ANVESHAN - GRAHGAAMI

Space Drone Competiton 2024

Contents

1 Preamble

Welcome to the UAV Competition 2024, organised by the CUAC! The Mars Exploration Program inspires this year's theme. Participants will be tasked with designing and operating drones capable of navigating the harsh and unpredictable Martian terrain, with a focus on dust storm detection and navigation.

2 General Information

2.1 Introduction to UAV Competition 2024

The UAV Competition 2024, themed "ANVESHAN," aims to inspire students to innovate and create UAVs that can withstand the rigours of Martian terrain, particularly focusing on dust storm conditions. The competition provides a platform for students to apply their engineering and problem-solving skills in a simulated extraterrestrial environment.

2.2 Objectives of the Challenge

- Design a UAV that can autonomously navigate a simulated Martian environment with dust storm conditions.
- Develop systems for obstacle detection and avoidance in low visibility.
- Demonstrate robust communication and environmental sensing capabilities.
- Promote teamwork, innovation, and practical application of STEM knowledge.

2.3 Schedule of Events

- Registration Deadline: - 31st August 2024
- Proposal Submission: - 31st August 2024
- Preliminary Rounds: - 1st September 2024
- Final Round: - 5th and 6th October, 2024

2.4 Venue

The competition will be held at the Aircraft Hangar and the indoor testing area.

2.5 Awards and Recognitions

- First Prize: - 70,000/-
- Second Prize:- 50,000/-
- Third Prize: - 25,000/-

2.6 Intellectual Property Rights

All designs and innovations remain the intellectual property of the respective teams. The organizers may request permission to showcase the designs for promotional purposes.

3 Problem Statement

3.1 Mission Objective

Develop a UAV capable of detecting simulated Martian dust storm conditions and navigating through them while maintaining communication with a base station.

3.1.1 Simulated Conditions

- Simulated high-speed winds (up to 30 km/h)
- Reduced visibility conditions
- Simulated electromagnetic interference

3.2 Key UAV Capabilities

- Wind-resistant flight
- Obstacle detection and avoidance in low visibility
- Robust communication system
- Environmental sensing

3.3 Specific Task

Design and demonstrate a UAV that can:

1. Take off from a designated launch area.
2. Navigate through a 100m x 100m test field with obstacles.
3. Detect changes in wind speed and direction using onboard sensors.
4. Adjust its flight path to avoid the heaviest simulated dust concentrations.
5. Maintain consistent communication with the base station, transmitting data on its position, and detecting wind patterns, and dust concentrations.
6. Navigate back to the starting point once the field has been fully surveyed or when instructed by the base station.
7. Complete the entire mission within a 30-minute timeframe.

3.4 Testing Environment

- An indoor test field with simulated Martian terrain features and obstacles.
- Industrial fans are placed strategically to create variable wind conditions.
- Non-toxic, fine particulate matter is released in controlled amounts to simulate dust.
- A computerized system to vary wind patterns and "dust" release during the test.

3.4.1 Evaluation Criteria

1. Accuracy of wind speed and direction measurements
2. Effectiveness in detecting and avoiding areas of the highest simulated dust concentration
3. Quality and consistency of communication with the base station
4. Ability to navigate and avoid obstacles in low visibility conditions
5. Overall mission completion time
6. Innovative approaches to dust detection and wind measurement

3.5 Interdisciplinary Elements

This challenge combines elements of aerospace engineering, meteorology, sensor technology, and communication systems. Teams will need to consider Mars-like conditions while designing for Earth-based testing, encouraging creative problem-solving and system optimization.

3.6 Safety Considerations

All UAVs must have a fail-safe return-to-home function and an emergency shutdown feature. Teams must comply with local aviation regulations and safety guidelines provided by the competition organizers.

4 Participating Teams

4.1 Registration

Teams must register online by the deadline. Each team should consist of 3-5 members.

4.2 Team Composition

Teams should have a mix of students from various disciplines, including engineering, computer science, and other relevant fields.

4.3 Team Lead Responsibilities

Each team must appoint a team lead who will be the primary point of contact with the organizers.

4.4 Selection Process

Teams will be selected based on the strength of their proposals, which should detail their design approach, innovation, and feasibility of their UAV.

5 Competition Requirements

5.1 Arena Specifications

- Size: 100m x 100m
- Surface: Simulated Martian terrain
- Terrain: Variable with distributed obstacles
- Environmental Conditions: Simulated dust storms and wind patterns

5.2 Navigation Task

The UAV must autonomously navigate the arena, detecting and avoiding simulated dust storm conditions while maintaining communication with the base station.

5.3 Task Duration

Each team will have 30 minutes to complete their tasks.

5.4 UAV Specifications

- Type: Rotorcraft
- Dimensions: Maximum 1m x 1m x 0.5m
- Mass: Less than 5kg
- Power: Battery-operated
- Communication: Robust RF control system
- Sensors: Must include wind speed, direction, and dust concentration sensors

5.5 Proposal Report Submission

Teams must submit a detailed proposal including design specifications, component lists, and an explanation of their navigation, dust detection, and communication strategies.

5.6 Scoring Criteria

Teams will be scored based on the accuracy of wind and dust measurements, effectiveness of navigation in low visibility, communication reliability, and overall mission completion.

6 Subsystems and Requirements

6.1 Frame and Structure

The frame and structure of the UAV must be lightweight yet durable to withstand the harsh Martian-like environment. Material choices may include carbon fiber, aluminium, or high-strength polymers.

- **Material:** Carbon fiber, aluminium, or high-strength polymer.
- **Weight:** Must ensure the total UAV weight is under 5kg.
- **Dimensions:** Must not exceed 1m x 1m x 0.5m.
- **Durability:** Must withstand impact and harsh environmental conditions.

6.2 Propulsion System

The propulsion system must provide sufficient lift and control for stable flight in a simulated low-gravity environment.

- **Type:** Electric motors with propellers.
- **Power:** Must be compatible with the UAV's power system.
- **Control:** This must allow for precise manoeuvring and stability.

6.3 Power System

The power system should ensure adequate flight time and support all onboard systems.

- **Battery:** Lithium polymer (LiPo) batteries are recommended.
- **Capacity:** Sufficient for at least 30 minutes of flight time.
- **Management:** Include a power management system to monitor and optimize our- age.

6.4 Navigation and Control System

The navigation and control system must enable autonomous operation and precise control in low visibility conditions.

- **Sensors:** GPS, IMU, altimeter, and obstacle detection sensors.
- **Autonomy:** Capable of waypoint navigation and obstacle avoidance in low visibility.
- **Communication:** Reliable RF communication for remote control and data transmission.

6.5 Environmental Sensing System

The UAV must be equipped with sensors capable of detecting wind speed, direction, and dust concentration.

- **Wind Sensors:** Capable of measuring wind speeds up to 30 km/h.
- **Dust Sensors:** Able to detect and measure simulated dust concentrations.
- **Data Processing:** Onboard system for real-time analysis of environmental data.

6.6 Communication System

The communication system must be robust enough to maintain consistent contact with the base station in simulated Martian conditions.

- **Range:** Capable of transmitting data over the entire 100m x 100m arena.
- **Interference Resistance:** Must function in simulated electromagnetic interference conditions.
- **Data Transmission:** Real-time transmission of position, wind data, and dust concentration measurements.

6.7 Data Acquisition and Transmission

The UAV must be able to collect and transmit data back to the base station.

- **Sensors:** Cameras and scientific instruments as required.
- **Storage:** Onboard data storage for flight logs and sensor data.
- **Transmission:** Reliable RF or similar communication system for real-time data transmission.

7 General Guidelines

7.1 Judging and Appeals

- The decision of the judges is final and binding in all matters related to the competition.
- No appeals or disputes will be entertained once a decision is made.

7.2 Professionalism and Conduct

- Teams must demonstrate professionalism and good sportsmanship at all times.
- Any form of misconduct, including cheating or unsportsmanlike behaviour, will result in immediate disqualification.
- Teams are expected to be cooperative with fellow participants, judges, organizers, and the venue staff.

7.3 Submission and Deadlines

- All submissions must be completed by the specified deadlines. Late submissions will not be accepted.
- Ensure that all documents and presentations comply with the format and size requirements stated in the registration guidelines.

7.4 Evaluation Criteria

- Prototypes will be judged on their practical application, functionality, and performance in the field round.
- The ability of the prototype to perform the required tasks effectively will be a key evaluation factor.
- The clarity, coherence, and professionalism of the presentations will be important in the evaluation process.

8 Annexure: General Rules and Regulations

8.1 Organizers' Disclaimer

The organizers reserve the right to make changes to the rules and schedule. All decisions by the organizers are final and binding.

8.2 Changes to the Competition Rules

Any changes to the rules will be communicated to the teams via email and updated on the competition website.

8.3 Deadline Extension

Extensions for deadlines may be granted under special circumstances, and any such extensions will be announced in advance.

8.4 FAQ

Frequently asked questions will be posted on the FAQ section of the competition website. Teams are requested to check the FAQ section before raising any queries.

8.5 Challenge Scoring Issues

All issues related to scoring during the challenge will be resolved solely by the independent jury. Teams cannot appeal to any other party.

8.6 Organizational Issues

Organizational issues, including team eligibility, conduct of the challenge, and execution of jury decisions, will be resolved by the organizers.

8.7 General Challenge Issues

In case of any conflict related to the challenge, the organizers' decision will be considered final and binding.

8.8 Disqualification

The organizers may disqualify a team in the event of a serious breach of the rules, safety regulations, or fair play. The organizers' decision in such cases shall be considered final and binding. Teams cannot appeal to any other party, including social media platforms.

8.9 Cancellation of Event

The organizers reserve the right to cancel the UAV Competition 2024 in the event of circumstances preventing its safe organization. In case of event cancellation, the organizers will decide on an alternative approach and present it to the affected teams.

8.10 Organisers' Responsibility

The organizers' civil liability is limited solely to the responsibility for organizing a mass event by local laws and regulations.

8.11 Copyright of the Challenge

The organizers retain all copyright to the competition rules, logo, tagline, and the de-description of the tasks. No alterations or additions to the competition rules can be made, and their sale is expressly forbidden. The rules can only be used or copied for UAV Competition 2024 connected activities (e.g., registration process).

8.12 Personal Data Storage

- Team members agree to their data, documentation delivered, and other promotional materials and visuals being stored and processed in the organizers' computer systems for the UAV Competition 2024 program.
- The organizers will keep all technical documentation confidential and will not publish or disclose it to any third parties without prior approval from the team's representatives. The sole exception to this is the challenge's jury team – technical documentation will be disclosed to judges for scoring and mentoring purposes only.
- The team members also give the organizers, parties designated by the organizers, and the audience the right to disclose and publish any photos, videos, or other visuals, their names and surnames, identifiable pictures of themselves and any other persons, as well as pictures of machines, devices, and equipment in any available formats, by any and every known method, in any and every known medium.
- Teams grant permission to the organizers to use promotional materials and visuals (e.g., photos and videos), as well as any additional photos, videos, portraits, documents, interviews, and other materials resulting from participation in the challenge

(using the name of the participant or not) on all media, in any language, anywhere in the world, in any manner, for advertising and promotional purposes.

8.13 Miscellaneous

- Individuals or teams may be excluded from participation at the discretion of the organizers for unauthorized behaviour, including but not limited to (i) impersonating an organizer whether intentionally or in a manner that confuses, (ii) misuse of the logos or identifiers of the organizers or any sponsoring organization, or any infringement of a commercial logo or trademark, (iii) failure to abide by
competition rules, directives or instructions from the competition host or organizers, and (iv) asserting or implying an affiliation or sponsorship where none exists.
- The organizers do not host pre-competitions or competitions conducted by any other organization. This competition is neither affiliated with nor sponsors nor endorses any other competition. Outside competitions have no bearing on the qualification or registration process for this competition, and any representation to the contrary is strictly prohibited.
- No competition may imply any affiliation with the organizers or use the organizers' logo without permission. Any assertions made by organizations that represent themselves as "Official Ambassador", "Judge", or any similar titles suggesting a tie to the organizers are unauthorized.
- Representations or suggestions that any organization or individual can assure teams of being accepted for registration or participation in the challenge are unauthorized. All requirements for participation are outlined in this rules book.

9 Contact for Further Queries

If you have any further queries or require clarification regarding the UAV Competition 2024: ANVESHAN, please feel free to reach out to the organizers using the following contact information:

- Email: -cuacindia@gmail.com
- Phone: - 9820023642
- Website: - https://cuac.in/contact-us/

We encourage you to visit the competition website regularly for updates, frequently asked questions, and any additional information regarding the challenge.