line) to the Mountain, whereas the areas Starting Area and Radio Masts Storage do not belong to the base area. The black tape and its virtual extension are also not part of the Base Area.

Radio Masts Base

The Radio Masts Base (Hula Hoop ring with 100cm diameter) will be randomly placed in the middle or one of the four corners of the Base Area. You can place a Target Marker within the Radio Masts Base.

Botguy Area

Botguy Area starts on the other side of the mountain and is approximately 140 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 in the Botguy Area. Botguy will be placed inside the ring touching the edge of it, so you can land inside the Botguy Zone without landing on Botguy. The Botguy Zone is part of the Botguy Area.

Starting Area

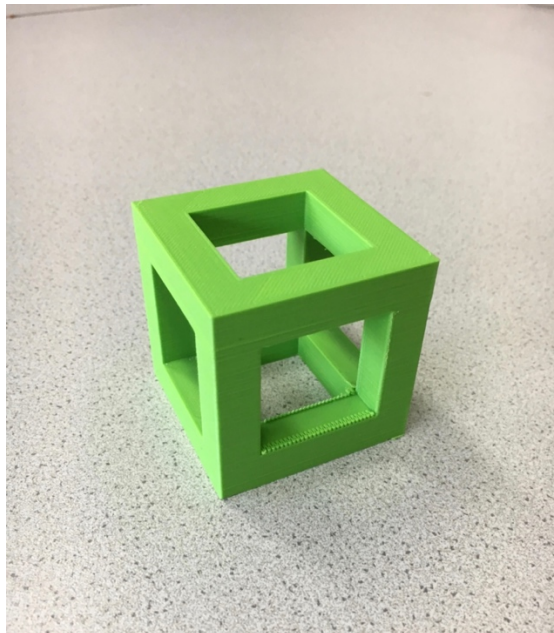
The Starting Area is located at the position as shown in the Top View. The dimensions of the zone will be 140 cm x 140 cm. The virtual height of the Starting Box is 38cm.

Supplies (Rescue Kits, Radio Masts)

The supplies are made of PLA printed cubes (approximately 5cm x 5cm x 5cm) in two different colors (red and green), for a picture see below. You can also download the STL file of the default supply from our [webspace](#). The red cubes will be placed in the Starting Area and teams are allowed to attach them on their drones before the game starts. The green cubes are placed in the Radio Masts Storage. Teams are allowed to place them as they would like within the boundaries of the Radio Masts Storage before the beginning of the game. Both in the Starting Zone and the Radio Masts 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 Rescue Kits and Radio Masts. Also make sure you have 6 supplies of each color, you are not allowed to use more or less supplies. It is valid to combine different kinds of supplies, as long as you end up with two sets of six supplies of uniform and distinct color. For example, you could replace a single provided supply with one of your own, as long as it matches in color. For details on how to construct the supplies please refer to the Supply Construction Rules. If unsure if something is permitted, ask aerial@pria.at, or in the forum if the question contains no confidential information.

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.



Default Supply

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. If unsure if something is permitted, then ask aerial@pria.at, or in the forum if the question contains no confidential information.

The thickness of the Target Marker may not exceed 5 cm and may not extend outside of the target surface. 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 in Radio Masts Base	20 (only counted once)
Drone lands in Mountain Base Zone	30 (only counted once)
Drone lands in Botguy Area	20 (only counted once)
Drone lands in Botguy Zone	50 (only counted once)

States scored when game ends	Points scored
Rescue Kits in Base Area but outside the Starting Area	1 per kit
Rescue Kits in Botguy Area but outside the Botguy Zone	10 per kit
Rescue kits in Botguy Zone	30 per kit
Radio Masts in Radio Masts Base	20 per mast
Radio Masts in Mountain Base Zone	30 per mast
Radio Masts in Botguy Area	50 per mast
Connection: Radio Masts in different target zones (Radio Masts Base, Mountain Base Zone, Botguy Zone)	Multiplier for Points scored by the Radio Masts: Radio Masts Base & one other: x1,5 Mountain Base Zone & Botguy Zone: x2 All 3: x3
Drones' final resting position is touching the ground in the Base Area	50 (only counted once)
Drones' final resting position is touching the ground in the Starting Area (drone has to leave the Starting Area during the game)	100 (only counted once)

For scoring on the ground, scoring items (drone, supplies) have to be fully inside the vertical projection of the scoring zone (Base Area, Radio Masts Base, Botguy Area, Botguy Zone) and touch the ground either directly or via other items (drone, supplies), or if allowed in the particular zone via the target marker. The only exception is when a drone has its final resting position between the Starting Area and the Base Area then this drone counts as to have its final resting position in the Base Area.

For scoring in the Mountain, scoring items (drone and supplies) have to be inside or break the vertical projection of the scoring zone, touch the top surface of the Mountain Base Zone (or the target maker which you may place on it) either directly or via other items (drone, supplies), and not touch the ground.

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

If you use multiple drones, points rewarded for the final resting position are determined based on the drone that would score the lowest. For example, if one drone rests in the Starting Area and the others only in the Base Area you will be awarded the points for resting in the Base Area. Also note that if one drone does not land at all you won't be rewarded any points for resting at all.

In order to receive the points for the final resting position in the Starting Area one drone needs to leave the Starting area. In that regard leaving the Starting Area is defined to completely leave the vertical projection of the Starting Area. So just taking off and landing again is not sufficient (even if you fly higher than the virtual height of the Starting Area).

If one of the supplies break it counts as long as it is still recognizable as a cuboid. Please be aware that it is the decision of the judge to determine if a supply is still recognizable as a cuboid. To be on the safe side and to avoid discussion make sure your supplies don't break ;).

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), especially for cases when a drone was still moving at that moment.

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 at 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 Area 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 team's entry must be able to autonomously sense when the game has started.
3. Teams whose aerial robots leave the Starting Area 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 mean value of the best two rounds is the final score.

Construction Rules

Robot Construction Rules

The following rules apply to all robots to be entered in the 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 in the Starting Area.
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 (with the exception of the target markers and the supplies) 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. 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.
12. Each robot must have a name suitable for broadcast over a public address system.

Marker Construction Rules

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

1. The marker must not extend beyond the Mountain Base Zone.
(marker \leq Mountain Base Zone)
2. The marker must not exceed the Radio Masts Base or the Mountain Base Zone.
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 structure which contains a microcontroller or microprocessor, or actively moves or consists of a grapping arm or something similar.
7. 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.
8. 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 end up with two sets of Supplies with different colors consisting of exactly 6 supplies per color. The supplies don't have to be structurally equivalent, but have to match in color.
2. One supply must weigh 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. Teams 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. Teams 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 structure which contains a microcontroller or microprocessor, or actively moves or consists of a grapping arm or something similar.
10. 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.
11. The rules 2, 3, 4, 6, 7, 8 from the robots construction rules also apply for the supplies.

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 will be as high as the mountain (so approx. 2,4m). 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 Area (140cm wide and 140 cm long) at game start. Also no cables will be allowed to break the boundaries of the Starting Area.
- The base of each Starting Area 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 2023 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
- RYZE DJI Tello
- Coex Clover Drone

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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