

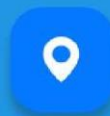


RULEBOOK

INTERNATIONAL SPACE DRONE CHALLENGE 2024



27 - 29th
Jan 2024



Coimbatore,
India



1.0 COMPETITION OVERVIEW

1.1 COMPETITION OBJECTIVE

SPROS International Space Drone Challenge (ISDC) is a space robotics engineering competition. It challenges university students to conceptualise, design, develop and operate an astronaut-assistive next-generation drone and perform specific missions in Mars simulated conditions. Space drones provide multiple advantages over rovers, such as better reach and range. It is easier for drones to reach places off-limit to the rovers. In addition to solo exploration, the drones can act as wings to the rover and explore together.

The objective of the competition is to provide students with a real-world interdisciplinary engineering experience, combining practical engineering skills with soft skills, including business planning and project management.

1.2 COMPETITION PROCEDURE AND SCHEDULE

The competition is divided into two stages:

- Review Stage (Online)
- Finals (On-site)

MISSIONS/SUB MISSIONS	POINTS
Review Stage(Online)	
System Design and Development Review	200
Finals(on-site)	
Navigation Mission	200
Science Mission	200
Project Implementation & Management Assessment (PIMA)	100

Figure 1.2 Points Distribution

1.2.1 Team Selection Criteria

The teams that successfully submit System Design and Development Review (SDDR) and have a working drone will be invited to compete in the on-site Finals. Specific details for each deadline (including deliverable format, submission requirements, and judges' expectations) will be posted to the SPROS website (www.spaceroboticsociety.org) and the ISDC website (www.roverchallenge.org/isdc). Additionally, officials may respond to teams with follow-up questions or requests for clarification at any of these milestones.

1.2.2 Registration

All teams have to declare an intent to compete. The registration form will be available online on the ISDC website (www.roverchallenge.org/isdc) from August 23 to October 15, 2023. No significant deliverables are required for this deadline, aside from team details requested via the ISDC website. The maximum number of students that a team may have for the competition is unrestricted.



Figure 1.2.3 ISDC - 2024 Award Ceremony Venue

1.2.3 Awards and Honours

- Grand Awards - These are presented to the ISDC's top three teams, i.e., the Champion, First Runner Up, and Second Runner Up.
- Excellence and Innovation Awards: These honours will be given to teams for their creative thinking in a specific subsystem and outstanding performance in any of the ISDC Finals missions. This category also includes the PIMA awards.
- Depending on the judges' verdict, further types of awards might possibly be given out.

1.2.4 System Design and Development Review (SDDR)

Teams are required to submit a System Design and Development Review (SDDR) package before November 20, 2023. The SDDR package will focus on both technical and project management aspects of drone development and has written a report of 10 pages. In the Project Management aspects, teams shall include the organisational structure of the team, resources management, project planning, a PERT chart showing the project timeline, initial budget, fundraising plans, sponsorships, team's recruitment process, educational and public outreach. In the technical aspects, teams shall include the current state of the drone development and prototypes, overall system design and the team's prototype testing strategy.

Competition Dates - ISDC Finals will be held during January 27-29, 2024, at PSG Institute of Technology and Applied Research (PSG iTech), Coimbatore, Tamil Nadu, India.

Note: Any changes in the dates or mode or rules due to any reason shall be communicated to the teams. The decision solely rests on the discretion of the organising team.

1.3 ADMINISTRATIVE REGULATIONS

1.3.1 Competition Information

The competition-specific rules and relevant information are defined in this Rulebook, and the specific guidelines issued separately for various submissions/missions will be available on the competition website. All the questions in the FAQ section on the ISDC section of the website

will also be considered part of the rules and guidelines. In addition, any official announcement shall also be considered part of these rules. Any issues not covered by these published rule sets will be addressed on a case-by-case basis by the officials. If there is a discrepancy, the Rulebook (this document) will take precedence over FAQs.

1.3.2 Queries regarding the Rules

Queries regarding any rules or guidelines may be asked to the officials only through email (contact@roverchallenge.org). The frequently asked questions (FAQ) section on the competition website must be checked before submitting a question. The officials will only answer questions that are not already answered in the rules or FAQs or that require new or novel interpretations. The official language of the competition is English. Refer to the competition website for specific directions on how to submit a query.

1.3.3 General Officials Authority

The officials reserve the right to revise the schedule of the competition and/or interpret or modify the competition rules at any time and in any manner that is, in their sole judgment, required for safe, fair and efficient operation. Therefore, all team members are required to cooperate with and follow all instructions from the officials.

1.3.4 Official Instructions

Failure of a team member to follow an instruction or command explicitly directed to that team and/or member will result in a 20 points penalty, which will be deducted from their overall score.

1.3.5 Conduct with Officials

Argument with or disobedience to any official will result in the team being eliminated from the competition.

1.3.6 Unethical Conduct

In case of unethical conduct by a team member, a 20 points penalty will be deducted from the team's overall score. A second violation will result in the expulsion of that member and his/her team from the competition.

1.3.7 Protests

If a team has a question about scoring, judging, policies or any official action, in that case, it must be brought to the officials' attention for an informal initial review before an official protest can be filed. A team may protest any rule interpretation, score, or officials' action which they feel has caused some actual, non-trivial harm to their team or has had a substantive effect on their score. If a resolution cannot be found through the initial review, a protest must be filed in writing and presented to the officials by the Team Leader. The decision of the officials regarding any protest will be in a written form and will be final, and no further protests will be considered on that same topic.

1.4 GENERAL REQUIREMENTS FOR TEAMS & PARTICIPANTS

1.4.1 Teams per University

There is no limit to the number of teams a university can send to the competition. Teams that are formed with members from two or more universities are treated as a single team. It is up to the members to decide if they want to represent one university or compete independently. Representing more than one university is not allowed.

1.4.2 Team Members

A person can be a part of only one team. Each team must have one team member identified as their team leader/captain. The team leader/captain is the main point of contact for the officials during the registration process and competition.

1.4.3 Student Status

Team members must be enrolled as degree-seeking undergraduate or graduate students in any university. Team members who have graduated before the competition are ineligible to participate.

Students seeking a PhD degree/PhD students or equivalent are not allowed to participate.

1.4.4 Age

Team members must be at least 18 years of age. Written permission from the official guardian should be provided for members below the age of 18 years on the date of January 1 of the year of the Finals.

1.5 FINANCES

The maximum allowable cash budget that a team can spend on the project is 500,000 INR (6,000 USD). It shall include components for the drone, drone module, drone power source, Drone communication equipment, and Drone base station equipment. Teams are encouraged to get financial and in-kind sponsorships and donations for their project. Teams should mention the sponsorship amount and donations in their SDDR.

1.6 DOCUMENTATION & SUBMISSION DEADLINES

1.6.1 Submission

Submitted documents may only be viewed by members of the submitting team, authorized judges and officials. The official website of the competition will be used for all online submissions. By submitting documents via the competition website, the team agrees that these documents may be reproduced and distributed by the officials, in both complete and edited versions, for educational and marketing purposes. Teams should check the competition website regularly to keep track of the submission deadlines.

1.7 GENERAL RULES

1.7.1 Forfeit for Non-Appearance

It is the responsibility of each team to be present at the competition site with their Drone at their scheduled timeslot, which will be communicated to them beforehand by the organisers. If a team is not present and ready to compete at the scheduled time, it forfeits its attempt at that mission/task.

1.7.2 Team Briefing

All team leaders/captains and members are supposed to attend the team briefing for that day. If any member is not present at the briefing, it's the team's duty to get those members up to speed. If any specific doubts are there regarding the mission, they can be cleared during the briefing. No doubts or clarifications will be entertained once the mission time has begun.

1.8 DRONE OPERATIONS

- Teams will operate their drones from designated base stations. These base stations will be isolated such that the visibility of the course is blocked to the operators. Basic Indian-style power outlets (220V, 50Hz), tables, and chairs will be provided.
- All the competition events will be held in full daylight or under adequate artificial light.
- The GPS coordinates provided shall adhere to the WGS 84 datum standard. The format for the same will be latitude/longitude in decimal degrees.
- Drones are expected to travel 400m at most from the command station and the maximum allowed elevation from the ground is 100 feet.
- Testing will not be allowed at the site during or before ISDC-2024.

2.0 DRONE GUIDELINES

2.1 FACULTY ADVISOR ROLE

- The drone entered into the competition must be entirely designed and built by the student team members without direct involvement from faculty advisors and industry professionals.
- The role of faculty advisor/coordinator/supervisor will be limited to mentorship and guidance. He / She may not make design decisions.
- Students should perform manufacturing and fabrication tasks themselves as much as possible. For cases where in-house manufacturing and fabrication are not possible, teams can approach contractors, but the amount charged will be considered in the team budget.

2.2 SIZE, WEIGHT AND DESIGN

- The drone shall be a stand-alone, off-the-grid, mobile platform. Tethered power and communications are not allowed. A single connected platform must leave the designated start line.
- The weight of the drone should be less than 5 Kg.
- There are no restrictions on the dimensions of the Drone.
- The drone must use power systems that may be applicable on Mars. Battery-powered systems can only be used for drones. Any potential hazardous material will require proper documentation to be submitted to the organisers before the competition.

2.3 COMMUNICATION EQUIPMENT

- The drone shall be operated remotely using wireless communications with no time delay. The operators will not be able to view the drone or the site directly as they will be operating sitting in their base stations. Teams must power down communications equipment at the event sites while not competing to not interfere with other teams.
- Both omnidirectional and directional antennae are allowed, but communications equipment must not rely on the team's ability to watch and track the Drone firsthand. Steered directional antennae may use a mechanized antenna mounted outside that is controlled via an electronic signal from the command station. Signal strength, relayed GPS, or other strategies may be used to give feedback on antenna direction, but it is not allowed to mount a camera on top of the antenna for visual feedback.

2.4 RESTRICTIONS ON THE 2.4GHZ COMMUNICATION BANDS

Teams must inform the organisers of ISDC about the communications standards they will be using, including frequency bands and channels, by December 1, 2023.

- 2.4 GHz frequency band (2.400-2.4835 GHz): Teams shall use centre frequencies corresponding to channels 111 of the IEEE (Institute of Electrical and Electronics Engineers)

802.11 standard for 2.4 GHz. A team shall be allotted three channels in each mission, details of which will be posted along with the competition schedule. The teams must strictly stay within the assigned channels, which will be monitored by the judges during the tasks.

- These restrictions apply to both the command station to Drone communications and any local wireless network such as (but not limited to) on-board the Drone between subsystems.
- Communication on the 5.8Ghz band is recommended for less interference.

3.0 COMPETITION MISSIONS (FINALS)

- The ISDC Finals will have two field missions and one assessment (presentation).
- Teams will get a maximum time of 15 minutes to complete a mission. If a team completes a mission in less than 10 minutes, the team will get 20% bonus points for that mission.
- All the penalties are additive: e.g. penalties of 10% and 20% would result in a score of 70% of the points earned during that particular mission. All the missions are scored independently, and it is not possible to score less than zero in a mission.
- Before the start of the mission, teams will get 10 minutes as the setup time to set up all necessary systems and equipment at the base station. After completing the mission, teams will have to switch off their radio communication equipment immediately, and they will have 5 minutes to disassemble all the equipment and vacate the base station.
- The drone is not required to be in the same configuration during the entire competition. Teams can change the configuration of the drone according to their needs and mission requirements. The drone will be accessible to the teams throughout the competition, and teams can make modifications and repairs between the missions.

3.1 INTERVENTIONS

An intervention can be called when a critical error hinders regular drone operation during a mission. Teams are allowed to call not more than one intervention during a mission. A 10% penalty of the total points scored in that particular mission will be imposed.

A request for intervention can only be called by the team members present at the base station. It must be relayed through the judges at the base station. Teams may designate any number of team members who may repair or retrieve the Drone (hereafter referred to as “runners”). Spectating team members may be asked to act as runners, and also drone operators may leave the base station and become runners, but those members who left the base station will not be allowed to re-enter the base station.

3.1.1 SPROSCAPE

- The ISDC - 2024 Finals will be performed within a specially designed 20,000 square meter simulated landscape called Sproscape.
- It will be the world’s largest arena of its kind. It will incorporate numerous Mars like topographical elements, such as craters, mounts, rocky gardens, rifts, quarry fines, etc. On the outer edges of the Sprosphere, base stations for controlling the drone will be present.



Figure 3.1.1 Sproscape, International Rover Challenge – 2023 (For Reference)

3.2 SCIENCE MISSION (SM)

During this mission, the drone will use its onboard sensors and instruments to gather atmospheric data and images from three separate locations. The goal is to locate and gather basic information about certain areas for future scientific research by astronauts. The teams will be provided with the approximate GPS Coordinates of those locations before the starting of the mission.

- The drone should conduct a minimum of two of the following analyses of the atmosphere: temperature, humidity and atmospheric pressure etc. The teams can do other analysis depending on their choice. While collecting the atmospheric data, the drone's elevation from the ground should be different for each location, with the first location's elevation being 10 feet, the second's being 20 feet, and the third being 30 feet. The drone controller's computer in the base station should constantly display the drone's elevation reading.
- The drone should take photographs of the three locations in as much details as possible.
- After completing the mission time, teams will have to prepare for a 10-minute presentation for the judges, based on the data collected. The presentation is mandatory for the teams, even if they are unable to collect data during the mission.
- The presentation to the judges should include:
 - Results of on-board drone tests performed, including data and images.
 - A comparison of the drone-collected atmospheric information and images with the atmosphere and surface of Mars.
 - Teams are expected to have basic knowledge about the Mars atmosphere, astrobiology and features.

3.3 NAVIGATION MISSION (NM)

To make future expeditions more effective, the drone is tasked to direct a fictitious rover as it travels across the surface of Mars. The rover's optimal paths to various locations on Mars must be discovered by the drone. The pathways should be chosen so that the rover faces the fewest obstacles possible by avoiding challenging terrain characteristics including craters, rifts, rocks, and loose soil, among others.

The drone will be required to move no more than 400 metres away from the base station while on the mission in order to find particular markers/GPS coordinates. Three markers will be dispersed over the field. The markings will be orange colour cones (the sample image for the cones will be provided on the website). For at least one marker, approximate GPS coordinates will also be given. On the map that was given to the teams at the base station, the teams should mark the allocated markers and the best path to get to them. Locating markers and figuring out best routes to those markers will earn you points.

3.6 PROJECT IMPLEMENTATION AND MANAGEMENT ASSESSMENT (PIMA)

The objective of the PIMA is the assessment and review of the project and final drone design. PIMA will have one-to-one interaction between the teams and the judges. The teams will have to give a presentation to the judges about their drone development. This presentation will cover the lessons learned during the whole life cycle of developing a drone. It will include mostly system engineering and management aspects about the project, from the project plan to manufacturing and testing the drone. Teams may also include spin-offs that have emerged from their drone project. Furthermore, this presentation offers the opportunity for the judges to ask some specific questions.

3.6.1 Project Implementation and Management Assessment Procedure

- More details about the format of PIMA will be provided separately in September.
- The details which are not covered in this rulebook will be shared in the form of separate guidelines and the FAQs section on the website.
- For any query related to the rulebook contact us at contact@roverchallenge.org