



FIRA Air – Autonomous Race Simulation Simulation Competition Rules (U14 & U19)

Version 1.0 — Competition Rules (U14 & U19) | 2026



Figure 1: Illustrative simulation race environment (not an actual simulator screenshot).

Abstract

The FIRA Air – Autonomous Race Simulation competition is held in U14 and U19 categories. Each team programs a virtual DJI Tello to autonomously navigate an indoor three-dimensional racecourse, pass the required gates in order without collision, and land on the designated pad. The simulation reproduces the official virtual aircraft's flight behavior and DJI Tello-compatible control interface. Manually piloted flights are not permitted in the main competition.

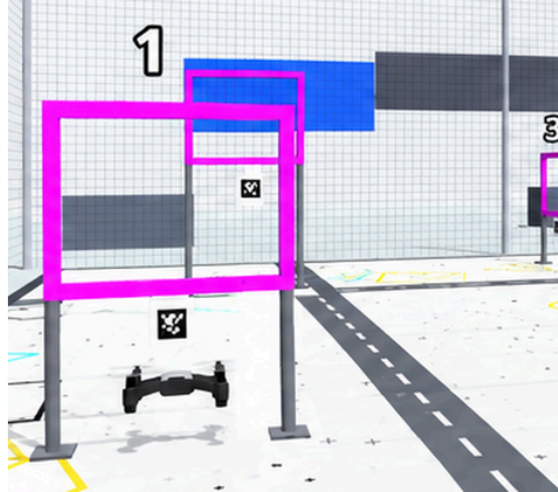


Illustration: Virtual DJI Tello used in the simulated race.

FIRA Air – Autonomous Race Simulation

The competition evaluates autonomous navigation, accurate gate traversal, and reliable landing in a simulated three-dimensional course using an identical virtual DJI Tello for every team.

The U19 race format follows the FIRA Air – Autonomous Race (U19) rules dated 5 December 2025, adapted only where physical provisions do not apply to simulation. Only autonomous control is permitted in the main race. AprilTag markers are preinstalled and fixed in the official course; teams may use the camera to detect them but may not select, upload, move, replace, or modify any marker.

Rules of the Game

Teams must develop autonomous navigation software for an indoor racecourse using permitted drone observations, such as the camera and flight-state data. External GPS/GNSS and direct access to hidden simulation state are not permitted.

Only the official virtual DJI Tello provided for the competition may be used. Physical restrictions on aircraft weight, size, and power source are not relevant to this virtual event. The following requirements apply to every team:

- The same official virtual DJI Tello model must be used by every team.
- The aircraft's size, mass, motors, flight dynamics, and collision model shall not be modified.
- Control is permitted only through the simulator's official DJI Tello-compatible interface. Direct modification of virtual coordinates or physical state is forbidden.

All teams in the same category and stage shall receive identical aircraft capabilities and environmental conditions.

The published general regulations for the event govern matters such as eligibility, conduct, referee authority, and appeals. The simulation-specific provisions in this document govern the

virtual race where physical procedures are inapplicable.

[FA-1]: Game Structure

Each virtual drone must take off from the assigned start pad, traverse the required gates in their prescribed order without collision, and land on the designated “H” pad. The course may include one or more scoring zones set by the Technical Committee. Each team has a continuous 15-minute official race session and may make unlimited attempts within that period. Every unsuccessful attempt incurs a one-point penalty. When a team does not complete the entire course, its highest valid zone determines its base score. In U14, two teams may undertake these sessions concurrently on identical, separate lanes according to [FA-7].

A trial is unsuccessful if the drone collides with a gate or obstacle, skips a required gate or crosses it out of sequence, leaves the permitted flight area, crashes, lands outside the designated pad, or is stopped before completing the mission. Any unfinished official trial at the end of the 15-minute session is unsuccessful. The scoring system records at most one failure penalty per unsuccessful trial.

The 15-minute competition timer starts when the referee activates the team's official session. Teams may prepare their programs, calibrate camera or sensor inputs, and run permitted tests during this period. A Safe Zone is defined around the takeoff point. Undeclared practice flights are permitted only within this zone and do not count as scored trials; crossing its vertical boundary must be recorded as an official trial. The competition timer does not pause for preparation, resets, or retries.

An official trial begins when the team uses the simulator's designated Start Attempt procedure after declaring its intent, or when an undeclared test flight crosses the Safe Zone boundary. Each official trial ends upon successful completion or a recorded failure. The official scoring system must record the result, time, and applicable penalty. A new trial may be started only after the previous one has ended and the aircraft has been returned to the prescribed initial state. The 15-minute session timer continues throughout.

The Technical Committee shall publish the number and structure of competition rounds, the advancement criteria, and the course and scoring-zone specifications before each applicable round. U19 follows the announced stage format; U14 follows the paired qualifying and head-to-head final format specified in [FA-7].

[FA-2]: Field of Play

The simulated field consists of a takeoff pad, one or more landing pads, and a sequence of gates. All gate, frame, and pad dimensions in the simulation match the applicable physical FIRA Air race specifications exactly; the gate-frame width is 5 cm. The organizers provide fixed AprilTag markers below the gates in the designated marker area matching the physical field specification. Their positions and identities are determined by the official course. Teams may detect these markers but may not upload, replace, reposition, conceal, or alter them. Marker illustrations do not override the official field geometry.

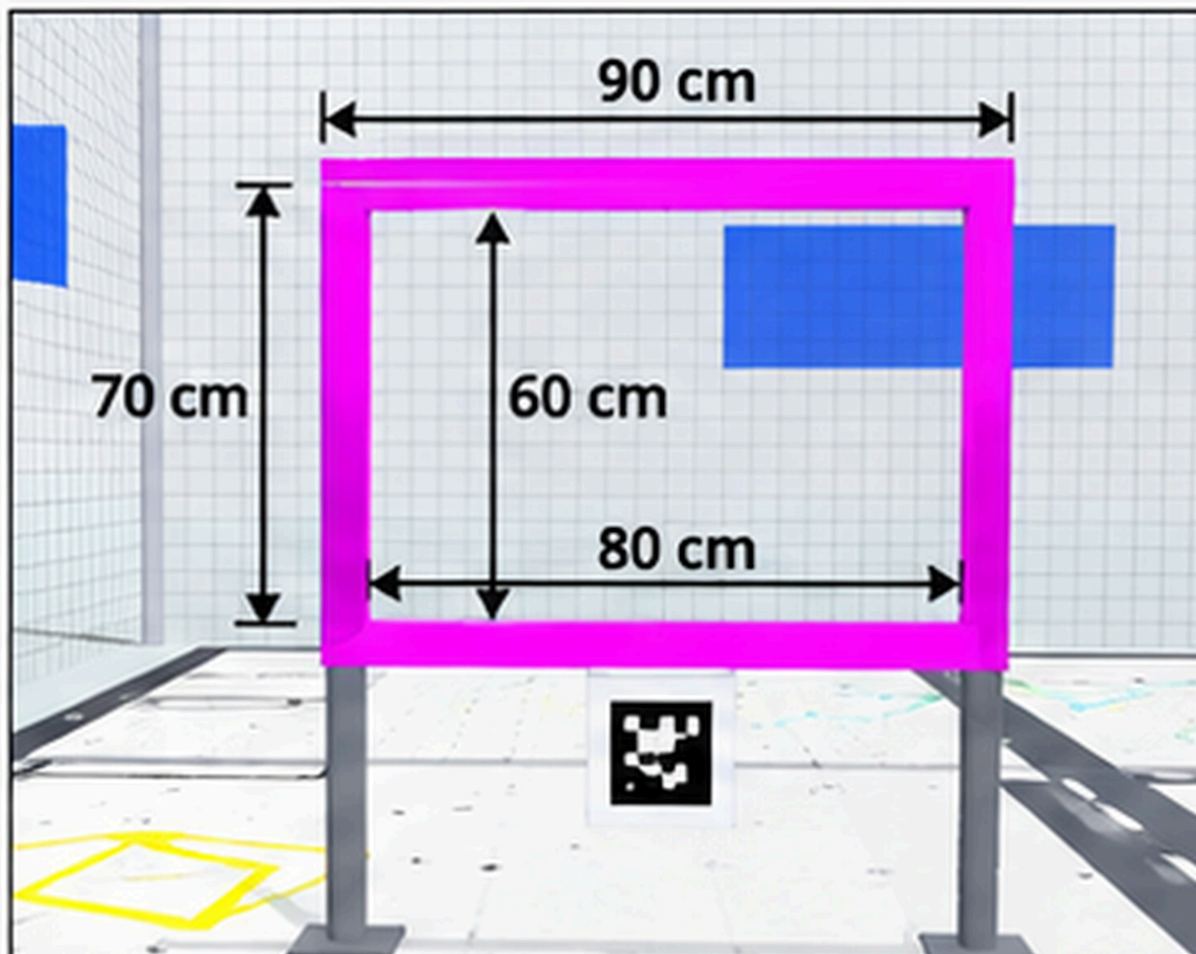


Figure 2: Illustrative gate visualization; exact gate and frame dimensions match the physical FIRA Air specification (drawing not to scale).

The Technical Committee determines the number and location of gates and scoring zones, with at least 1 m clearance between gates. Visual floor features may be present to support optical-flow sensing. The illustrated track is an example only: it does not fix the competition's final route or zone positions.

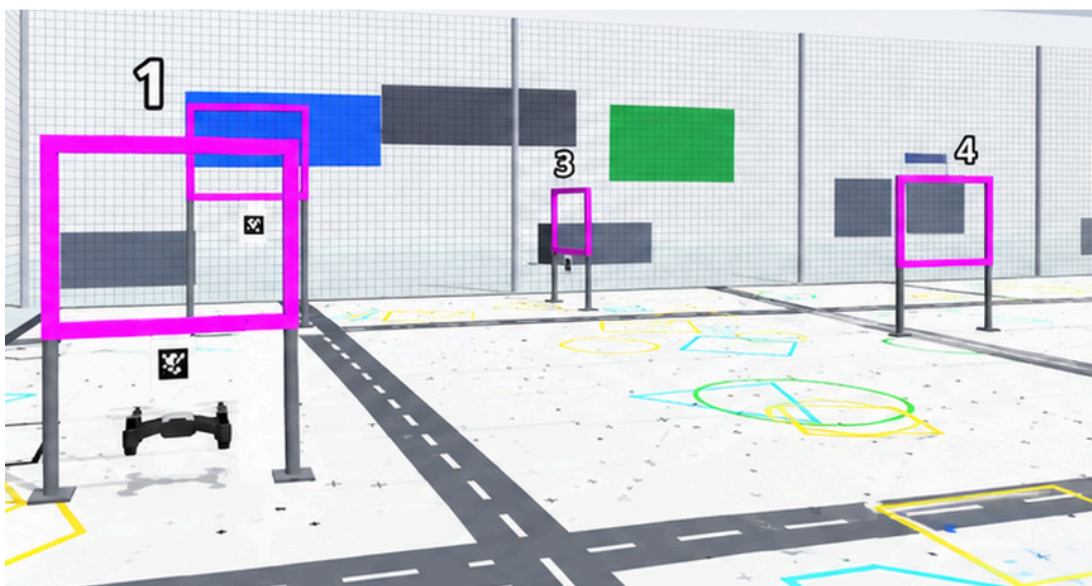


Figure 3: Example virtual U19 racecourse (illustrative; U14 uses two identical adjacent lanes).

Takeoff and landing pads measure exactly $0.5 \text{ m} \times 0.5 \text{ m}$, as in the physical FIRA Air rules, and display a blue “H”. Their positions, the number of gates, and the number of potential finish pads are set for each round. If multiple landing pads are present, the referee or official simulator selects one target at random after takeoff. A successful finish requires a valid landing within that designated pad after traversing all required gates. Landing on another pad does not complete the course.

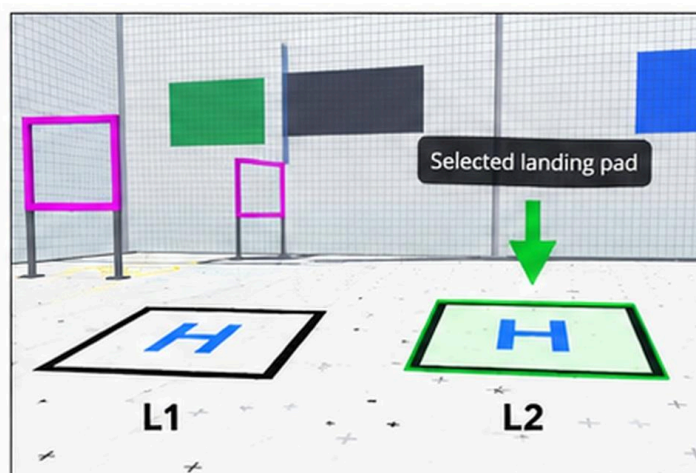


Figure 4: Virtual landing pads and selected target (illustrative).

Some stages may use high-contrast strips or panels that partially obstruct a gate opening, as in Figure 5. The remaining free opening is the only valid passage. A gate is considered passed only when the entire

collision volume of the drone crosses the gate plane in the prescribed direction and order without touching the frame, strips, or panels. Any such contact invalidates that passage and ends the trial as a failure.

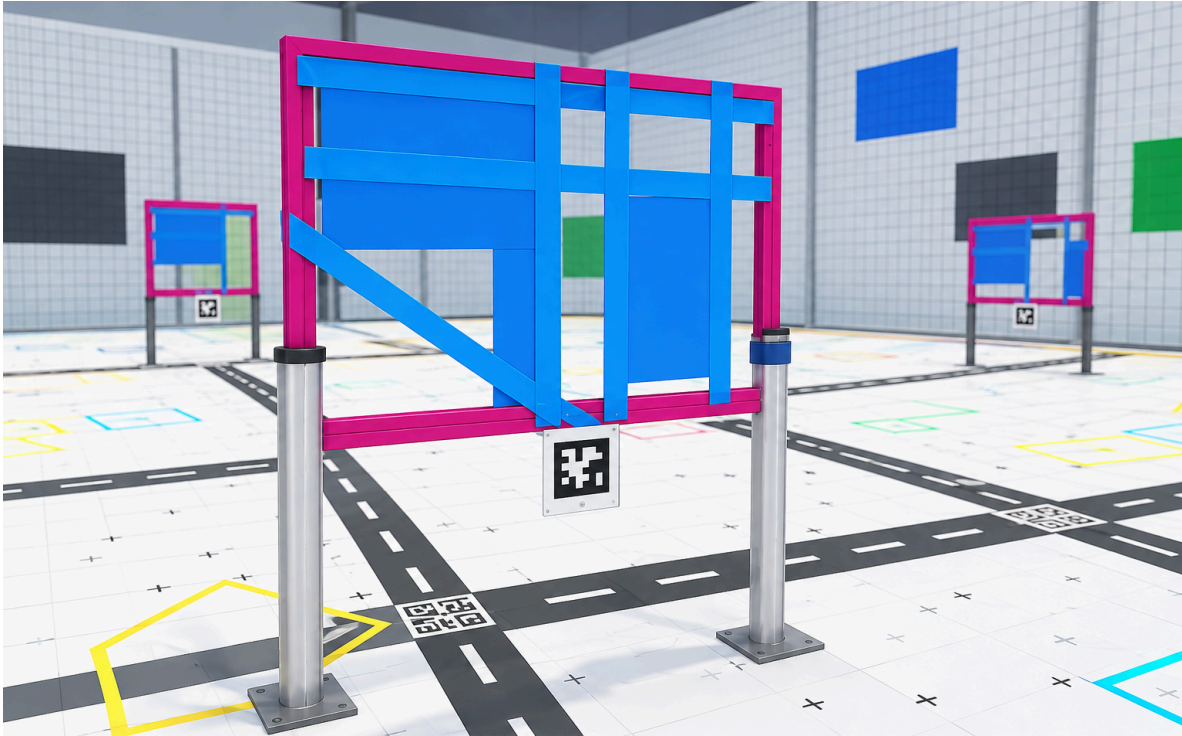


Figure 5: Example of a narrowed virtual gate with visual obstructions and a marker (illustrative simulation rendering).

[FA-3]: Number of Drones

Only one official virtual DJI Tello may fly within a single race lane at a time. U19 trials use one drone on the relevant course. U14 allows two drones to fly simultaneously, with one drone on each of two identical adjacent lanes. The lanes and their collision and scoring systems must remain independent. Before a new attempt, the simulator resets the drone to the published starting position and orientation. Teams may modify their code between attempts within the official session but may not modify the aircraft model or its physics.

[FA-4]: Level of Autonomy

Only autonomous off-board control is eligible in this simulation competition. The team's program makes flight and navigation decisions without manual steering during an official trial. The same autonomy coefficient, $K_a = 1$, applies to U14 and U19. No onboard-processing bonus is available.

[FA-5]: Method of Scoring

The maximum base score in each official race session is 25 points. Full completion earns this base score only when the drone traverses every required gate in order without collision and lands on the designated pad. Partial completion is scored according to the furthest valid scoring zone

entered after all preceding gates have been passed. Zone values shall be announced before the relevant round (with a default of 10 points for a course containing only one intermediate zone). The session's base score B is its highest valid base score across all attempts. Every unsuccessful official attempt incurs one penalty point P, irrespective of multiple failure events in that attempt; a later failure does not erase earlier valid progress. The scoring formula is $S = (B - P) \times K_a$. With $K_a = 1$ in this simulation league, $S = B - P$; negative results remain valid. In U19, teams are ranked by score and then by shortest time to the highest valid zone. The same score-first comparison applies to individual U14 qualification rankings and head-to-head outcomes, as detailed in [FA-7].

Example 1: Full Track Completion on the First Trial

- **Scenario:** A virtual DJI Tello completes all gates in the correct order and lands on the selected pad on its first trial, using autonomous off-board control.
 - **Base Score:** 25 points (full completion, first trial)
 - **Penalties:** 0 (no failed attempts)
 - **Ka (Autonomy Coefficient):** 1 (Autonomous, off-board processing)
 - **Total Score:** $(25 - 0) \times 1 = 25$ points

Example 2: Partial Track Completion with Off-board Processing

- **Scenario:** A drone reaches the second zone and fails three times. Assume Zone 1 = 5 points and Zone 2 = 10 points.
- **Base Score:** 10 points (last valid zone: Zone 2)
- **Penalties:** 3 points (three failed attempts)
- **Ka (Autonomy Coefficient):** 1 (Autonomous, off-board Process)
- **Total Score:** $(10 - 3) \times 1 = 7$ points

Example 3: Full Track Completion with Off-board Processing and Multiple Attempts

- **Scenario:** A virtual DJI Tello completes the course on its third trial after two failed attempts, using autonomous off-board control.
- **Base Score:** 25 points (full completion)
- **Penalties:** 2 points (two failed attempts)
- **Ka (Autonomy Coefficient):** 1 (Autonomous, off-board Process)
- **Total Score:** $(25 - 2) \times 1 = 23$ points

Important notes:

- To receive a zone score, the drone must validly enter that zone after passing every earlier required gate; merely approaching or skipping to a zone is not sufficient.
- A gate counts as passed only when the entire drone crosses the valid opening in the prescribed order without any collision with the gate or its obstructing elements.

- The racecourse uses fixed organizer-supplied AprilTag markers. Teams may not place, upload, replace, remove, conceal, or alter any marker, nor may they directly modify course objects or access hidden simulator information.

[FA-6]: Age Classification

This competition has two separately ranked junior age categories: U14 (under 14 years old) and U19 (under 19 years old). Age eligibility and the reference date are determined by the event's published general rules. Teams may have an adult official, but the competing software and flight decisions must be produced and executed by eligible student team members. Student membership and supervision requirements otherwise follow the general event regulations.

[FA-7]: U14 Dual-Lane Autonomous Racing

[FA-7.1] Scope and Purpose

U14 is an autonomous drone-racing category designed for junior teams. It follows the common rules in [FA-1] through [FA-6] and the simulation safeguards in [FA-8], except where this section expressly establishes a U14-specific procedure. Participants compete with the standard virtual DJI Tello, and all flight decisions in an official trial must be made by their own program. The U14 event uses side-by-side virtual drone racing to make progress and race outcomes visible while remaining fair to teams with different programming experience.

[FA-7.2] Two Identical Race Lanes

The official U14 arena contains two adjacent and geometrically identical lanes, designated Lane A and Lane B. Each lane has its own takeoff pad, ordered gates, zones, and designated landing pad. The lanes shall have identical gate dimensions, distances, orientations, AprilTag configurations, obstacle positions, and scoring boundaries. All gates, frames, and pads retain the same physical dimensions as the corresponding FIRA Air field. Only one drone is permitted in each lane at a time. Drones must not cross into the neighboring lane, collide with one another, or affect one another's simulation state, sensors, timing, or scoring. The organizer must prevent cross-lane visual interference from giving either team an advantage.

[FA-7.3] Junior Course Difficulty

The U14 route shall be less complex than the U19 course. This shall be achieved through simpler gate placement, fewer difficult turns and altitude transitions, and a more predictable route—not by changing DJI Tello flight physics, gate dimensions, or the scoring formula. The actual number of gates, approved map, zone boundaries, and partial-score values shall be published for each round. Both U14 lanes shall use the same approved map for the same heat. A new layout may be used in a subsequent stage only if it is announced to all affected teams under equal conditions.

[FA-7.4] Permitted Navigation Methods

Pre-programmed flight-command sequences are allowed in U14. Teams may also use available camera or flight-state information, including the fixed organizer-supplied AprilTags, but advanced computer vision is not mandatory. AprilTags cannot be changed by competitors. Manual flight control during an official trial is prohibited. All teams may use the same approved DJI Tello-compatible control interface.

[FA-7.5] Landing Target

The standard U14 course uses a fixed and visibly designated landing pad, announced before the relevant round, rather than a randomly selected target after takeoff. The drone must pass every mandatory gate in the correct order without collision and land within its own lane's designated pad. If a future round uses multiple potential landing pads, that exception and its selection procedure must be published before that round and applied identically to both lanes.

[FA-7.6] Simultaneous Qualifying Heats

In qualification, two teams are assigned to Lane A and Lane B and their official sessions start together on the same referee-controlled countdown. Each team has an independent, continuous 15-minute session and may complete multiple attempts under the common rules. A failed attempt or reset in one lane shall not stop, restart, penalize, or otherwise influence the other team's attempt. Qualifying scores are calculated independently and used to rank all participating U14 teams, not merely to choose the winner of each pair. If the number of teams is odd, one team may run alone under otherwise identical conditions; this must not change its scoring or time allowance.

[FA-7.7] Head-to-Head Final Rounds

The highest-ranked qualifying teams advance to the announced head-to-head elimination bracket. Two teams race simultaneously on the same approved map, one in each lane, with a common start signal and identical official time allowance. The higher final score wins the match and advances. The organizer shall announce before qualification how many teams advance, how they are seeded, and how any bracket byes are assigned. The field must not be changed between the paired competitors' runs in the same match.

[FA-7.8] U14 Scoring and Ties

U14 retains the physical FIRA Air scoring principle: $S = (B - P) \times K_a$, with $K_a = 1$ and a maximum base score of 25 points. B is the highest valid progress score reached in the session, and P is the number of unsuccessful official attempts. Match and qualification results are compared first by total score, then by the shortest valid flight time required to reach the highest-scoring zone or complete the course. If a knockout match remains exactly tied after these criteria, the teams shall compete in a referee-supervised tie-break run on identical lanes; the race setup and time allowance shall be the same for both teams. Any additional tie must be resolved by repeating this equal-condition procedure under referee supervision.

[FA-7.9] Race Display and Results

The official simulator shall record gate crossings, completed zones, landing results, penalties, and times separately for both lanes. During paired races, progress and results for Lane A and Lane B shall be shown clearly to referees and, where a spectator display is used, to the audience. All rankings and bracket decisions shall rely on the official scoring records rather than subjective observation of which drone appeared to finish first.

[FA-8]: Simulation-Specific Provisions

All official trials shall run on the same approved version of the simulator and the standard virtual DJI Tello model. The field, aircraft physics, collision system, available observations, and timing rules must be consistent among teams in the same category and round. Official timekeeping must not depend on a participant's computer performance. The simulation-speed multiplier must remain fixed at the officially announced value (normally 1×) during scored sessions.

The aircraft may be controlled only through the approved DJI Tello-compatible interface. Reading hidden object coordinates, altering collision shapes, modifying aircraft parameters or scene files, or injecting direct simulation-state changes is prohibited. Camera-view changes for observation do not authorize manual flight controls. Built-in demonstration or dummy-pilot functions may not operate the drone in an official trial.

Before each new trial, the simulator restores the prescribed initial aircraft position, orientation, and field configuration. Every attempt, completed zone, gate contact, failure, target pad, and elapsed time must be logged. A Reset, New Session, or Auto-retry feature shall not erase prior failures, penalties, or elapsed session time. If automatic retry is allowed, each failed trial must still count separately. Team-requested termination of a scored trial is unsuccessful unless an organizer-side fault is verified.

When a verified failure of the official simulator or organizer-provided infrastructure compromises a fair trial, the referee may authorize a penalty-free replay and restore the affected trial's fair opportunity. Errors in a team's own code, command sequences, or algorithm do not qualify. Referee decisions and appeals are governed by the event's published procedures.

SDK commands, connection instructions, software setup, and sample programs are maintained in a separate technical guide and do not form part of these competition rules.