



Space Robotics
Society

SPACE ROBOTICS SOCIETY (SPROS)

INTERNATIONAL ROVER DESIGN CHALLENGE (ONLINE)

An Event of International Space Robotics Week (SPROS Week)

RULEBOOK



Semi Finals
10-12 Jan 2025

Finals
1 Feb 2025



1.0 COMPETITION OVERVIEW

1.1 COMPETITION OBJECTIVE

The Space Robotics Society's International Rover Design Challenge (IRDC) 2024-25 is an online space engineering design competition. It challenges university students to conceptualise and design Next-Gen Rovers, which shall be fully equipped and mission ready for future exploration operations on extra-terrestrial bodies. Teams are supposed to carefully plan each sub-system of the Rover considering various extra-terrestrial parameters in design (exceptions, if any shall be mentioned). This online research-oriented competition is designed for students to explore their minds and spark the innovative design thinking of individuals, free from constraints on available physical resources. Students are encouraged to be as imaginative, creative, and insightful as possible within practical implementable limits for the human race.

The IRDC 2024-25 will be a part of the International Space Robotics Week (SPROS Week).

The guidelines in this Rulebook provide teams with direction and an outline for their designs. Any scenarios or specifics not mentioned in the rulebook regarding rover capabilities and sub-systems can be considered "Open to Interpretation". Teams can make assumptions in these scenarios, as long as they provide proper justification. This approach is intended to encourage imagination and creativity in teams, rather than restricting them with numerous constraints. It is important to note that there is no "Right Answer" in this competition. We expect to see a variety of approaches and strategies from teams. Teams will be primarily judged on the merit of their System Concept Review (SCR) Package, which includes a written report and a 25-second rendered video submission of their designs.

2.0 GENERAL GUIDELINES

2.1 Competition Format

The IRDC 2024-25 edition will consist of a 3-stage competition. In Stage 1 (qualifiers), teams will need to submit the System Concept Review (SCR) Package. Stage 2 (semi-finals) will involve the top 12 teams from Stage 1 presenting their ideas to the judges during one-on-one online presentations. In Stage 3 (Finals), teams will be required to present their designs in person to the judges. For the first time ever, qualifying teams will be invited to attend the International Space Robotics Week and IRC Finals at Birla Institute of Technology, KK Birla Goa Campus, Goa, India from January 28 to February 2, 2025. The top 5 teams will present their designs to the judges on February 1, and the award ceremony will take place the next day. **However, if a team is unable to attend the Finals in person, they can present their design to the judges online.**

SPROS reserves the right to use and reproduce the information submitted by teams in the competition for educational and promotional purposes through any of its media channels while duly citing the contribution made by respective teams.

2.2 Registration

The registration window for the IRDC 2024-25 will be open from September 25 to October 25, 2024, and the System Concept Review (SCR) Package submission deadline is 23:59 IST, December 20, 2024. The top 12 teams will be further asked to present their designs to the judges from January 12-14, 2025.

The registration details and form are available at www.roverchallenge.org/irdc.

2.3 General Official 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. All team members are required to cooperate with and follow all instructions from the officials.

2.4 Queries Regarding the Rules

If there are any issues not covered by the published rule sets, the IRDC Judging Panel will address them on a case-by-case basis. You can contact the panel at irdc@roverchallenge.org, and any matters raised by teams will be posted on the IRDC FAQ section of the competition website. We advise teams to check the FAQ section regularly for updates.

Teams must prepare a System Concept Review (SCR) Package for their Rovers, based on the mandatory parameters outlined in this document. The SCR should include a written report and a 25-second rendered video.

3.0 SYSTEM CONCEPT REVIEW

3.1 SCR Report

Page 1 of the SCR Report should bear the Team Logo, Institution Logo, Space Robotics Society (SPROS) Logo, Team Name, Team Lead Name, and Contact Information. Document Margins should be 2.54cm from each side. Font Sizes should range between (11pt-16pt) in the document, used appropriately for Headings, Sub-Headings, Text, and Annotations.

The font should be uniform across the entire report. All Images should be annotated. Teams are encouraged to adopt a mission-based approach in the Report. Starting with rover composition and base system information, and then explaining each of their additional systems by showing their application in their mission approach. The team's approach to each mission needs to be individually elaborated.

The Teams are required to include one Orthographic/Isometric Image of the entire Rover on Page 2, labelling the primary systems of the Rover (Sample: tinyurl.com/IRDC-image), with system descriptions not exceeding 15 words per system. A higher number of illustrations, images, CAD models, flowcharts, simulations, and representative figures are encouraged.

Teams are required to compulsorily cite any published material that they may use for developing their design at the end of the SCR in an Appendix section. The System Design Review Report shall not exceed a total of 26 Pages (Excluding the appendix).

3.2 SCR Video

Teams must make a rendered video of their Rover performing any of the given mission objectives. The video should not be more than 25 seconds and should be in MP4 format. The SCR will be judged based on:

1. Compliance of Rovers to the given parameters, and effectiveness on mentioned tasks.
2. Depth of extra-terrestrial conditions and parameters considered in systems.
3. The depth of justification and reasoning provided in the SCR on each design decision.
4. The novelty, innovation, and imaginativeness of the design.
5. System Sophistication and effectiveness of the presentation.

4.0 COMPETITION MISSIONS

Over the past 60 years, numerous robotic missions have successfully explored the lunar surface, significantly enhancing our understanding of the Moon's environment, geology, and potential for habitability. However, the polar regions of the Moon have received less exploration. A significant milestone was achieved in 2023 when India's Chandrayaan-3 Mission landed in the southern pole region, marking the first exploration of this area. Further missions are essential to conduct more in-depth studies of this region. Sending a more advanced robotic mission to thoroughly explore and investigate the area would be an excellent option to unveil its characteristics.

4.1 Theme

A robotic mission to explore and investigate Statio Shiv Shakti or Shiv Shakti Point (<https://tinyurl.com/IRDC2024-25>), the landing site of the Indian Space Research Organisation's (ISRO) Chandrayaan-3 lunar mission.

4.2 Mission

Conceptualise and design two Moon Rovers, a mother rover and a daughter rover, to explore and characterise the area around 'Statio Shiv Shakti' situated between the lunar craters Manzinus C and Simpeliuss N. The landing site coordinates are 69.373°S 32.319°E. The mother rover should have the capability to carry and transport the daughter rover, which should be a micro-rover weighing less than 10 kg, to the exploration site.

During the mission, the primary objectives of the Rovers would be to:

- Explore the unique region of the Moon near the Shiv Shakti Point.
- Conduct a visual reconnaissance of the region by navigating and traversing successfully through the different terrains of this region.
- Conduct various scientific experiments (biological, geological, etc.) and analysis, including in-situ analysis with the Rover for signs of microbial life, habitability, and characteristics.
- Collect and analyse regolith samples from a depth of 3 ft and build a sample depot of 10 tubes.
- Characterise surface and subsurface physical properties and mineralogical composition of the layered landscape.
- Characterise the climate and local weather of the landing site, and conduct an aerobiology investigation.

Note: The above-mentioned list of objectives is not exhaustive. They have been provided just to give the teams a direction about the Rover's capabilities. Exploration of the Moon is a complex task, and there are a lot of other objectives and aspects that the teams might find more suitable for their Rover exploration mission.

For this mission, teams should make the following assumptions:

- The mother Rover has already been transported to the exploration location.
- The mission length is 2 lunar days.
- The mother Rover is placed onto the layered terrain near the Shiv Shakti Point.
- An astronaut base station with all the necessary resources is situated at a distance of 40 km from the rover.

4.3 Rover Sub-System Guidelines

Teams are encouraged to design the maximum proportion of the rovers indigenously. Teams are, however, allowed to use readily available products/parts in the market. In such cases, the reasoning behind the component selection will be judged rather than the actual design of such market-ready components. The rover design will undergo evaluation in three crucial aspects: reliability, adaptability to the lunar conditions, and the innovative nature of the design.

1. **Mechanical Design-** All the mechanical systems, including but not limited to wheels, motors, drive/actuation mechanisms, robotic arm, and science module, should be readily operable on the Moon.
2. **Electronics Design-** The focus is to design and conceptualise a reliable electronic system. The judges understand that some of the electronics may not be able to function properly on the Moon. Teams may treat this as an exception and are not required to look at material aspects of electronic components. All other parameters are to be considered for lunar operation.
3. **Scientific Experiments and Analysis (Science) Package –** All lunar parameters must be considered while developing instruments and equipment for scientific analysis.
4. **Power and Communication System Design -** Teams should consider the challenges presented by frigid conditions near the poles, the rover must overcome various difficulties.