Space Robotics Society

SPACE ROBOTICS SOCIETY (SPROS)

INTERNATIONAL ROVER CHALLENGE

An Event of International Space Robotics Week (SPROS Week)

RULEBOOK

Dates
28 Jan - 2 Feb 2026

Venue
Udupi, Karnataka

@SpaceRoboticsSociety

PREFACE

Welcome to SPROS International Rover Challenge - 2026

The Space Robotics Society (SPROS) is pleased to present the official rulebook for the SPROS International Rover Challenge (IRC) 2026. The forthcoming edition will take place from 28 January to 2 February 2026 in the coastal city of Udupi, Karnataka, India.

Since its inception, the International Rover Challenge has grown to become one of the leading platforms for aspiring space engineers. With its integration into the International Space Robotics Week (SPROS Week), the competition has expanded its outreach and impact, engaging over 1,000 students in its most recent edition and consolidating its reputation as the largest and most dynamic event of its kind.

The Society is particularly delighted that IRC returns to Udupi, a region situated between the Arabian Sea and the Western Ghats of Karnataka. The 2019 edition, also hosted in Udupi is remembered as one of the most successful in the competition's history, and we are confident that the 2026 edition will build upon that legacy.

Informed by the constructive feedback of previous participants, this edition of the IRC introduces several significant revisions and enhancements. These improvements are designed to strengthen the academic and practical value of the competition, and to further its twin objectives of fostering innovation and advancing experiential learning for students.

In addition to the IRC, the SPROS Week will also include the International Rover Design Challenge (IRDC) and the International Space Drone Challenge (ISDC). For further details on these related competitions, please visit:

ISDC: www.roverchallenge.org/ISDC IRDC: www.roverchallenge.org/IRDC

The rulebooks for other online events, including the Mars Base Challenge, will be released in the second half of September 2025.

Let us come together to shape a Brighter, Open, Limitless and Developed (B.O.L.D.) future through space advancement.

We extend our best wishes to all participating teams and look forward to an exceptional IRC 2026.

Sagar Dhaka
Event Director (IRC)

1.0 COMPETITION OVERVIEW

1.1 COMPETITION OBJECTIVE

SPROS International Rover Challenge (IRC), also referred to as “the challenge” or “the competition,” is a leading space robotics engineering competition. It challenges university students to conceptualise, design, develop and operate astronaut-assistive, next-generation space rovers.

Competing teams are required to demonstrate their rover systems through a series of mission-oriented tasks conducted in a simulated Martian terrain. These tasks are designed to test technical competence, innovation, and problem-solving abilities critical to advancing future space exploration.

The objective of the competition is to offer students a comprehensive, real-world interdisciplinary engineering experience that integrates practical engineering expertise with essential soft skills, including business planning and project management.

The idea behind the competition missions is to prepare humanity for a future scenario in which a second-stage Mars settlement (in-settlement habitat) has already been established, and rovers are employed to support exploration and enable its expansion into a fully developed, post-settlement habitat. For a conceptual illustration of this vision, reference may be made to the accompanying hypothetical scenario, set in the year 2X9X, depicting a future Mars town. Mars’ First Human Habitat - www.roverchallenge.org/SprosNagar

1.2 COMPETITION PROCEDURE AND SCHEDULE

The competition is divided into two stages:

- Qualifiers (Online)
- Finals (On-site)

MISSIONS/SUB MISSIONS	POINTS
QUALIFIERS (ONLINE)	
SDDR VIDEO	100
SDDR REPORT	100
TOTAL (QUALIFIERS)	200
FINALS (ON-SITE)	
ASTROBIOLOGY EXPEDITION (ABEX)	300
INSTRUMENT DEPLOYMENT AND MAINTENANCE OPERATION (IDMO)	250
RECONNAISSANCE AND AUTONOMOUS DELIVERY OPERATION (RADO)	250
ASSESSMENTS (ON-SITE)	
PROJECT IMPLEMENTATION AND MANAGEMENT ASSESSMENT (PIMA)	100
BUSINESS AND PARTNERSHIP PLAN (BPP)	50
EXHIBITION	50
TOTAL (FINALS)	1000

Table 1.2 Points Distribution

1.2.1 Team Selection Criteria

All teams shall undergo a review and down-selection process during the qualifiers. Only the top 26 teams that successfully pass each milestone will be invited to participate in the on-site finals.

Detailed information regarding deadlines, deliverable formats, submission requirements, and judges' expectations will be published on the official SPROS website (www.spaceroboticssociety.org) and the IRC website (www.roverchallenge.org). These details will also be communicated directly to the respective team leaders.

At any stage of the milestone evaluations, the officials reserve the right to request clarifications or seek additional information from teams.

Teams are strictly prohibited from using drones during any IRC mission. However, teams engaged in the development of drone technologies are encouraged to participate in another event of SPROS Week — the International Space Drone Challenge (ISDC).

Out of the 26 finalist positions, three shall be reserved for wildcard entries. Only non-Asian teams will be eligible to apply for these wildcard slots. Teams seeking consideration for a wildcard entry must demonstrate their readiness by presenting a live, working showcase of their rover to the judging panel before 1 December 2025.

The maximum number of students permitted in a team for participation in the finals is unrestricted.

1.2.2 Registration

All teams must formally declare their intent to participate in the competition. The official registration form will be made available online via the IRC website from 12 September to 20 October 2025.

No major deliverables are required at this stage, apart from the submission of the team details requested through the registration portal. Information regarding the registration fees for both the qualifiers and the finals will be published on the IRC website.

Early Bird Offer: Teams that register and complete payment for the competition before 26 September 2025 shall be eligible for a discount on the registration fee for the finals.

1.2.3 Awards and Honours

- Grand Awards: These are presented to the IRC's top three teams, i.e., the Champion, First Runner Up, and Second Runner Up.

- Astrobiology Poster Presentation Awards: These are presented to the best-performing individuals or teams in the Astrobiology Poster Presentation.
- Emerging Team of the Year: This is presented to the team that has made the most significant progress. Only teams that have recently been formed will be eligible for this award.
- Mission Awards: These honours will be given to teams for their creative thinking in a specific subsystem and outstanding performance in any of the competition missions. This category also includes the PIMA, BPP, and Exhibition awards.
- Depending on the judges' verdict, additional categories of awards may be conferred. This list only serves as an example of the prizes given out in prior IRC events.

1.2.4 System Design and Development Review (SDDR)

All teams shall submit a System Design and Development Review (SDDR) package no later than 20 November 2025, comprising a written report and a video component, addressing both technical and project management dimensions of rover development.

The project management section shall include: team organisational structure, resource management, project planning, a PERT chart depicting the project timeline and dependencies, initial budget, fundraising plans, sponsorships, team recruitment processes, and education and public outreach activities.

The technical section shall include: current rover development status and prototypes, overall system architecture and design, science strategy, and prototype testing strategy with verification approaches and milestones.

The video component shall be a 5-minute presentation highlighting salient features of the rover design and its readiness for mission tasks, succinctly evidencing integration and testing progress.

The top 26 teams shall advance to the on-site finals on the basis of their SDDR scores, with no scores from the qualifiers carried over to the finals; all selected teams must confirm their participation by 5 December 2025, failing which the place may be forfeited and offered to the highest-ranked reserve team.

Competition Dates - IRC finals will be held from 28 January to 2 February 2026 in Udupi, Karnataka, India.

The fees do not include the cost of travel or accommodation; participating teams are responsible for arranging and funding their own travel and lodging. Teams are strongly advised to secure accommodation and transportation promptly upon receiving the SDDR result, as the Coastal Karnataka region is a popular tourist destination and February constitutes peak season.

Note: Any change to the dates, venue, or rules of the finals, for any reason, will be communicated to all teams, and all such decisions rest solely at the discretion of the IRC organising team.

Figure 1.2.4 KAUP, UDUPI, KARNATAKA

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 IRC 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 IRC officials. If there is a discrepancy, the Rulebook (this document) will take precedence over FAQs. The rules are designed to be as clear and specific as possible, but there may still be occasional errors or ambiguities. In these cases, the

spirit of the rules takes precedence over the exact wording. The key terms "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as specified in RFC 2119, regardless of capitalisation.

1.3.2 Queries Regarding the Rules

Queries regarding any rules or guidelines should be directed to the officials via email (irc@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. No response will be provided to email addresses other than the designated contact point, as these emails will be considered spam. The official language of the competition is English.

All official communications will be sent only to the registered team email or the team leader's email address. Teams must check this inbox regularly, including spam/junk folders, to ensure no updates or notices from the organiser are missed.

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.

The judges have the authority to reschedule if unexpected events, like rain, occur, causing a delay or cancellation of a competition day. Teams must be prepared to participate in multiple missions in a day. If, despite a reschedule, it is not possible to complete all the tasks for all the teams due to time constraints or organising difficulties, those tasks will not count towards the overall scores. It is important to note that teams still able to perform will receive a score to assess their performance, but it will not contribute to their points. If all field missions are cancelled, winners will be determined based on assessments and SDDR scores. This is the only scenario in which SDDR scores will be considered in the finals. Any issues with the rover or team absence (whatever may be the reasons) will not be valid reasons to reschedule tasks.

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-point penalty, which will be deducted from their overall score. Multiple failures to follow an instruction may lead to disqualification of the member or the team from the competition.

1.3.5 Conduct with Officials

Arguments 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-point 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 Appeal

During the mission, teams may clear their doubts and seek clarifications only from the designated field judge. Once the mission has been concluded from the field judge's side, no further interaction with them is permitted. Should any issue remain unresolved, a formal appeal may be submitted exclusively to the Arbitrator. Such appeals may relate to matters of scoring, judging, policies, or the interpretation and application of rules contained within the Rulebook.

Appeals must be submitted in writing via email to the arbitrator's designated address (to be provided at the finals) within 30 minutes of the completion of the mission. Only appeals directly related to rules or official policies will be considered. Complaints concerning time delays, loss of communication, scheduling, task repetition, or any matter not governed by the Rulebook shall not be entertained. Each appeal must include comprehensive details together with all supporting material available to the team. The officials' written decision shall be final and binding, and no further protests on the same matter will be accepted.

The team leader and faculty advisor shall be the only representatives authorised to interact with the judges, officials, and arbitrators in the matter of appeal, and under no circumstances may any other team member be appointed or permitted to act in this capacity. If any other member does so, a penalty of 20 points will be deducted from the team's overall score. Multiple violations may result in disqualification of the team or the member from the competition.

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 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 20,00,000 INR. It shall include components for the rover, rover module, rover power source, rover communication equipment, and rover 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, authorised 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 rover 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 and will be scored zero for that task.

1.7.2 Team Briefing

All team leaders/captains must attend the team briefing for that day. 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 ROVER OPERATIONS

- Teams shall operate their rovers wirelessly from designated base stations, which will be isolated to block the operators' direct visibility of the competition site and the rover. These base stations may be tents or concrete rooms. Basic Indian-style power outlets (220V, 50Hz), tables, and chairs shall be provided.

- Teams shall operate their rovers remotely with no time delay, utilising live video feeds from onboard cameras, engineering telemetry for navigation, and additional sensors for situational awareness and control; with or without a direct line-of-sight radio communication to the rover. The use of public cellular networks (4G/5G), wireless internet, or satellite internet is prohibited. Rovers are expected to travel a maximum distance of 500 meters from the base station.

- The complete communication setup, including antennas, computers, wires, and more, is entirely the responsibility of the participating team. While these components are not part of the rover itself, they are considered integral to the overall system design.

- Teams are allowed to place their communication antenna within 3 metres in front of the base station to optimise signal quality, including achieving line-of-sight when possible. Teams must be prepared to operate in both line-of-sight and non-line-of-sight conditions, as in rare cases due to physical features line of sight communication might not be available.

- 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.
- Testing will not be allowed at the site during or before IRC-2026.

2.0 ROVER GUIDELINES

2.1 FACULTY ADVISOR ROLE

- The rover participating in the competition must be designed and built entirely 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.
- Each team is expected and encouraged to have at least one and a maximum of two Faculty Advisors appointed by the college/university. The faculty advisor/s will be considered by competition officials to be the official university representative accompanying the team. Their presence during the competition is recommended for all the event days on-site.

2.2 SIZE, WEIGHT, AND DESIGN

- The rover shall be a stand-alone, off-the-grid, mobile platform. Tethered power and communications are not allowed. A single, self-contained rover platform must cross the designated start line as one connected unit.
- The maximum allowable mass of the rover when deployed for any competition mission is 65kg. The total mass of all fielded rover parts for all events is 85 kg. For example, a modular rover may have a robotic arm and a sensor that are never on the rover at the same time. The rover plus arm and rover plus sensor combinations must each be under 65 kg, but the total rover plus arm plus sensor must be less than 85 kg. The limitations on the rover's weight do not include any spares or tools that may be required to build or maintain the rover. If the rover is overweight during a mission, the team will be charged a penalty of 10% of the points scored for every kilogram over 65kg.

- The maximum allowable length and breadth of the rover are 1.5m and 1.2m, respectively. There is no vertical height limit for IRC 2026. If the rover is oversized during a mission, the team will be charged a penalty of 40% of the points scored during that mission.

- The rovers must use power systems that may be applicable on Mars. Battery-powered systems can only be used for the rovers. Any potential hazardous material will require proper documentation to be submitted to the organisers before the competition.

- All rovers must be equipped with a "kill switch" placed on the exterior of the rover. The kill switch should be accessible and visible at all times. This switch must be able to cease any movement by the rover and withdraw all power from the batteries in case of an emergency.

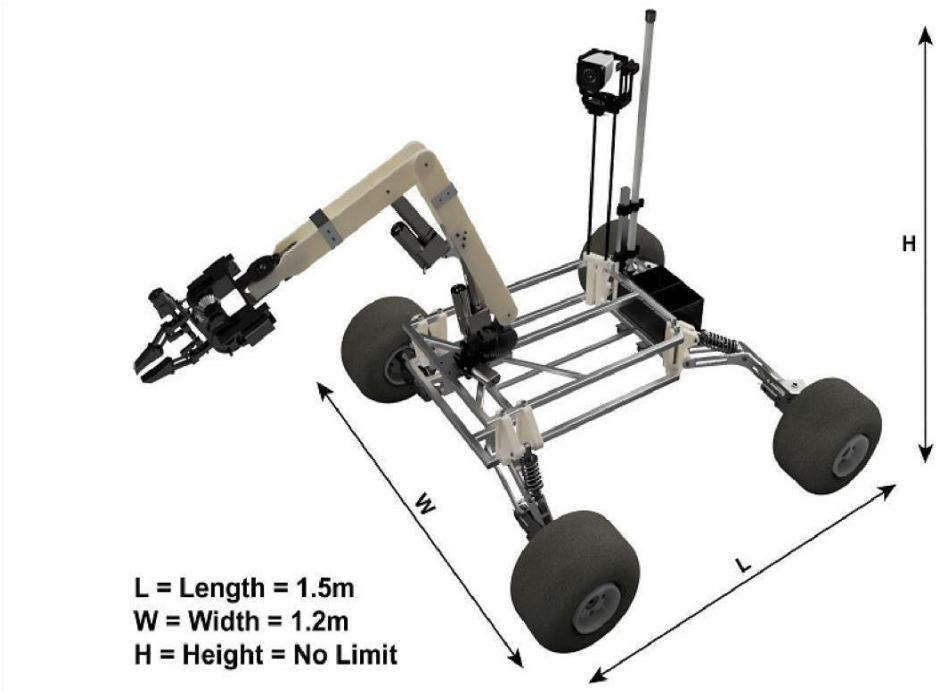

Figure 2.2 Rover Dimensions

2.3 COMMUNICATION EQUIPMENT

- Teams shall operate their rovers wirelessly from designated base stations, which will be isolated to block the operators' direct visibility of the competition site and the rover. These base stations may be tents or concrete rooms. Basic Indian-style power outlets (220V, 50Hz), tables, and chairs shall be provided.

- Teams must turn off their communication equipment at the event sites when they are not competing to prevent interference with other teams. Before switching on any communication equipment, teams must first obtain permission from the field judge. Any team that is found in violation of this guideline shall face a penalty that entails a reduction of their maximum mission time by 50 percent.

- Both omnidirectional and directional antennae are allowed, but communications equipment must not rely on the team's ability to watch and track the rover firsthand. Steered directional antennae may use a mechanised 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. If teams are using a directional antenna, it must always be pointed away from the competition area when not competing.

- Base station antenna height is limited to 3 metres and shall adhere to all applicable regulations. Antenna must be located within 3-metre arc of the team's command station.

- Any ropes or wires used for stability of antenna only may be anchored within 3 meters of the command station.

- The design and reliability of communication systems form an integral part of this competition. Teams are expected to approach it as a core challenge, demonstrating innovation, resilience, and adaptability in their systems. The competition environment itself is deliberately demanding, designed to test how well teams can develop and operate robust communication links. No team will be permitted to cite interference as grounds for complaint. Missions will not be paused, repeated, or delayed to ensure an interference-free environment. Designing communication systems that can withstand interference is a core part of the competition challenge.

- Each team is solely responsible for establishing and maintaining its own communication link.

- The organisers will not allocate or manage communication channels.

- Teams have complete freedom to select channels within the permitted spectrum, encouraging innovative approaches to communication system design.

- Only unlicensed frequency bands, as designated by the Department of Telecommunications (India), may be used. If a team chooses to operate outside these bands, it is their responsibility to obtain the necessary licence.

- The competition venue will be a congested RF environment, with multiple teams likely transmitting simultaneously.
- All communication systems must be capable of assessing the RF environment before transmitting. Occupied frequencies should be avoided, and systems should dynamically select the clearest available channels.
- Automatic or manual switching between frequency bands is required, allowing systems to adapt quickly in the event of interference (including interference from unauthorised or innocent third-party transmissions).
- Teams should carefully account for the dense RF environment expected during the finals. Encryption and mitigation techniques must be incorporated into system design, ensuring reliable and secure links.
- Non overlapping channels, particularly within the 5.8 GHz band, are strongly recommended as they typically experience less congestion.
- Obtaining an amateur (ham) radio licence is encouraged, as it may provide additional resilience in communications.
- Each team must submit a formal declaration of the communication standards, frequency bands, and channels they intend to use by 5 December 2025. During the finals, the organisers will actively monitor the frequency spectrum, and any team found operating in a manner inconsistent with their declared specifications will face immediate disqualification.

3.0 COMPETITION MISSIONS (FINALS)

- The IRC finals are divided into three categories – Expeditions, Operations, and Assessments.
- Expeditions are missions that are investigatory in nature and for which teams shall present the findings and results to the judges after the completion of the mission. Expeditions contain both dynamic and static components.
- Operations are the missions that contain only dynamic components and in which the rover has to perform specific tasks in the field.
- Assessments are missions that are static in nature like Project Implementation and Management Assessment (PIMA) and Business and Partnership Plan (BPP).

- For each mission, the team must arrive at the respective base station at least 30 minutes before the scheduled slot for preliminary rover checks and the mission briefing. If the team is late, time would be deducted from their mission time of 30 minutes.
- The teams should design their rover so that it can be safely carried by two members over short distances during the missions with little risk of injury.
- Teams will get a maximum time of 30 minutes to complete a field mission.
- Teams are eligible to attempt bonus tasks only after completing 15 minutes of the mission time.
- During the field missions, if a rover does not score any points within the first 10 minutes, the mission will be aborted.
- Only the teams which score more than 30% points (without including bonus points) during the first 20 minutes of a particular mission are allowed to utilise the entire mission time of 30 minutes. The teams that score less than 30% points will have to stop their mission after 20 minutes.
- 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. Upon mission completion, radio communication equipment must be powered down immediately. Teams then have 5 minutes to pack up and vacate the base station.
- A maximum of 5 team members may serve as operators at the base station, and up to 2 additional team members may serve as runners accompanying the rover within the competition field. Any other team member is considered a spectator. Spectators are not permitted to enter the competition field at any time, including during setup.
- The rover is not required to be in the same configuration during the entire competition. Teams can change the configuration of the rover according to their needs and mission requirements. The rover will be accessible to the teams throughout the competition, and teams can make modifications and repairs between the missions.
- Any area or object within the competition field that is marked in red will be considered a contaminated area and treated as a no-go zone. If the rover enters this area, a penalty of 10% of the points awarded for that mission will apply. Multiple violations will incur multiple penalties. No-go zones may include anything such as red-coloured rock or a red traffic cone.

3.1 INTERVENTIONS

An intervention can be called when a critical error hinders regular rover operation during a mission. However, the following set of guidelines is to be followed to service an intervention call.

- The teams can take a maximum of 4 interventions during the IRC finals. The teams are allowed to request a maximum of 2 interventions during a particular mission. However, each intervention will incur a 20% penalty on the total points earned in that mission. As a result, multiple interventions can lead to cumulative penalties. Upon requesting a second intervention during a mission, the team shall restart the mission/stage from the designated start line. After the restart, the rover may attempt only those sub-tasks that remain pending. Repeating sub-tasks already completed will not yield additional points. The mission clock continues to run throughout any intervention.

- A request for intervention can only be initiated by team members (operators) who are present at the base station. To request intervention, operator must enter the intervention circle located outside the base station and inform the field judge. The operators who leave the base station to repair the rover will not be permitted to re-enter the base station.

- Any team member not designated as an operator or runner is deemed a spectator and must not interfere with rover operations during missions, no communication (verbal or nonverbal) is permitted between spectators and base-station operators or runners, all spare parts and repair tools required for interventions must be with the runners or operators before mission start, and once the mission begins no movement of personnel, equipment, or tools is permitted into or out of the mission area.

- A maximum of 5 team members may act as operators at the base station, and up to 2 additional team members may serve as runners accompanying the rover within the competition field. Anyone else shall be considered a spectator.

- Runners must maintain at least 5 metres of distance from the rover during normal operations and must not appear in any rover-mounted camera view. Runners shall not indulge any action that obstructs sensors, interferes with navigation, or influences task execution. Their main responsibility is to use the kill switch in an emergency. During intervention times, runners may also assist in repairing the rover.

- Teams must not change the rover's position during the intervention. After completing the intervention, the rover must be precisely at its pre-intervention position and orientation.

3.1.1 Sproscape

- The IRC 2026 finals will be performed within a specially designed simulated landscape called Sproscape.
- It will be one-of-the world's largest arena of its kind. It will incorporate numerous topographical elements, such as craters, mounts, rocky gardens, rifts, quarry fines, etc. Base stations will be situated either along the edges of the Sproscape or at some distance from it to ensure unhindered rover operations.

Figure 3.1.1 Sproscape, IRC 2023

3.2 ASTROBIOLOGY EXPEDITION (ABEx)

In this mission, the rover will serve as a mobile science laboratory to collect samples from designated sites and conduct basic scientific evaluations of these samples using a carefully designed set of tests and experiments. The objective is to identify and characterise the sites for their capabilities to support microbial life and seek signs of extinct or extant life in those sites. The rover may use cameras or other passive instruments to investigate the designated area and collect samples using mechanical methods. The rover must be equipped with at least one instrument or assay capable of detecting life, chosen by the team. The rover must analyse samples using onboard instruments and collect at least one uncontaminated sample in a sealed, cached container or tube. The rover will drop this sample at a designated location for future retrieval during the Reconnaissance and Autonomous Delivery Mission, so it should be designed with the ability to retrieve the sample (cached container or tube) in mind. All instruments and tests must be conducted onboard the rover, as there will be no laboratory analysis at the base station.

One month before the IRC finals, qualified teams will have to submit a poster presentation for their Science Plan to the judges. The submission date and format will be informed to the teams. The teams will have to present this to the judges through a recorded video. Teams may nominate a maximum of three members to be part of the poster presentation, as there will be individual awards up for grabs. Teams may nominate up to three members for the poster presentation. These presenters will be eligible for individual poster presentation awards.

- During the finals, teams will be collecting data of scientific relevance in the context of the Martian biosphere, and the rover must have the ability to select, collect, and analyse (investigate) samples from multiple sites.

- Teams shall document each selected site by investigating it using a wide-angle panorama of a minimum 1:3 height-to-width ratio showing the full context of the site. The panorama must indicate cardinal directions and scale, GPS coordinates of each site, elevation, and accuracy range. Thorough documentation is especially crucial for the sample that is to be retrieved.

- Provide a close-up, well-focused, high-resolution photograph of the sampling site with a clear indication of scale, which may be added after capture.

- Based upon the investigation of the selected sites, teams shall then collect and store a subsurface soil sample from a depth of 10 cm or deeper. Sample(s) must be at least 10g and may consist of a single rock, loose soil, or anything in between.

- The teams should conduct these analyses on both soil and atmosphere: sub-surface temperature, humidity, pH, and atmospheric pressure. The teams can do other analyses depending on their choice. Teams should conduct only those tests and analyses that provide conclusive results in the allotted mission time of 30 minutes.

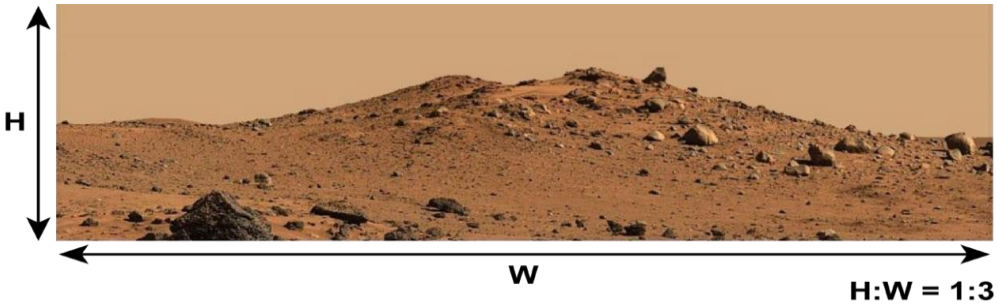

Figure 3.2 Wide-Angle Panorama

- Any chemicals used on-board, including water and other chemical products, must follow a no-spill policy and should not spill on the ground during the mission. In addition, the use

of hazardous chemicals must be pre-approved before the competition by submitting a usage plan, transportation, safety precautions, and accident plan.

- Teams must submit their analysis and findings to the judges in the form of an AbEx Mission Report within 30 minutes after completing the mission. The report should include the results of on-board rover tests, along with relevant data and images. Submissions must be made in both digital and hard copy formats. The report should not exceed 5 pages in length, excluding any pictures taken during the mission. Teams should prepare the report in advance and only need to add data, findings, and pictures from the mission afterward. There is no requirement for teams to present this report to the judges.

- The mission report submission is allowed even if the rover was unsuccessful in performing any of the field tasks. The report should include:

  - Results of on-board rover and laboratory tests performed.

  - Method used to ensure the sample was collected at least 10 cm below the surface and sealed without contamination in a tube/cache container.

  - Reasoning for sample site selection and documentation of the sites. Meaning of data collected with respect to the habitability potential, the geology of the site (past and present), and implications of the site being suitable for life.

  - Scientific knowledge of Mars based on responses to judges' questions.

The score for this task will be based on the following components:

- Thoroughness of the investigation of sites (panoramas, site selection, stratigraphic profile).

- Quality and applicability of the onboard and laboratory analysis (moisture, temperature, science capability of choice).

- Quality of the sample/s collected (weight, depth, possible contamination).

- Scientific knowledge of astrobiology.

3.3 RECONNAISSANCE AND AUTONOMOUS DELIVERY OPERATION (RADO)

In this mission, rovers shall be required to conduct reconnaissance operation over terrain not more than 500 metre away from the base station. The rover will search, locate, pick up, and deliver objects to specific locations (GPS coordinates) and/or pick up and store objects until

the mission's end to deliver them to the base station. The objects will be scattered over the field. Hence, this task will require the rover to have a storage facility and an arm for assistance.

3.3.1 Reconnaissance

In this stage, the rover will have a maximum of 10 minutes to reconnaissance through an area to search and locate various objects around the competition site. Teams shall document each located object by taking its photograph and the GPS coordinates of its location. The team may choose to pick up and store any one object of its choice during this stage (Not to be delivered in this stage). The rover may carry at most one object in its storage cache (carrying an object by gripping will not be allowed) during this stage. The remaining time at the end of this stage will not be added to the following stage, which will begin immediately after this stage.

3.3.2 Autonomous Delivery

At this stage, the rover will have 20 minutes to pick up objects and deliver them to designated locations. The rover can use a gripper or other mechanisms for the delivery of objects. While object pickup does not need to be performed autonomously, the delivery must be completed autonomously to earn full points. Teams are required to notify the judges each time they enter autonomous mode. If a team chooses to perform the delivery non-autonomously, they will only receive 50% of the points for each sub-task related to the delivery of objects to the required locations. Teams must communicate their choice regarding the delivery mode (autonomous or non-autonomous) before the finals.

In autonomous mode, team members may monitor video and telemetry information sent from the rover but may not transmit any commands. No scouting will be allowed before the start of this mission.

- Objects will include small, lightweight hand tools (e.g., screwdriver, hammer, wrench), supply containers (e.g., toolbox), or rocks up to 5 kg in mass. All items will be graspable, with diameters no greater than 7 cm. The maximum dimensions will be 40 cm x 40 cm x 40 cm, but teams should expect a variety of sizes and weights. The terrain will vary from soft sandy surface to rough stony terrain and may contain rocks and boulders, vertical drops, sand dunes, and slopes. The difficulty of the task will increase with further levels.

- Approximate GPS coordinates or colours of the markers will be provided for all the delivery locations, although accuracy may vary. The rover can take any sequence/path it wants. However, certain sequences or parts of the terrain may be compulsory to complete the mission, and the same information will be provided beforehand. In addition, the instructions regarding the markers' colour and the objects (if necessary) will be provided in advance.

- Teams will be scored based on their ability to search, locate, and deliver/store the correct objects from/to the correct locations and based on the proximity of the object placed to the objective within the specified time.
- The pictures of the objects will be shared with the teams before the finals.

3.4 INSTRUMENT DEPLOYMENT AND MAINTENANCE OPERATION (IDMO)

This mission will be divided into two stages, Instrument Deployment and Instrument Maintenance. The rover is expected to traverse a short distance to operate on a mock-up instrument panel to perform a set of precise maintenance and deployment operations. The rover will have to use robotic manipulators to carry out this mission.

The mission may include multiple operations. The provided list is not exhaustive, and the mission may include operations similar to those mentioned below. Teams must be ready for certain flexibilities.

3.4.1 Instrument Maintenance

- Picking up a cache and traversing to the panel. The cache will have a handle of at least 10 cm in length and not more than 5 cm in diameter. The cache will weigh less than 5 kg.
- Open a drawer to place the cache inside it and close the drawer.
- Push buttons, flip switches, turn knobs.
- Operate a joystick.
- Undo latches.
- Open panels.
- Connect an electric three-pin plug to a standard three-pin socket.

3.4.2 Deployment

The deployment leg of this mission will require teams to retrieve and carry sample cache components for deployment in particular designated locations near the collection panel. The cache(s) may have to be deployed in a particular pattern/orientation, details of which will be provided at the competition site itself. The cache components will consist of standard graspable features such as handles, ropes, etc.

After the deployment of the components, the rover has to read certain codes/patterns/text displayed on or near the panel or on any of the components that are being deployed. This code needs to be noted by the base station team using the transmitted video feed.

The deployment leg will be considered completed only after correctly placing the cache(s) in designated spots and the correct submission of the code to the judges by the base station team.

The maximum height of the instrument panel will be 1.5m from the ground.

Teams can do the sub-missions in any desired order. Points will be awarded for completing each sub-mission successfully.

3.5 PROJECT IMPLEMENTATION AND MANAGEMENT ASSESSMENT (PIMA)

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

3.5.1 Project Implementation and Management Assessment Procedure

- More details about the format of PIMA will be provided separately in November.

3.5.2 Business and Partnership Plan (BPP)

- The objective of the BPP is to evaluate the team's ability to develop the business acumen of the team and encourage them to build partnerships with the industry and academia which aids them in the development of their project.
- The business plan must relate to the specific rover and team entered in the competition.
- Specific details for the BPP will be provided in November.

3.5.3 Rover Exhibition

- To raise awareness and generate interest in space robotics within the local community while inspiring students, a rover exhibition will be organised during the competition days.

Teams are encouraged to effectively showcase their rover and team by using up to two standee flex banners, each measuring 3 feet by 6 feet. Participation in the exhibition is mandatory for all teams and will account for a total of 50 points in the competition.

- The scoring for this event will be divided into two parts: 30 points will be awarded based on the quality of the banners and the rover showcase, while the remaining 20 points will be determined by the audience, local academia, or judges.
- The organisers may update the rules at their discretion. A revised rulebook will be published if any rules are updated. All communications will be sent only to the official email address of the team.
- The details that 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 irc@roverchallenge.org