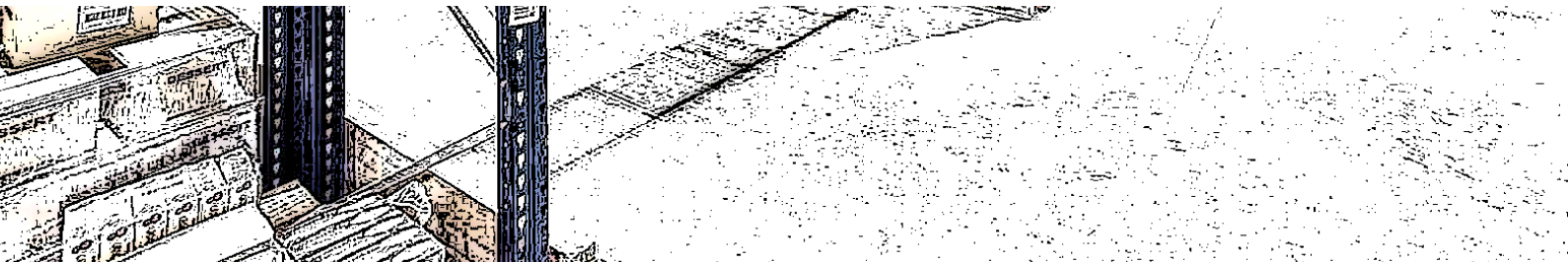
COMPETIÇÃO BRASILEIRA de ROBÓTICA

RoboCup Brasil

FLYING ROBOT TRIAL LEAGUE

RoboCup Brasil



INTRODUCTION

The **Flying Robot Trial League** (FRTL) of RoboCup Brazil aims to stimulate the study and development of autonomous and intelligent flying robots in the execution of different tasks applied to the industrial and logistics sector. The Challenge is a reduced and playful model that tries to simulate logistical problems in an arena with 2 suspended bases for landings and takeoffs, a takeoff base, and three mobile land bases.

Among the research challenges still existing in the world on autonomous and intelligent robots, the **Flying Robot Trial League of RoboCup Brazil** aims to stimulate the development of aerial robotic systems and robust flight controllers (trajectory, altitude, and pose); with precise and independent camera tracking and location; high capacity embedded processing; and devices for manipulating and loading objects. This year, **RoboCup Brasil's Flying Robot Trial League** competition will take place 100% **PRESENTIAL**.

THE FLYING ROBOT

Each team may bring to the **RoboCup Brasil Flying Robot Trial League** competition several flying robots with vertical takeoff and landing, here called Drone, provided they meet the prerequisites stipulated in this rule. The Drones that will participate in the competition phases must meet the following prerequisites that will be verified during the inspection phase:

- The Drone cannot use GPS or RTK-GPS systems to locate itself in the arena;
- No aid system external to the arena (eg beacons) may be used to locate the Drone;
- During the challenge phases, the Drones must act autonomously, that is, without any external control or human intervention that will result in the completion of the attempt of the phase being executed, except in emergencies;
- Only drones propelled by electric motors and energy through batteries incorporated in the robot will be allowed. The use of helicopters and vehicles with combustion engines or gas balloons is prohibited;
- Drones weighing over 100 grams must have a button (kill switch) that arms or disarms the motors and must be located on the drone;
- The Drone must be able to maintain a fixed position with respect to the ground at a minimum height of one (1) meter;
- The use of any type of control and detection hardware built into the Drone is permitted as long as they do not pose a risk to participants or the public due to the emission of radiation or another level of signal considered unsafe for humans;
- During challenges, the use of wires, cables, and/or umbilical cords, whether for control, communication, or any other purpose, is prohibited;

- Although the Drone must act autonomously during the challenges, the team must constantly maintain remote supervision of the flying robot in accordance with current legislation, ensuring the resumption of control of the flying robot due to any technical problems and/or instability.
- The Drone may have its control loop embedded or may receive control commands remotely (i.e. through a computer that sends the commands). In case the Drone receives control commands remotely, the team must have a dedicated communication system (radio, wi-fi, or Bluetooth) between the remote computer of the team that will process the information and the robot. The organization will not be responsible for interference in the communication signal.
- Drones can have a maximum weight of 10 kilograms and a maximum distance between the propeller axes of 500 mm (see figure below);

- The emergency pilot or the captain of the E team All Drones over 100 grams must be registered in the ANAC SISANT system[1]

- Exceptionally for PHASE 4, Drones **must** have a maximum weight of 1 kilogram and a maximum distance between the propeller axes of 330 mm (see figure below);

[1] https://santosdumont.anac.gov.br/menu/f?p=133

NOTE 1: If the drone is not approved in the inspection phase, meeting all the requirements described above, the team will not be able to use it in the competition. If none of the team's drones meet the requirements of the inspection phase, the team will be disqualified.

NOTE 2: Although each team can bring several drones to the competition, only 1 (one) drone can be used at the time of each phase run, even if they are one drone for each phase.

The team must be able to start or stop the Drone at the referee's whistle signal via the remote control. **It is important to note that flying robots must demonstrate the ability to adapt to conditions that exist in the real world, dealing with situations such as the lack of ideal lighting conditions in the environment and people moving around the arenas, among other sound and visual noises.**

During the inspection phase, drones may or may not obtain the Open-Hardware classification.

DEFINITION: Open-hardware means any drone that can be assembled with parts (pre-fabricated or not), whose assembly can be changed to different configurations. In other words, it allows the exchange of different types of motors, propellers, sensors, and mounting configurations, which, in addition, can provide access to even the lowest level of hardware abstraction for code reprogramming.

These characteristics are conditions for participation in the Challenge and will be checked by the judges before the start of the competition.

THE TEAMS

Teams for this challenge can be formed by an arbitrary number of members at any level of education. There are no age limitations for team members. Each team will have a captain who will be responsible for interacting with the judge and giving the signal to initialize the code. To enter the arena, the team member must have the appropriate personal protective equipment (PPE). **It is the responsibility of the teams to bring their protective equipment.** It is the responsibility of teams to bring their personal protective equipment. The mandatory list of PPE is:

- Protective goggles;
- Helmet;
- Anti-cut glove;
- Fluorescent signaling vest.

Each team will have a work area consisting of a table, chairs, and a power outlet.

It is important to note that the responsibility for the operation of flying robots meets all legal requirements, particularly ANAC (Brazil Commercial Aviation Regulation Agency) resolutions.

All team members must be linked to an educational (and/or research) institution.

Teams will also have Internet access at their desktops. During the waiting time between competition phases, teams can work freely on their flying robots within the designated area for each group.

During the waiting time between competition phases, teams can work freely on their flying robots within the designated area for each group.

THE ARENA

The **RoboCup Brasil Flying Robot Trial League** arena will be built in an area of 64m^2. The arena features a takeoff base, two overhead bases, and three mobile land bases. Figure 1 shows a simulated representation just to give an overview of the arena.

- The takeoff base is where the flying robot must leave and return from its tasks, defined in each phase of the challenge.
- The suspended bases and the land mobile bases represent the landing/takeoff bases of Drones during the performance of the service/task.
- The arena has a competition banner located near the takeoff base.

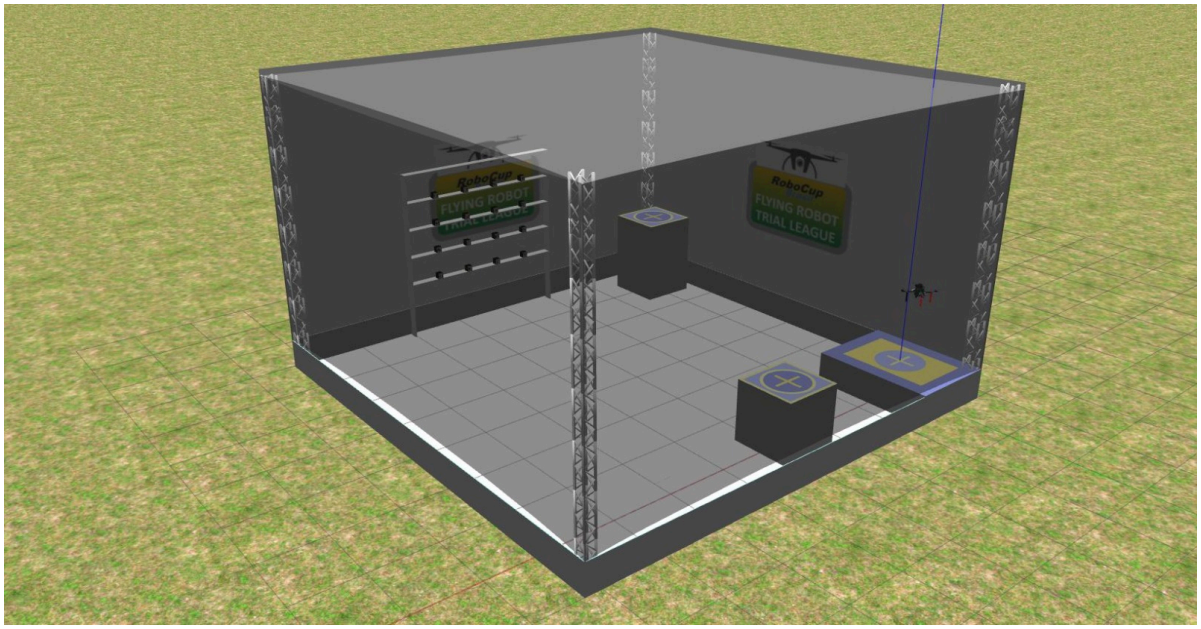


Figure 1 – Overview of the **RoboCup Brasil Flying Robot Trial League arena.**

In addition to the suspended, ground, and takeoff bases, the arena has a shelf shown in Figure 2, approximately between 3 m and 5m long and 0.3 m and 0.5m deep. The first shelf is 1 m from the floor, and the remaining shelves are 0.5 m above each other. The bookcase has 4 shelves and can be seen in its dimensions in Figure 2 below.

Figure 2 – Phase 3 shelf and its dimensions.

The dimensions of the arena and bases for construction are shown in Figures 4 and 5 below:

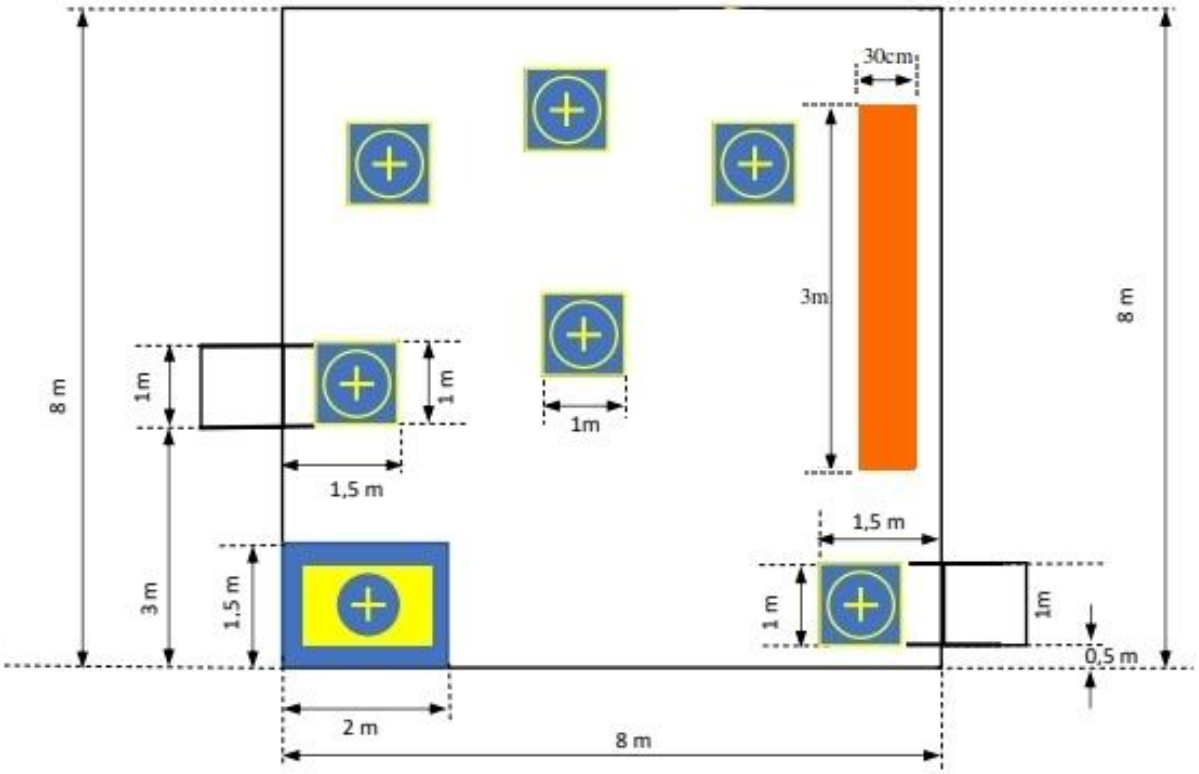


Figure 3 – Dimensions of the **RoboCup Brasil Flying Robot Trial League** arena.

The landing/takeoff bases, whether mobile or suspended, will have a minimum thickness of **9 mm**. Figures 2 and 3 present an overview of the world and its bases.

Takeoff Base	Suspended Bases or Land Furniture (The Yellow lines have 5cm of width)

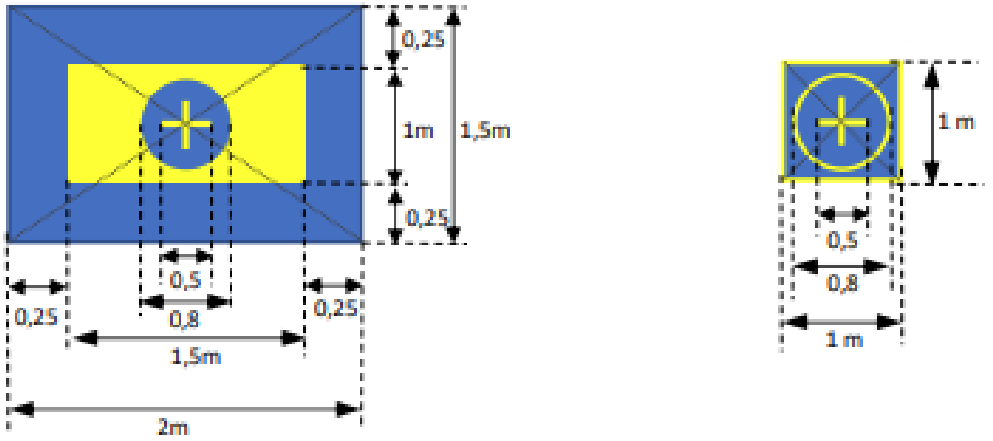


Figure 4 – Dimensions of the takeoff, suspended, and mobile bases.

The arena can be made directly on the ground or on an 8mx8m covering of MDF (any color) with a thickness of **12mm.**

NOTE 1: The arena floor will be smooth (homogeneous) and without features, and may have some degree of reflection depending on the paint used on the floor or on the base paint.

The entire arena will be lined with protective netting 4 m or more in height, **except for the ceiling**. There will be two openings in the net, one on the side of the takeoff base, so that the team can place the robot before the start of the challenge phases. And another, larger size, in the corner of the arena, so that team members can enter the arena. **One of the sides (the one facing the takeoff base) will not have a net, but a large banner with the logo of the league and RoboCup Brasil.**

The suspended bases will be at **a minimum height of 1 meter and a maximum of 1.5 meters** above the ground. The takeoff base and the side walls that surround the arena will be **approximately 0.5 meters high**.

NOTE 2: The arena assembly location may suffer from variable external light (sunlight through windows that causes non-uniform lighting), and it may be assembled close to walls. Competition drones must be robust to these variations.

NOTE 3: NO changes to the arena by teams will be allowed.

THE CHALLENGE

The **RoboCup Brasil Flying Robot Trial League** has 4 phases. Each phase deals with a problem that must be faced by the Drone autonomously.

The team will not need to carry out all phases. However, the final score will be given by the simple sum of the scores obtained by the team in all phases. Phases are sequential.

During the competition phases, each team will have 30 minutes to make up to 3 attempts to complete the tasks of the respective phase.

NOTE: Within 30 minutes, the team will be able to carry out tests and change the source code until they make their first attempt. After the first attempt, the team will no longer be able to open the source code or script or make any type of change to the code or parameters.

NOTE 2: The only possibility of changing strategy will be, when executing the code in the terminal, to use a flag that calls another script. However, once the code has started, the operator will no longer be able to touch the computer until the attempt is completed.

NOTE. 3: During the execution of tasks, at least one member of another team must be available to observe and supervise the team that is competing.

NOTE. 4: The teams participating in this phase must save the positional record of the drone (or rosbag), as well as the record of the task's activities (base locked, bar code read, etc.), for cases in which the judge wants to request it. These records are necessary for deeper analysis of the robot's movement.

The competition days will be configured as follows: warm-up + competitions. The inspection phase of the participating teams' drones will be carried out hours before the start of the first phase, right after the warm-up phase. The day and time for each team to carry out the warm-up, as well as the competition order, will be defined by drawing lots and the timetable will be provided one week before the competition.

When registering, each team must submit the TDP as part of the necessary information and send a copy to the e-mail address tiagopn@ci.ufpb.br.

A Whatsapp group will be created for real-time communication between the chair and the leaders of each team as soon as registration is finalized.

TEAM DESCRIPTION PAPER (TDP)

Sending TDPs to the competition is mandatory and has an eliminatory character. Only teams that submit the TDP along with a video demonstrating the drone's flight capability will be able to pay the registration fee and participate in the event. **The TDP needs to be done in the Springer article pattern, with a minimum of 6 and a maximum of 8 pages** and containing the following information on the authors:

- Title: must be the name of the team
- Authors: must be the names of the team members (full name)
- Just below the Keywords, there should be a link to the autonomous flight video with the following command:
  - \noindent\textbf{LINK to the Video: }\url{https://youtu.be/XXXXXXX}
- The Springer template has the \institute{} command that places information about the authors at the bottom of the first page. This information must contain:
  - University where the team comes from
  - Phone number of 2 contacts for Whatsapp Group
- As for the article itself, the TDP must contain:
  - A brief introduction and literature review
  - Drone mechanics (with open-hardware project if applicable)
  - Drone electronics (with open-hardware design if applicable)
  - Navigation System (software, with open git-hub)
  - References

PHASE 1 - LOCATION AND MAPPING

The heterogeneity of drone landing sites aimed at logistics applications is quite varied. Landing often needs to occur suddenly, and a suitable landing site needs to be found by the drone. This mapping is essential for an autonomous task to be performed safely.

Thus, PHASE 1 will require the team's robots to recognize the arena, map the environment to detect mobile land bases (randomly allocated before the start of the phase), and detect suspended landing/takeoff bases.

THE TASK

The task to be performed by the Drone in PHASE 1 is the following: The robot must leave the takeoff base, and travel around the arena while detecting the 4 (four) mobile bases and the 2 (two) suspended bases. The Drone must detect each existing base and land 1 (one) time on each of the detected bases, be it suspended or mobile. After that, the Drone must return to the takeoff base and land.

CONDITIONS

Suspended bases are fixed. On each team's turn, the mobile bases will have their positions known only when the task is carried out. They will be placed randomly in the arena.

The coordinates of the fixed bases with respect to the takeoff base will be provided on the first warm-up day.

NOTE: No measurement by the teams will be allowed (not even with respect to fixed bases).

A time will be defined for each team to carry out PHASE 1. Each team will have 30 consecutive minutes to carry out up to 3 attempts to complete the tasks. The score obtained in the best of the 3 attempts will be considered, the others being discarded. Each attempt can take up to 10 minutes.

CONCEPT: Attempt = Attempt is the act of trying to execute a certain phase starting with the drone takeoff and ending when the drone lands (automatically) or when control of the drone is resumed by the pilot.

Interaction with the Human: in this PHASE 1, the robot can return to the takeoff base with a command given by a human (team member by remote control) or return autonomously. Upon returning to the takeoff base, the attempt ends.

SCORE

This phase has a maximum score of 320 points.

For each base visited for the first time, the team will receive 10 points for each fixed base visited and 20 points for each land mobile base visited. It will be considered that the robot has visited the base if the drone lands on the base (noticeable in the touch of all the landing gear of the drone on the base).

CONCEPT: Visiting = Visiting a base is the act of the drone identifying (by vision) AND landing on a specific landing base.

With each repeated visit (landing) in a base, the team loses 5 points.

If the robot returns to the takeoff base, autonomously or by human order, the attempt ends. If the drone successfully lands on the takeoff base, the score obtained in the arena **doubles (2x)** if the score is positive. If the score is negative, if the robot returns to the

takeoff base, the team does not score the attempt. If the robot does not return to the takeoff base, the team may choose to stop the attempt, without penalty, at any time or when the 10 minutes of the attempt expire.

If the team decides to stop the robot at any point in an attempt, the score will count until the moment of interruption. All 3 attempts must be made with the robot starting from the takeoff base.

NOTE: If the drone used by the team is open-hardware, the entire score obtained in the phase will be doubled (2x) if the score is positive.

PHASE 2 - INVENTORY CONTROL

In the distribution chain, inventory management is a very important aspect that must be observed carefully. After all, both the accumulation and lack of stocked materials can be harmful, as, in excess, products can expire and compromise the company's turnover. On the other hand, the absence of inputs hinders production and sales. In this way, logistics inventory carried out efficiently has the purpose of maintaining ideal stock levels, in accordance with the company's objectives and demands. Currently, this type of process is carried out manually and is generally repeated several times in an attempt to minimize counting errors.

The system that uses Drones for inventory control aims to contribute to increasing the efficiency of processes, speeding up tasks, and obtaining better results. By eliminating the need to perform manual operations, the system allows more free time to perform other more analytical tasks compatible with human intelligence. Therefore, PHASE 2 will require the teams' robots to count the products on a shelf by reading barcodes spread across four rows and four shelves of a rack.

THE TASK

The task to be performed by the Drone in PHASE 2 is as follows: The robot must leave the takeoff base and go to the shelf on the other side of the arena. Then, the robot must go through each of the shelf shelves in turn while detecting and reading one barcode at a time until all 16 packages spread across the shelf are detected or until the team wishes to complete the task. After this, the Drone must return to the takeoff base and land.

CONDITIONS

The shelf to be visited has 4 shelves and can be seen in its dimensions in the Figure below.

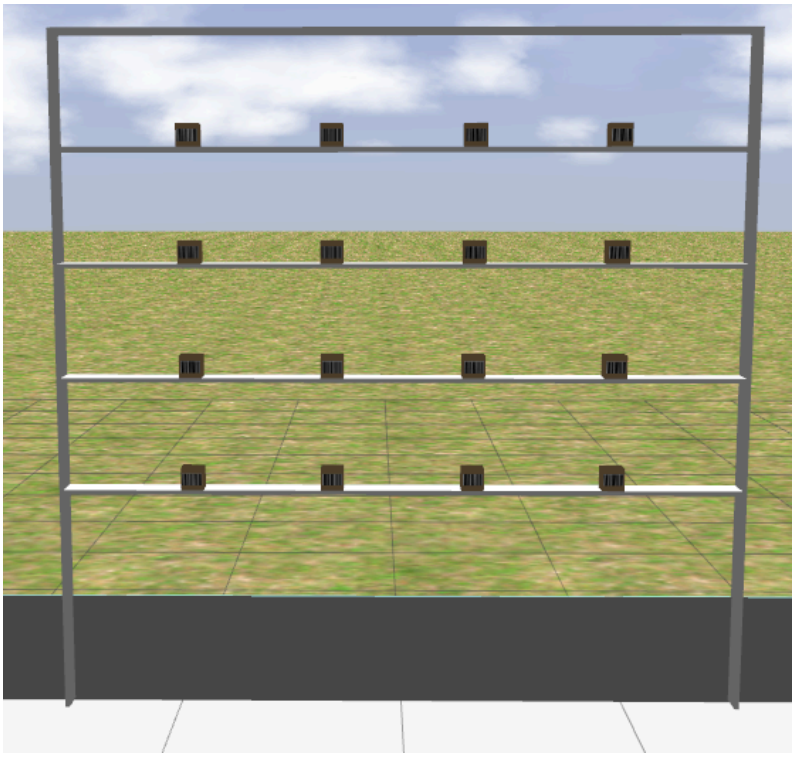


Figure 5 – Shelf with boxes.

NOTE: The 16 packages **ARE NOT spread evenly** on the shelf.

Each shelf has four barcoded boxes. All boxes are fixed at a random distance from each other and from the shelf pillars, with their face positioned flush with the front limit of the shelf. Each barcode is approximately 10 cm x 5.9 cm. Each barcode has the following encoding: A0, A1, A2, A3, B0, B1, B2, B3, C0, C1, C2, C3, D0, D1, D2, D3.

NOTE: No measurements by teams will be allowed. Only an example of the barcodes will be made available.

NOTE 2: During the test, the boxes may have their barcode vertically.

An example of the barcode can be seen below:

Figure 6 – Barcode.

A time will be defined for each team to carry out PHASE 2. Each team will have 30 minutes to make up to 3 attempts to complete the tasks. The score obtained in the best of the 3 attempts will be considered, with the others discarded. Each attempt can take up to 10 minutes.

Interaction with the Human: in this PHASE 2, the robot can return to the takeoff base with a command given by a human (team member via remote control) or return autonomously. Upon returning to the takeoff base, the attempt ends.

SCORE

This phase has a maximum score of 320 points.

For each barcode detected and read for the first time, the team will receive 5 points. It will be considered that the Drone has detected and read the barcode when the team shows on the competition computer screen (which initiates the Drone's flight code) the read barcode (with the code information) and the total number of codes read so far to the judge.

For each wrong count and reading, the team loses 2.5 points.

It is prohibited to read all barcodes from more than one shelf in a single image. The robot needs to go through each of the shelves or the detection will not be computed.

If the robot returns to the takeoff base, autonomously or by human order, the attempt ends. If the drone successfully lands on the takeoff base, the score obtained in the arena doubles (2x) if the score is positive. If the score is negative, if the robot returns to the takeoff base, the team does not score the attempt. If the robot does not return to the takeoff base, the team can choose to stop the attempt, without penalty, at any time or when the 10 minutes of the attempt are up.

If the team decides to stop the robot at any time in an attempt, the score will be valid until the moment of interruption. All 3 attempts must be made with the robot starting from the takeoff base.

NOTE: If the drone used by the team is open-hardware, the entire score obtained in the phase will be doubled (2x) if the score is positive.

PHASE 3 - PACKAGE TRANSPORTATION

Increasingly, Drones can quickly transport equipment, materials, and packages between landing/takeoff stations. This is especially useful in distribution centers or in companies that deliver packages, be they medical equipment between hospitals or in e-commerce companies.

Thus, PHASE 3 aims to demonstrate cargo transport technology using autonomous Drones.

THE TASK

In PHASE 3, the robots will have to transport packages from one landing/takeoff base (whether suspended or mobile) to another. The robot must leave the takeoff base, search for packages on the fixed suspended and/or mobile bases, and check to which base the package should be sent. The Drone must transport each package to its respective base.

When the team completes the transport of all packages to their respective bases correctly, the robot can return to the takeoff base, finishing the phase or attempt.

CONDITIONS

The mapped bases will be identified by letters (A, B, C, D, and E) up to 2 hours before the start of the phase so that teams can relate the position of the mapped bases with the identification letters provided. Each package will have, at the top, a QRCODE with the letter of the base where it should be delivered. Examples of QRcode to be used can be seen below

Figure 7 – Package QRCodes

The packages will be cubes measuring 10 cm on each side, all in black, with a QRcode placed at the top. The QRcode will have a white background. The cubes will be made of Styrofoam, with a thin ferromagnetic metal plate (3mm 1020 steel plate) on top, covered with matte black paper, with a minimum weight of approximately **160g**. The maximum weight can be chosen by the team.

Each team will have a time defined by draw to use the arena at this stage. In this PHASE, each team will have 30 minutes and up to 3 attempts. Each attempt can only last a maximum of 10 minutes. The highest score obtained in one attempt will count.

Interaction with Humans: in this PHASE 3, the robot can return to the takeoff base with a command given by a human (team member via remote control) or return autonomously. Upon returning to the takeoff base, the attempt ends.

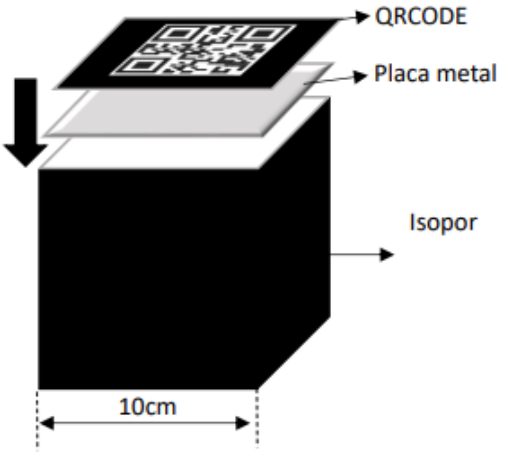


Figure 8 – Dimensions of packages.

SCORE

This phase has a maximum score of 600 points.

For each package correctly detected by the robot at a base, the team will receive 10 points. The package will be considered detected when the robot shows the letter detected in the package's QRCODE on the screen. The team can choose to just detect the QRCODE and finish the task if their strategy is not to obtain all the PHASE points.

If the robot grabs and lifts the detected package, the team will receive an additional 10 points.

Delivering the package to the correct base identified by the package will award an additional 10 points to the team. When left on the correct base, the package will be considered delivered and will no longer count points (if it is detected again) nor will it suffer any subsequent penalties (if it is dropped, detected, or lifted again).

Note: If the drone reads the QRCODE, does not pick up the box, but goes to the correct base, the team will only score points for correctly reading the QR codes, that is, 10 points per correctly detected code.

After correctly transporting all 5 packages, the robot should issue an alert on the FINISHED screen. After this alert, the robot will be able to return to the takeoff base autonomously.

If the package is dropped or dropped by the drone after being removed from its home base, anywhere other than the correct base, the team will lose 5 points, and the package will be invalid for any subsequent scoring or penalty.

If the robot returns to the takeoff base alone (without human intervention) after having transported at least 1 of the packages correctly, and if the drone lands at the base successfully, the team will have its score **doubled (2x)** if the score is positive. The score will be doubled if, and only if, the robot has transported at least 1 package correctly. If the score is negative, if the robot returns to the takeoff base, the team does not score the attempt. If the robot does not return to the takeoff base, the team can choose to stop the attempt, without penalty, at any time or when the 10 minutes of each attempt are up.

If the team decides to stop the robot at any time in an attempt, the score will be valid until the moment of interruption.

All 3 attempts must be made with the robot starting from the takeoff base.

NOTE: If the drone used by the team is open-hardware, the entire score obtained in the phase will be doubled (2x) if the score is positive.

PHASE 4 - HUMAN-SWARM INTERACTION

Commercial aircraft inspectors play an indispensable role on the runway, serving as a visual bridge between pilots and ground crew. Armed with signal wands – portable, illuminated beacons – they communicate vital instructions to pilots, from slowing down and turning to stopping or shutting down the engines. This visual signage, characterized by its intuitiveness and redundancy, guarantees clarity and minimizes errors. This scenario summarizes the potential of harnessing human body movements as command inputs within systems, laying the foundation for advanced Human-Robot Interaction (HRI). HRI, as a domain, investigates the complexities of incorporating humans into the control loop, thereby influencing robotic behavior. An extension of this paradigm is Human-Swarm Interaction (HSI), which amplifies the challenge by integrating a swarm of robots, ensuring that their inherent autonomy remains unchanged.

Therefore, PHASE 4 will require the teams' robots to land on mobile and fixed platforms based on a human's visual command.

THE TASK

The task to be performed by the Drones in PHASE 4 is as follows:

- The human operator must position himself in the middle of the arena, facing one of the arena's two banners.
- After positioning the human operator, the Drone must perform the take-off autonomously (by command from the team's computer).
- After the take-off, the drone must only correct its orientation to detect the human operator, maintaining the same position above the base.
- Once the human operator is detected, the drone will be able to approach the human in a more "suitable" Field-Of-View position of the drone.
- From there, the drone and human can move freely to complete the phase.
- When carrying out the phase, the aerial robot must land on all mobile and fixed bases guided only by the visual commands of a human.
- All movement of the robot must be carried out by visual command with the human, that is, by Human-Robot Interaction.
- No commands originating from pre-programming or environmental feature detection should be used to detect the base or land on it.
- The robot must post the name of the visual commands made by the IHR operator on a terminal for the judge to view.
- In this task, each team can use up to 2 (two) robots at the same time, characterizing Human-Swarm Interaction.

CONDITIONS

The land landing platform will be the same size as the platforms used in phases 1 and 3. In this phase, we will have two fixed suspended bases and four mobile bases. The drones used in this phase cannot be larger than 330 mm.

NOTE: Drones used in this phase MUST have propeller protectors.

A time will be defined for each team to carry out PHASE 4. Each team will have 30 minutes to make up to 3 attempts to complete the tasks. The score obtained in the best of

the 3 attempts will be considered, with the others discarded. Each attempt can take up to 10 minutes.

At this stage, each team can use 1 or 2 drones simultaneously in each attempt. If the team chooses to use 1 drone, it must land on the 6 bases of the arena. If the team wishes to use 2 drones simultaneously, they must each land on 3 bases. Landing bases cannot be repeated, that is, each drone must land on different bases from each other.

NOTE 2: The human who will control the drones through gesture recognition must be inside the arena. For this, the competition will provide 1 helmet, 1 pair of anti-cut gloves, 1 protective goggles and 1 signaling vest. The team member must be wearing jeans, a coat, or a sweatshirt with long sleeves and boots.

Interaction with Humans: in this PHASE 4, all drone movement commands must be made by recognizing gestures or actions from one of the team members inside the arena. Furthermore, the robot can return to the takeoff base with a command given by a human (team member via remote control) or return autonomously. Upon returning to the takeoff base, the attempt ends.

SCORE

This phase has a maximum score of 400 points.

At the beginning of the phase, that is, during the take-off of the aerial robot, the human operator must be in the middle of the arena facing one of the two banners in the arena.

Before the Drone begins the task of landing on the bases, and after positioning the human operator in the center of the arena, the aerial robot must detect and recognize the human operator, and its recognition/detection must be shown on the team's computer terminal.

If the drone does not recognize the human operator, no points will be counted.

All detected movements must be shown on the team's computer terminal (examples: the human's coordinate in the world, the human's skeleton, the image, etc.).

For each base visited for the first time, the team will receive 10 points for each fixed base visit and 20 points for each land mobile base visit.

The robot will be considered to have visited the base if the Drone lands on the base (the touch of all the Drone's landing gear on the base being noticeable).

For each repeated visit (landing) to a base, the team loses 5 points. If the team is using two drones and one of the robots lands in an arena in which the other robot has already landed, the team loses 10 points.

At the end of the attempt, if the robot(s) returns to the takeoff base, autonomously or by human order, the attempt ends. If the drone successfully lands on the base, the score obtained in the arena **doubles (2x)** if the score is positive.

NOTE: If the team is using two drones, for the score to be doubled, both drones must land on the takeoff base successfully at the end of the test.

If the score is negative, if the robot returns to the takeoff base, the team does not score the attempt. If the robot does not return to the takeoff base, the team can choose to stop the attempt, without penalty, at any time or when the 10 minutes of the attempt are up.

If the team decides to stop the robot at any time in an attempt, the score will be valid until the moment of interruption. All 3 attempts must be made with the robot(s) starting at the takeoff base.

NOTE: If ALL the drones used by the team in this phase are open-hardware, all the points obtained in the phase will be doubled (2x) if the score is positive.

THE WINNER

The winning team will be the one with the highest number of points combined. In case of a tie, the following conditions will be adopted for the tiebreaker, in this order:

1. The tiebreaker will be in favor of the team that scored in the most different phases;
2. If the tie persists, the team that scores the most in PHASE 4 will be the winner;
3. If the tie persists, the team that scores the most in PHASE 3 will be the winner;
4. If the tie persists, the team that scores the most in PHASE 2 will be the winner;
5. If the tie persists, the team that scores the most in PHASE 1 will be the winner;
6. If, after all the above criteria, the tie persists, the tied teams will be declared winners in the same place.

NOTE 1: The team that obtains ZERO points in all phases will be automatically disqualified from the competition.

NOTE 2: The team that decides not to fly will lose by W.O. and you will automatically get ZERO points in the respective phase.

Note 3: Only teams that scored points in at least one phase can be in first, second, or third place in the competition, even if the lack of points means there is no winner.

AWARDS

The teams placed in the top three positions will receive champion, runner-up, and third-place certificates.

EXTRA – TECHNICAL CHALLENGE

To encourage teams to exceed expectations and advance in state-of-the-art flying robot technology, a separate challenge will be held on the last day of the competition. The technical challenge, also called Technical Challenge, will be carried out in a Workshop format as a way of disseminating the drone technologies that each team has, and dissemination of knowledge that each team has.

The participation of teams in the Technical Challenge is NOT mandatory and registration for participation in this challenge will be carried out on the first day of warm-up.

The topics for the Technical Challenge are free, with the only prerequisite being autonomous drone technologies that are being developed by the teams and that can be proven in their presentations, whether through simulations or experiments.

On a scheduled date and time, teams participating in the Technical Challenge must present innovative techniques that are being developed by the teams.

To carry out the demonstration, a maximum of 10 minutes of presentation and 5 minutes of questions will be defined.

The panel will be made up of teachers who are part of the teams involved. The evaluation will be secret and the results will be computed at the end of the evaluation of all teams. Each team will be evaluated by three teachers. The team teacher will not be able to evaluate the team itself to maintain the smoothness of the evaluation process. In the end, the average of the evaluators' scores will be the team's score.

The evaluators' grade will be based on the average of the following criteria:

1. Technological innovation: What technology was developed, and how innovative is it?
2. Scientific Contribution: How much does this technology advance state-of-the-art science in the area of drones?
3. Implementation Complexity: How difficult is it to develop the technology presented? How many people were involved in the process? What is the degree of complexity?

Each aforementioned criterion must be evaluated with a score from 0 to 10 and the average of the 3 criteria must be the team's score given by the evaluator.

In the end, the team that obtains the highest score given by the average of the scores of the three evaluators will win.

OMISSIONS

Situations not foreseen in the rules (and/or issues related to the interpretation of these rules) will be clarified and/or decided by the organizing committee and the judges. Their decision on the matter shall be final.

FAIR PLAY

The characterization of a lack of Fair Play by a team and/or one of its members at any time will imply the adoption of sanctions that may include (but are not limited to) warning, loss of points, round elimination, elimination of the competition, banning from the current and subsequent events. The penalty adopted by the Organizing Committee will take into account the seriousness of the transgression.

FINAL CONSIDERATIONS

This year, we hope everyone has a great experience. If it is a successful experience, this simulated platform could become official as a posteriori and a test platform for other teams in future years. If you have any questions, do not hesitate to contact the chair of the event.

Prof. Dr. Tiago Nascimento
tiagopn@ci.ufpb.br