

“Smart Aerospace Mastery”

Technical Guidelines for the 11th China Graduate Future Flight Vehicle Innovation Competition

"The China Graduate Future Flight Vehicle Innovation Competition" (hereinafter referred to as the "Competition") is one of the flagship events within the "China Graduate Innovation and Practice Series Competitions". It is under the guidance of the Department of Degree Management and Graduate Education of the Ministry of Education, organized by the Chinese Society of Academic Degrees and Graduate Education (CSADGE), in conjunction with the Children and Youth Science Center of China Association for Science and Technology (CAST), and co-hosted by the Chinese Society of Astronautics (CSA) and the Chinese Society of Aeronautics and Astronautics (CSAA).

Adhering to the philosophy of “Innovation Reshapes the Future”, the Competition focuses on flight vehicle technological innovation, aiming to enhance graduate students' capabilities in scientific research, engineering practice, and interdisciplinary collaboration within the aerospace field.

This edition of the Competition is hosted by the Zhuhai Municipal People's Government, in collaboration with Beijing Institute of Technology, Zhuhai. The organizers are committed to partnering with academic institutions to elevate this competition into a premier national event with significant impact across graduate student communities,

higher education institutions, graduate student communities, aerospace research and industrial sectors and general public engagement. Through sustained collaboration, the organizers aims to achieve global recognition from academia and industry stakeholders worldwide, gradually progressing towards becoming a high-level international event.

Chapter I Competition Overview

1. Competition Structure

The Competition consists of two stages: a preliminary round and a final round. The preliminary round will be conducted online, while the final round will involve live presentations and physical demonstrations.

(Note: The Challenge Track does not have a preliminary round.)

2. Theme and Challenge Topics

(1) Theme

“Smart Aerospace Mastery”

(2) Challenge Topics

1. Regular Track

1.1 Overall and Subsystem Design of Aviation Aircraft

Overall design of various types of aircraft flying in the atmosphere. And the design of new configurations, layouts, materials, structures, payloads, and control subsystems for aviation aircraft.

Registration Link:

<https://cpipc.acge.org.cn/platformEnWebsite/fillRegister/2c90801896f759>

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1.2 Integrated and Subsystem Design of Spacecraft

This encompasses the overall design and mission planning for flights in Earth's atmosphere, Earth orbital space, cis-lunar space, and deep space, as well as the design of subsystems such as new configurations, materials, propulsion systems, and payloads.

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1.3 Key Technologies of Propulsion Systems for Future Flight Vehicle

To meet the demand for new power systems in future flight vehicle (including aircraft, spacecraft, missiles, rockets, etc.), analyze application scenario, develop and verify the key technologies of the overall design, subsystem (such as power, thrusters, etc.), core components (such as cathodes, nozzles, valves, etc.), testing devices, simulation models, and other aspects for various new propulsion systems.

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1.4 Special Topic on New Energy Aircraft Technology

To address the technical requirements of long-endurance,

high-payload, and high-energy-efficiency for aircraft, this research focuses on novel energy applications including solar energy, hydrogen energy, laser power transmission, microwave power transmission, and advanced energy storage batteries. The study encompasses aircraft system design technology, energy/structure integration technology, hybrid energy propulsion technology, and energy management technology. The outcomes should include completed technical solution design demonstrations or prototype designs.

Registration Link:

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1.5 Aerospace Flight Vehicles for Efficient Transportation

Focusing on typical scenarios such as global high-speed reaching and large-scale space entry and exit, the concept and application mode of a new type of aerospace transportation flight vehicle that supports efficient cross domain flight and efficient round-trip into space are proposed. The overall scheme of the flight vehicle system, as well as the demonstration and design of subsystems such as aerodynamics, power, structure and mechanisms, thermal protection, navigation and guidance, and decision control should be accomplished.

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1.6 Special Topic on Air-Water Cross-Medium Vehicles

This topic focuses on the integrated operation scenarios of air and water, and proposes a concept and application mode of an aircraft with the ability to enter and exit water multiple times. The key tasks include the overall design of the aircraft, the layout of air/water dynamics coupling, cross-media power conversion, pressure-resistant and anti-corrosion materials, biomimetic variant mechanisms, cross-media communication and navigation, etc. These technologies aim to meet the requirements of military-civilian integration scenarios such as low-altitude surface inspection and underwater detection and rescue, promoting the innovative development of air-sea collaborative equipment.

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1.7 Deep Space Probe Design

The overall design of the spacecraft for the exploration of the moon, planets, and small bodies, as well as the design of subsystems such as landing and takeoff, surface attachment and locomotion, autonomous perception and mission planning, and payload. Provide the technical scheme or the prototype.

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1.8 Cooperative Technology of Unmanned Aerial Vehicle (UAV) Swarm

For future cooperative operation scenarios of unmanned aerial vehicle (UAV) swarms, satellite constellations, cross-domain/cross-medium swarms, and manned/unmanned swarms, design technical solutions for mission cooperative, intelligent cooperative sensing, cooperative navigation and positioning, cooperative mission decision-making, cooperative mission planning, cooperative guidance and control, as well as swarm health monitoring and effectiveness evaluation.

Registration Link:

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1.9 Microsat Design and Application Technologies

Microsat are widely utilized in fields such as Earth observation, communication, scientific research, and technology validation. In anticipation of future large-scale deployment and on-orbit applications of small satellites, it is essential to design the overall architecture, subsystems, and application scenarios, including on-orbit remote sensing communication, situational awareness, on-orbit services, and data

processing.

Registration Link:

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2. Challenge Track

2.1 Air-Ground Collaborative Intelligent Obstacle Avoidance and Inspection Technology

This track focuses on the development of autonomous control systems for unmanned aerial vehicles (UAVs) and ground vehicles, with applications in autonomous collision avoidance innovation and line inspection (e.g., urban power transmission lines, elevated traffic routes, underground utility tunnels, etc.). The tasks include autonomous UAV takeoff, UAV/ground vehicle autonomous inspection, collaborative path planning and obstacle avoidance, and UAV precision landing to achieve coordinated inspection missions. The competition consists of a single-round final with no preliminary rounds, and interruptions during the event are not permitted.

1) Task Description

During line inspection, the dense arrangement of pipeline equipment and static/dynamic obstacles limits the ground vehicle's perception, making terrestrial obstacle avoidance challenging. UAVs can perform 3D inspections of line faults while collaborating with ground vehicles to

assist in obstacle avoidance. This track simulates urban inspection scenarios where UAVs and ground vehicles work together to inspect lines. Participating teams must use UAVs and ground vehicles to complete the following tasks:

Task 1: Autonomous UAV Takeoff

The ground vehicle carries the UAV to the designated takeoff zone, where the UAV autonomously takes off. The vehicle may remain stationary during takeoff.

Task 2: UAV Inspection and Obstacle Avoidance

The course simulates urban power transmission lines in a loop layout, including line faults (at least 4), aerial obstacles, and ground obstacles (blocking the vehicle's line of sight).

- The UAV uses onboard cameras to locate aerial obstacles, plan flight paths, and avoid collisions.

- It must identify and locate 4 line faults (distinguished by size or color from ground obstacles).

- Adjusting speed and attitude, it collaborates with the ground vehicle to scan and record fault dimensions and colors.

- Provides aerial perception to assist the ground vehicle in path planning and obstacle avoidance.

Task 3: Ground Vehicle Obstacle Avoidance and Inspection

The ground vehicle integrates its own and the UAV's perception data

to plan paths and avoid obstacles. It must also identify line faults and collaborate with the UAV to scan and record fault details.

Task 4: Precision UAV Landing

Upon reaching the landing zone, the UAV must precisely locate and land within a designated QR code area.

2) Competition Process

Preparation Phase (10 min limit):

- Teams upload programs to UAV/vehicle systems and conduct debugging.

- One team member presents a 5-minute briefing on vehicle configuration.

- After takeoff approval, judges issue the start command to begin timed tasks.

Task Phase (15 min limit):

- The ground vehicle carries the UAV to the takeoff zone for Task 1, then proceeds to the inspection zone for Tasks 2–3, and finally to the landing zone for Task 4.

- Teams may attempt a second run immediately after the first, but exceeding 15 min voids the second attempt. Scores are averaged.

- Real-time transmission of fault identification data is required for judge verification during Tasks 2–3.

3) Competition Scenario

The indoor venue ($30\text{m} \times 5\text{m} \times 8\text{m}$) has three zones (all enclosed by safety nets):

- Takeoff Zone (Orange): Obstacle-free.
- Inspection Zone (Gray): Contains aerial/ground obstacles and line faults.
- Landing Zone (Blue): Features a QR code ($50\text{cm} \times 50\text{cm}$) at center for UAV landing.

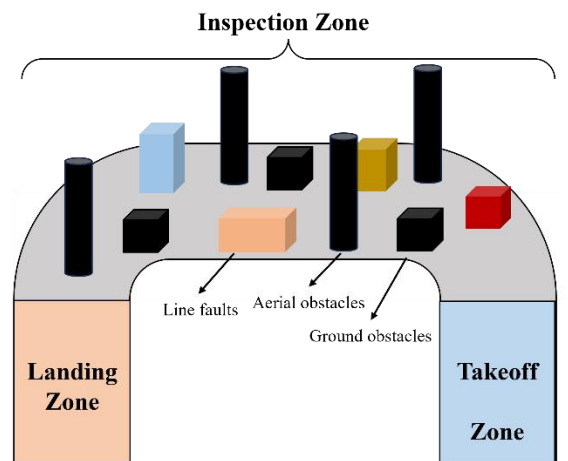


Figure 1: Competition Layout

4) Line Fault Specifications

a. Rules:

- 10 pre-set faults are available; 4 are randomly selected per round.
- UAV and vehicle must collaboratively identify fault colors/sizes and return text/image data.

b. Identification Requirements:

- Text Data: Dimensions ($L \times W \times H$) and color of each fault.
- Image Data: 3D images with annotated fault bounding boxes and

metadata.

c. Notes:

- Faults are placed randomly; manual input/preset data is prohibited.
- Judges may replace faults to ensure fairness.

5) QR Code Specifications (Landing Zone):

- Type: 4×4_250 ArUco code (ID undisclosed).
- Quantity/Size: One 50cm × 50cm code at zone center.

6) Technical Requirements

a. Equipment:

- Teams provide their own UAV (max 7kg takeoff weight) and ground vehicle (max 1.5m length, 100kg weight).

- Tiebreakers: Compliance, innovation, and reliability of hardware/software solutions.

b. Task 1: UAV must take off before the "latest takeoff line" and reach ≥ 2 m height by that line.

c. Task 4: UAV must land within the QR code area.

7) Scoring Criteria

Component

Points

Takeoff (S_a)

10: Success; 0: Failure (must reach height by deadline).

Fault ID ($n_1 \times 10$)

10 per fault (max 40; text + image required).

Collision Penalty ($n_2 \times -20$)

-20 per collision (UAV/vehicle).

Landing (S_d)

10: Center within 1/8 QR width;

5: 1/8–1/4;

2: 1/4–1/2;

0: Outside.

Efficiency $\frac{T_1 - T}{T_1} * 40$

40 * (Cumulative time of all teams – Current team's elapsed time)/

Cumulative time of all teams.

Exceeding 15 min = 0.

Presentation (S_f)

Total S_c 0–10 (5 min max).

ore Formula:

$$S = S_a + S_d + S_f + (n_1 \times 10 - n_2 \times 20) + \frac{T_1 - T}{T_1} * 40$$

8) Disqualification Rules

- Violating technical requirements.
- UAV exiting competition area.
- Exceeding time limits.
- Landing outside the designated zone.

Final interpretation and rule modifications reside with the organizing

committee.

9) Personnel

- Chief Judge (1), Photographers (1–2), Assistant Judges (2), Secretary (1). Full event recording required.

10) Awards

- 1st Prize: Top 10%.
- 2nd Prize: 20%–30%.
- 3rd Prize: 30%–60%.

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2.2 Dynamic Programming and Decision-Making for Multi-Target Visit in Low Earth Orbit (LEO) Region

1) Mission Description

The technology for multi-target visit in LEO region is a key capability for on-orbit services, environmental remediation, debris removal, and situational awareness missions. Spacecraft platforms based on electric propulsion are an important means to achieve low-cost and high-efficiency multi-target visits. As the demand for autonomous space operations increases, the ability to perform efficient dynamic planning within a short time frame becomes a critical metric for evaluating planning algorithms. Against this backdrop, a challenge competition titled

“Dynamic Programming and Decision-Making for Multi-Target Visit in Low Earth Orbit Region” is organized. Participating teams are required, on the provided computing platform, to generate multi-target visit strategies within a given timeframe, based on randomly generated initial conditions of the spacecraft platform, control parameters, space target database and initial states, using their own designed dynamic programming and decision algorithms, followed by feasibility verification.

2) Competition Rules

① The simulation environment includes:

Dynamics environment: Orbital mechanics considering J_2 perturbation;

Initial state of the spacecraft platform: Orbital elements, mass;

Control parameters of the spacecraft platform: Thrust magnitude, specific impulse, fuel mass;

Space target database and initial states: Number of targets, orbital elements of each target;

Maximum mission duration.

These parameters will be randomly generated within predefined ranges (exact bounds to be announced later). All participating teams will conduct the competition in this randomly generated simulation environment.

② Both sides aim to maximize the number of targets accessed successfully, with the key evaluation metric being the number of accessed targets, denoted as n .

③ When the planning time reaches 15 minutes, the round ends. The organizers will verify the solutions submitted by both sides and announce the winner accordingly.

3) Competition Format

This competition does not have a preliminary round and takes place during the final. It employs a single-round format, meaning each pair of teams will compete once, and each match consists of three games against each other.

4) Win-Loss Determination and Scoring Criteria

① At the end of each game, if either side has not submitted a verifiable solution or the submitted solution fails verification, that side loses; if neither submits a solution or both solutions fail verification, it is a draw. If both sides submit solutions that pass verification, the outcome is determined by the number of targets accessed: the higher number wins; if both access the same number of targets, it is a draw.

② The total score for each game is the sum of the feasible solution score and the win-loss score.

Total game score = Feasible solution score + Win-loss score

Feasible solution score: +2 points for passing the solution

verification

Win-loss score: +5 points for winning, +1 point for a draw, +0 points for losing under any condition

5) Competition Process

① Each team enters with their own designed dynamic programming and decision-making algorithms.

② Both sides start deploying and debugging their algorithms simultaneously. Debugging time is limited to 10 minutes. If not successfully debugged within this period, the team that fails may request to pause and receive an additional 3 minutes of debugging time. If still unsuccessful, this match's total score will be 0.

③ After successful debugging and with referee approval, the competition begins.

④ The competition ends when either 15 minutes have elapsed or both sides have submitted solutions for verification.

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<https://cpipc.acge.org.cn/platformEnWebsite/fillRegister/2c90801896f7594701973e0ba1047b4b>

2.3 Unmanned Fighter Aircraft Virtual Combat

2.3.1 Mission Overview

A 2v2 air combat simulation in a virtual environment will be conducted for key airspace defense and attack. The competition uses a

specific type of unmanned fighter jet as the platform, equipped with airborne radar, short-range air-to-air missiles, and a virtual cannon. Each team will load their intelligent algorithm into a self-provided embedded computing device (connected via USB to a simulation server). The algorithm controls one aircraft by receiving server-provided information and sending commands for aircraft maneuvers, radar operation, and weapon usage. This semi-physical simulation aims to guide future real-flight tests of intelligent computing devices.

2.3.2 Technical Highlights

Autonomous situational prediction and analysis;

Collaborative decision-making for air combat strategies;

Robust autonomous flight maneuver decisions;

Weapon deployment decisions for fighter jets;

Obstacle avoidance and mission planning.

2.3.3 Competition Rules

2.3.3.1 Technical Requirements

Hardware: Embedded computing devices (e.g., NVIDIA TX-2, NX, or similar). Teams must provide their own devices.

Simulation system and interface format: Simulation software runs on a PC connected to the computing device via USB. Teams must test performance impacts due to USB latency. Simulation software and interface specifications will be released after registration.

control method: Fully autonomous combat.

2.3.3.2 Environment and Rules

This subject does not set flight airspace boundaries. Competing teams must shoot down the opponent or force them out of the central cylindrical airspace. The altitude range of the key airspace is 0 km to 20 km above sea level, with its center located at the midpoint of the field. No battlefield terrain is set on the ground, and aircraft flying below 0 km altitude will be considered as crashed into the ground/sea. The competing teams will draw lots to determine the Red and Blue teams. The initial positions of each side's two-aircraft formation are randomly generated within the starting airspace as shown in Figure 1. The Blue team's initial airspace is 80 km due north of the key airspace, with the two aircraft symmetrically positioned relative to the key airspace and spaced 10 km apart horizontally. The Red team's initial airspace is 80 km due south of the key airspace, with the two aircraft symmetrically positioned relative to the key airspace and spaced 10 km apart horizontally. Both teams start at an altitude of 10 km, with an initial speed of Mach 0.8 and an initial fuel load of 80%. The initial heading of both teams is directed toward the center of the key airspace.

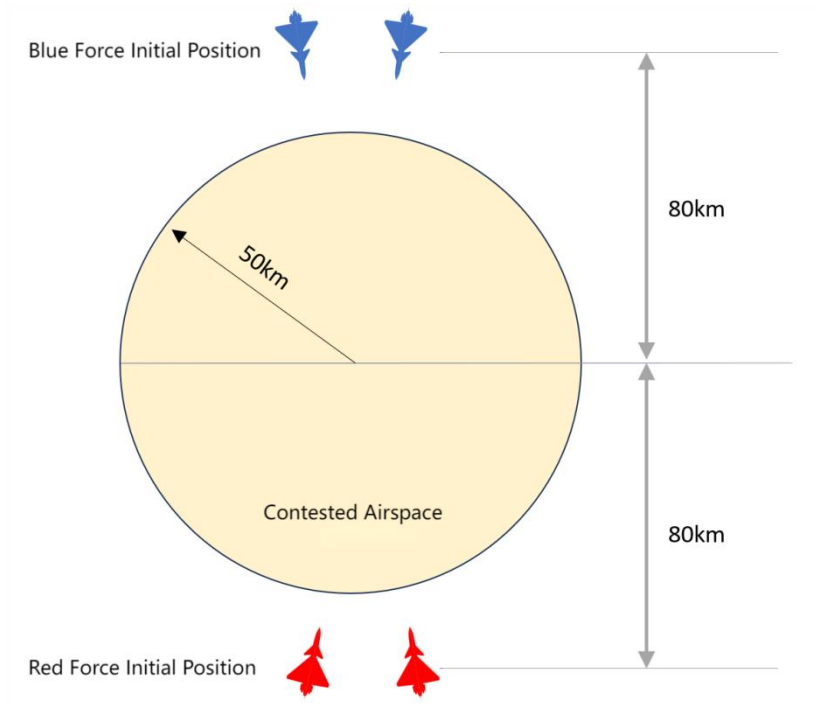


Figure 1: Virtual Air Combat Zone Schematic

Both teams must shoot down all enemy combat drones or force them out of the designated airspace to establish air superiority.

A round ends when any of the following conditions is met:

All aircraft of either side have exited the match, with no air-to-air missiles in flight;

Either side achieves air dominance for 60 consecutive seconds;

The simulation time reaches 10 minutes.

Aircraft Elimination Criteria : being shot down by cannon/missile fire, descending below sea level, experiencing stall conditions for over 10 seconds, or colliding with another aircraft.

Air Dominance Time Calculation:

Taking the Red side as an example, the Red side's air dominance

time begins accumulating if and only if the key airspace contains only Red side UAVs. If Blue side aircraft re-enter the key airspace, the accumulation of Red side's air dominance time is suspended. If there are no Red side aircraft in the key airspace, the accumulated air dominance time of the Red side is reset to zero. The calculation method for the Blue side's air dominance time follows the same principle.

The occupation timing of the key airspace is independent of the number of aircraft.

The accumulation precision is 1 second, with fractions rounded down to 0. For example, if the Red side arrives at the key airspace 0.9 seconds before the Blue side, both sides' air dominance time remains 0. When accumulation resumes after enemy aircraft enter and are subsequently expelled or destroyed, any previously accumulated fraction of a second is reset to 0. For instance, if the Red side's accumulation was paused at 10.9 seconds, after expelling or destroying Blue aircraft, the air dominance time resumes counting from 10 seconds.

2.3.3.3 Scoring and Victory Criteria

At the end of the simulation, if all aircraft of one side have exited the match, the opposing side wins.

If one side achieves 60 seconds of air dominance time, that side wins. For example, if the Red side reaches 60 seconds of air dominance time—even with only 1 aircraft remaining while the Blue side has 2—the

Red side still wins. In this case, the Blue side's 2 aircraft must have been outside the key airspace for over 60 seconds, suggesting passive avoidance.

If neither side reaches 60 seconds of air dominance time by the end of the simulation, and both sides have the same number of remaining aircraft (e.g., 2 vs. 2 or 1 vs. 1), the side with longer accumulated air dominance time wins.

If both sides have equal remaining aircraft, air dominance time, and health at the end of the simulation, the side with more remaining missiles wins.

Draw: If both sides have identical remaining aircraft, air dominance time, health, and missile count at the end, the match is declared a draw.

Scoring combines elimination points and outcome points, summed for the total round score:

Total score = Elimination points + Outcome points;

Elimination points: +2 per enemy aircraft destroyed. If a friendly aircraft is shot down, the opponent gains +2. No points are awarded for non-destruction losses (e.g., stalls/crashes);

Outcome points: +5 for winning, +1 for a draw, +0 for losing.

Examples, Winning by destroying 2 enemy aircraft: 2 (first kill) + 2 (second kill) + 5 (win) = 9 points (maximum per round). If Blue destroys 1 Red aircraft but Red achieves 30 seconds of air dominance: Red (5

points), Blue (2 points). Mutual destruction (1 kill each) ending in a draw:
Both sides score 2 (kill) + 1 (draw) = 3 points.

2.3.3.4 Competition Format

The first round is a group stage. Teams will be divided into groups based on the total number of participating teams, with no more than 8 teams per group;

In the group stage, each group follows a single round-robin format, where every pair of teams competes exactly once. Each match consists of 6 rounds. The initial Red/Blue roles are determined by draw, with roles alternating each subsequent round;

After the group stage, teams in each group are ranked based on their total match points. The top teams from each group advance to the finals (the exact number depends on the group count, with no more than 5 teams qualifying). If teams are tied in points, both advance. If tied teams meet again in the finals, they share the same rank;

The finals also adopt a single round-robin format, with each match consisting of 10 rounds. Ranking rules remain the same as the group stage;

The top two teams will play a 4-round exhibition match, which does not affect final standings.

2.3.3.5 Competition Process

Each team brings two intelligent computing devices. The initial

Red/Blue roles for the first round are determined by draw, with devices connected to the server. Roles alternate in subsequent rounds.

Teams simultaneously begin device debugging (15-minute limit). Unprepared teams may request one 3-minute extension. Failure to pass debugging results in a match score of 0.

Upon successful debugging and referee approval, the match begins.

Before each round (including the first), teams may request one 3-minute pause for adjustments.

2.3.3.6 Simulation Model Specifications

Aircraft Dynamics: Two UCAV models (Type I & II) with jet propulsion.

The two UCAV models exhibit distinct yet comparable flight dynamics, both approximating typical third-generation manned fighter characteristics. Prior to the competition, the Type I UCAV model and training environment will be released for practice. The official competition will exclusively employ the Type II UCAV model. The Type II model specifications will be published one day before the official matches, allowing teams to familiarize themselves with its performance parameters. Each team is permitted five test sorties using the Type II UCAV in the competition system for debugging and training purposes before the official matches commence.

The intelligent algorithm can control the aircraft in two distinct

modes: stick-and-rudder mode (longitudinal/lateral stick, rudder, and throttle) and coordinated turn mode (normal load factor, roll rate, and throttle). The aircraft will respond within its dynamic performance limits. Additionally, the algorithm can independently operate the aircraft's sensor modes, target locking, and weapon firing. The aircraft starts with 80% internal fuel capacity and can continue gliding without power after fuel depletion until crash.

Situational Awareness and Onboard Sensors

Each aircraft in this competition is equipped with an onboard radar (simplified digital simulation model) for target information acquisition, including: Identification Friend or Foe (IFF) data, hostile aircraft bearing/range/velocity, and friendly aircraft bearing/range/velocity. The radar enables hostile target locking and short-range air-to-air missile launches, with a data refresh rate of 20Hz.

When the distance between the aircraft and a target (hostile or friendly) is less than 5km, the aircraft can obtain target information (IFF data, hostile aircraft bearing/range, friendly aircraft bearing/range). This capability is not subject to off-boresight angle limitations, with a data refresh rate of 20Hz.

In addition to onboard radar and visual-range situational awareness, both teams receive AWACS support providing IFF data, enemy position, and friendly position information without range limitations, with a data

refresh rate of 0.2Hz.

When the onboard radar detects multiple hostile targets simultaneously, the intelligent algorithm may select one target for locking. While one target is locked, motion data of other detected targets remains available.

The onboard radar cannot lock onto friendly aircraft, but can detect and provide bearing, range, and velocity information of allied aircraft.

Each aircraft model is equipped with basic radar warning and missile approach alert systems. When the aircraft is either radar-locked by another aircraft or under attack by short-range air-to-air missiles, the competition system will send alert type and directional information (azimuth and elevation angles) to the intelligent algorithm, without providing range data.

Airborne Weapon 1: Air-to-Air Missiles

The competition employs standard medium-range and short-range air-to-air missiles with simplified seeker models. Medium-range missiles have a maximum range of approximately 150km, while short-range missiles have a maximum range of about 20km. Actual engagement range varies based on launch speed/altitude, target speed/altitude/approach angle, and target maneuvers. Each aircraft carries 4 medium-range and 2 short-range air-to-air missiles.

Missiles require radar target lock for launch authorization.

Medium-range missiles receive command guidance post-launch until seeker acquisition, then transition to autonomous guidance. Short-range missiles must achieve seeker lock before launch ("lock-before-launch"). Both types operate on fire-and-forget principles after launch.

During flight, missile seekers continuously scan their field of view without IFF capability or ranging functionality. If angular separation between aircraft is less than 1° , the seeker may lock the closer target, potentially causing friendly fire.

Minimum launch ranges: 500m for medium-range missiles, 300m for short-range missiles. Launch is prohibited when target distance is below these thresholds.

Target destruction is confirmed when missile-to-target distance is less than 10m. Missiles deactivate when velocity drops below Mach 0.8.

Airborne Weapon 2: Virtual Cannon

Attack Capability Settings: A 2° light cone in the nose direction, with the axis aligned along the longitudinal axis of the aircraft. Maximum range is 1000m, and minimum firing distance is 100m. Virtual cannon ammunition is calculated based on firing time, with each aircraft's cannon ammunition lasting 20 seconds.

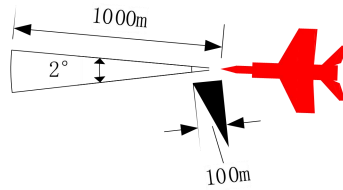


Figure 2 Virtual Cannon Engagement Zone

Attackable target engagement angle: omnidirectional;

Firing is impossible when the virtual cannon's light cone does not illuminate the target or when the enemy distance is less than the minimum firing range;

When an aircraft's light cone illuminates a target and fires, the target's health depletion is inversely proportional to the relative distance. The health depletion per simulation step is as shown in Formula (1), where dt is the simulation step length. Each aircraft's initial health is 3, and the target is considered shot down once its health is depleted.

$$h_t = 2 \times \frac{1000 - dist}{900} dt \quad (1)$$

When multiple aircraft attack the same target simultaneously, their health depletion rates stack.

If multiple targets are within an aircraft's light cone, ammunition is automatically directed at the nearest target. The system does not support multi-target engagement. Friendly fire may occur.

The simulation system includes a basic communication model, allowing allied aircraft to exchange data via datalink under

low-bandwidth, high-latency conditions (0.1 kb/s, 500ms delay).

2.3.4 Competition Mechanism

This track operates without preliminary rounds and runs concurrently with the final rounds. The competition adopts a single round-robin system, wherein every participating team competes against each other exactly once. Rankings are determined by overall win rate. In cases of identical win rates, the ranking is decided based on head-to-head results.

Registration Link:

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3. Cross-disciplinary Track

3.1 Exploration of Emerging Low-Altitude Economy Models

1) Task Description

This track focuses on the innovative design of low-altitude aircraft and the exploration of practical and groundbreaking functions for low-altitude flight operations across various scenarios, such as transportation and logistics, tourism and cultural experiences, and emergency response. Participants are encouraged to develop novel business models—such as shared aerial mobility platforms, integrated three-dimensional transportation systems, and aerial logistics networks—to promote the low-altitude economy as a new engine for high-quality

development. The track consists of two sub-directions:

Low-Altitude Transportation: Centered around low-altitude airspace, this direction leverages a variety of manned and unmanned aerial vehicles (UAVs) to propose innovative and high value-added transportation models. These may include, but are not limited to, Urban Air Mobility (UAM), regional air transport, integrated multi-modal transportation systems, low-altitude cargo delivery, and aerial tourism. This direction focuses on the innovation of transportation modes, the effectiveness in addressing traditional transportation safety and efficiency issues, and the impact on promoting industrial chain development and economic growth.

Applied Economics: This direction focuses on novel mechanisms for value realization in the low-altitude economy, such as securitization of airspace usage rights, flight data ownership and trading, and carbon credit derivatives. It encourages the development of blockchain-based distributed clearing systems, risk hedging tools, and inclusive financing solutions, while constructing a full-cycle financial support system spanning aircraft development, operation, and recycling. This direction emphasizes the following: (1) Thematic Relevance: Research problems should be clearly defined, such as focusing on the intelligent evolution of drone logistics industry clusters or pricing models for low-altitude economic data assets, avoiding overly broad discussions. The study must cover the intelligent evolution of low-altitude economic industry clusters,

including technological, policy, and market dimensions, while addressing innovations or restructuring of financial infrastructure, such as payment and settlement systems, insurance, and supply chain finance. Additionally, the work should analyze the interplay between industrial evolution and financial needs, such as how financial tools support industry development or how industrial changes create new financial demands, supported by specific cases or data. (2) Innovation: Innovation is evaluated across three levels: theoretical, technical, and model-based. For theoretical innovation, the work should propose new models or frameworks, such as complex network evolution models for low-altitude economic industry clusters or financialized pricing algorithms for airspace resources. For technical innovation, cutting-edge technologies like blockchain, AI, or digital twins should be applied to solve practical problems, with demonstrated technical feasibility. Model innovation focuses on novel business designs or financial instruments, such as drone logistics accounts receivable securitization or low-altitude carbon trading derivatives. Innovation is graded as follows: breakthrough innovations address industry gaps; incremental innovations optimize existing solutions with efficiency improvements of over 30%; conventional solutions with minimal innovation score lower. (3) Methodological and Logical Rigor: Research methods must be scientifically robust with sufficient data support. Data sources should be credible, such as enterprise cases, government reports,

or simulation data, with clear indications of data volume and acquisition methods. Analytical tools should employ quantitative methods, such as system dynamics modeling, econometric analysis, or Monte Carlo simulations. Logical rigor requires a complete argumentative chain from problem definition to analysis, solutions, and validation, avoiding logical gaps. The work should reflect interdisciplinary integration, combining approaches from economics, finance, and engineering.

(4) Practical Value and Feasibility: The potential for real-world implementation is a key evaluation criterion. Industrial applicability must align with actual demands, such as evidence of collaboration intentions or pilot plans with local governments or enterprises. Economic feasibility should be demonstrated through cost-benefit analysis, such as a return on investment (ROI) exceeding 15% or operational cost reductions of over 20%. Policy compliance must adhere to current regulations, such as those from the Civil Aviation Administration of China (CAAC) or FAA. Scalability evaluates whether the solution can be replicated in other regions or scenarios, such as expanding from drone logistics to urban air mobility.

(5) Presentation and Collaboration: The quality of presentation and team execution are equally important. Reports or pitches must be logically clear, with professional visuals, such as dynamic visualizations or comparative case tables. During Q&A, teams must respond accurately to judges' questions, demonstrating deep project understanding. For team

collaboration, members should come from diverse disciplines (e.g., economics, engineering, finance) with clearly defined roles.

Design Direction: Innovate around low-altitude economy and aviation themes, proposing new practical functions, enhancing flight experiences, and shaping innovative lifestyles. Develop related aircraft and business models, presented through product design schemes and corresponding business strategies. Evaluation criteria include (1) **Innovativeness:** The design solution examines whether it creates new and valuable functions, enjoyment, experiences, or lifestyles. (2) **Feasibility of the business model:** The business model is comprehensively and thoroughly constructed, ensuring that all stakeholders receive corresponding value. The model demonstrates a relatively strong feasibility for generating profit. (3) **Cultural and Social Worth:** The design possesses positive and meaningful cultural and social value. (4) **Aesthetic value:** The design solution demonstrates a high level of aesthetic value.

This track encourages interdisciplinary teams from fields such as Transportation Information Engineering & Control, Applied Economics, Aerospace Science & Technology, Design, and Law. The goal is to collaboratively advance greater breakthroughs in technological innovation, application expansion, and industrial development for future aircraft.

2) Competition Rules

Entries cover multiple themes such as (but not limited to): integrating design with flight performance, economic applications of low-altitude flight, and new low-altitude transportation models. Submissions can be concept designs or physical prototypes.

3) Evaluation Criteria

Innovation

Functional Breakthrough: Creates entirely new application scenarios.

Revolutionary Experience: Human-machine interaction design enables unique flight experiences.

Model Disruption: Reconstructs industry value chains.

Technical Integration: Level of cross-disciplinary innovation.

Business Model

Value Network Integrity: Includes fair profit-sharing mechanisms for all stakeholders (airspace management, infrastructure providers, operators).

Robust Profit Model: Cost-benefit analysis accounts for hidden costs (e.g., airworthiness certification, insurance).

Scenario Scalability: Base platform supports functional expansion.

Risk Controllability: Plans address policy/regulation changes and airspace conflicts.

Cultural & Social Value

Social Equity: Ensures flight rights for diverse groups.

Cultural Integration: Design language reflects regional characteristics.

Eco-Friendliness: Meets environmental standards (e.g., noise reduction, energy recycling).

Ethical Foresight: Addresses privacy protection and AI ethics.

Aesthetic Value

Form Expression: Design language aligns with functional purpose.

Material Expression: Visual impact of surface treatments on new composite materials.

Registration Link:

<https://cpipc.acge.org.cn/platformEnWebsite/fillRegister/2c90801896f7594701973e1b91477bc9>

4. Corporate Track

4.1 eVTOL Power System Configuration Design

The research includes, but is not limited to, the following three directions:

1) Pure Electric eVTOL Configuration: Under fixed payload conditions, study different aircraft configurations (such as multirotor, ducted fan, compound wing) to minimize battery capacity and maximize range.

2) Hybrid Power Architecture for eVTOL: Study hybrid power

schemes, including power configurations (range extender, parallel hybrid, battery-engine configuration, fuel type) and aircraft configurations, to propose efficient power systems for long-endurance eVTOLs.

3) Motor Drive System Structure for eVTOL: Focus on multirotor or ducted electric drive systems, and study motor, controller, structure, and process under air or liquid cooling conditions, aiming for the highest torque-to-weight ratio and system efficiency.

Registration Link:

<https://cpipc.acge.org.cn/platformEnWebsite/fillRegister/2c90801896f7594701973e1c49117bd5>

(3) Competition Schedule

- 31 May 2025: Official competition announcement released.
- 31 May - 31 August 2025: Online registration.

The registration for competing teams will close on August 31 at 10:00 PM (Beijing Time). The registration link can be found in the introduction section for each challenge topic.

- 31 May - 1 September 2025: Eligibility review & preliminary submission.

The submission deadline for preliminary round entries is September 1 at 10:00 PM (Beijing Time). The submission link will be sent via email to the address you provided during system registration. For any questions, please contact the contest organizer at grd@bitzh.edu.cn.

- 2 - 19 September 2025: Remote evaluation of entries by expert panels.
- 26 September - 9 October 2025: Finalist shortlist published.
- Early November 2025: On-site finals at Beijing Institute of Technology, Zhuhai.

4. Submission Requirements

Entries are categorized as creative or physical.

All registered teams shall electronically submit the project report through the designated competition portal no later than 10:00 PM (Beijing Time), September 1, 2025. The report shall include:

- Innovation differentiation matrix;
- Comparative technological advantage analysis;
- Technical implementation blueprint.

The project report serves as the definitive evaluation material for the competition. Supplementary materials—including design specifications, digital models, animations, videos, and research documentation, etc.—may be submitted alongside the project report. For entries containing physical prototypes:

- Preliminary Stage: Video documentation is required.
- Final Stage: On-site physical demonstration or video presentation (where applicable) is mandatory.

The competition prohibits submissions containing classified

materials or works embroiled in intellectual property disputes. Participants shall bear full legal liability for any violations thereof. Previously awarded entries from past competitions, if lacking substantial innovation, will be deemed substantially similar derivatives. Such works, upon expert validation, shall be disqualified from award eligibility.

5. Partners & Organizers

- Media & Academic Support: *People's Daily*, CCTV, *Academic Degrees & Graduate Education*, and *China Graduate*, etc.
- Host Organizations: Zhuhai Municipal People's Government & Beijing Institute of Technology, Zhuhai Campus

Chapter II Participation Guidelines

1. Participation Eligibility

1.1 Current postgraduate students and undergraduates admitted to postgraduate programs in higher education institutions or research institutes in China (including the Chinese mainland, Hong Kong, Macao, and Taiwan);

1.2 International postgraduate students enrolled in overseas universities, and international postgraduate students enrolled in Chinese universities;

1.3 Incumbents at higher education institutions or research units within one year after postgraduate graduation;

1.4 For the Enterprise Track, eligibility extends to incumbents within five years after postgraduate graduation.

2. Participation Guidance

Teams are encouraged to compete in a team format. Each team may consist of up to 5 members, with cross-institutional collaboration permitted. Sino-foreign student teams are strongly encouraged. This edition features an Interdisciplinary Track, promoting participation from multi-disciplinary teams (interdisciplinary teams may include up to 8 members). All teams must register, submit entries according to competition requirements, and undergo eligibility verification by the team leader's institution.

All teams must complete online registration by 31 August 2025, and pass eligibility verification by 1 September 2025. Domestic teams shall register, submit entries, and complete institutional verification exclusively through the Official Platform (<https://cpipc.acge.org.cn/>). International participants must contact the organizing committee via email (grd@bitzh.edu.cn) for registration procedures.

Chapter III Award Architecture

This edition of the Competition will recognize outstanding entries with the following awards: First Prize (with the top 3 winners receiving the Champion, First Runner-up, and Second Runner-up awards respectively), Second Prize, and Third Prize for the participating entries. Additionally, an "Outstanding Organizing Unit" award will be selected and presented to eligible organizing entities.

1. Prizes:

- Champion: CNY 50,000 per entry
- 1st Runner-up: CNY 40,000 per entry
- 2nd Runner-up: CNY 30,000 per entry
- First Prize: CNY 10,000 per entry (excluding the top three ranked entries)
- Second Prize: CNY 3,000 per entry
- Third Prize: Honorary certificate (no monetary reward).

2. Award Quantities:

The exact number of awards in each category will be dynamically determined based on the total number of qualified submissions received, ensuring proportional representation of excellence.

Chapter IV Appeal Arbitration and Disciplinary Sanctions

All participating training institutions shall conduct rigorous eligibility verification of contestants through cross-departmental credential audits. Non-compliance with qualification standards will result in:

1. Disqualification of the submitted work from competition eligibility;
2. Revocation of the training institution's excellence award qualifications;
3. Termination of the host unit's future bidding rights for event

organization.

A detailed violation report will be escalated to all members of the Organizing Committee.

Contestants are expressly prohibited from engaging in the unlawful acquisition of third-party technical data, intellectual design concepts, or the submission of previously awarded competition entries. Violations of these provisions will result in the immediate disqualification of the contestant, formal notification to their affiliated training institution, and the imposition of disciplinary measures by said institution in accordance with established ethical guidelines.

All functional entities, including the Competition Secretariat, Expert Committee, and Judging Panel, shall strictly enforce competition regulations with transparency, impartiality, and equity. Any instances of professional misconduct, including dereliction of duty or collusion, will necessitate the disqualification of implicated entries, termination of responsible personnel from their roles, and a comprehensive reporting of such breaches to all constituent units of the Organizing Committee.

Chapter V Intellectual Property and Confidentiality

Entries must exhibit originality and be devoid of intellectual property disputes. Contestants shall assume full legal liability for any infringement arising from intellectual property claims.

The intellectual property protection of all entries depends on their

project origins or related agreements. Contestants may independently pursue national intellectual property protection for their works; the Organizing Committee shall not participate in such proceedings.

No entry may contain classified information, or such content must undergo formal declassification. Contestants bear sole responsibility for unauthorized disclosure resulting from their submissions.

Chapter VI Competition Schedule

1. Domestic Track

NO.	Time	Event
1	31 May 2025	Release of Competition Announcement; Launch of Promotion Campaign
2	31 May - 31 August 2025	Online Registration, Eligibility Review, and Preliminary Submission
3	31 May - 1 September 2025	Preliminary Evaluation of Entries
4	2 - 19 September 2025	Announcement of Finalists
5	Early November 2025 (ZhuHai)	National Finals and Award Ceremony

Chapter VII Contact Us

1. Official Website: <https://cpipc.acge.org.cn/cw/hp/3>
2. Contact Email: grd@bitzh.edu.cn

3. WeChat Official Account QR Code:



Graduate Education at BIT, Zhuhai



WeChat Official Account

4. Staff and Contact Information for the 11th Competition:

Organizing Committee Contacts:

XIAO Wenying: +86-10-68914502 (Overall Coordination)

WANG Ru: +86-756-3622786 (Competition Organization)

HE Hongwen: +86-10-68915135 (Expert Evaluation)

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Challenge Topics 2.2-2.3, 3.1, 4.1)

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Challenge Topic 2.1)

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International Participants)

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of Northwestern Polytechnical University)

The final interpretation authority of the Competition resides with the
China Graduate Future Flight Vehicle Innovation Competition
Organizing Committee.

The Organizing Committee of
China Graduate Future Flight Vehicle Innovation Competition



June 12, 2025