STUDENT AIRRACE

Sporting Regulations

08.07.2022

v0.0.1
Munich

Contents

1 Competition Outlines

1.1 Objective of the competition

1.1. *What are our values? What is the ultimate goal of the competition? What do we want to achieve?*

1.2 Participants

1.1. Only enrolled university (or of comparable institutes) students are allowed to actively take part in the competition.

1.2. If a team member has graduated during six months before the competition, they may still participate.

1.3. If a team member has graduated during the eighteen (18) months before the competition and has played a significant role within the team, the team may send an application to the organizer, requesting their participation.

1.4. Students attending other universities which are within a reasonable distance of a participants university (e.g. in the same city) may join a student team from said university.

1.5. If a students university already has a competing team, the student is not allowed to join a competing team of another university.

1.6. The team size is not limited to a maximum number of members. However the organizer may limit the of allowed on site participants to a maximum of 15 for each team at the final event.

1.7. PHD candidates who are still enrolled or working for the university are allowed to join the teams.

1.3 Competition Rewards

Position	Dicipline	Moneytary Award
1st	Overall	25%
2nd	Overall	15%
3rd	Overall	10%
1st	AI racing	15%
2nd	AI racing	9%
3rd	AI racing	6%
1st	Safety	5%
1st	Design Maturity	5%
1st	Innovation and Sustainability	5%
1st	Special Prize	5%

1.1. Every winner of one of the categories mentioned above will receive the following prizes:

- Trophy according to their position and discipline
- Free entry to the competition in the next year.
- Special prizes like tours etc. by sponsors
- Prize Money according to the table

1.2. There is currently no prize money planned for the competition. Since the registration fee is only intended as a way of giving an incentives to the teams to actually compete the registrations fees might get split up between the winning teams.

Furthermore Student AirRace is looking into the possiblity of collecting further money as potential prize money for the teams. If the option for prize money is agreed upon, then it would be split according to the percentages in the table above.

2 Competition Processes

2.1 Registration Process

2.1. Teams can register for the competition on the website of Student AirRace. The sign up page can be found at www.student-airrace.com/recruiting

2.2. Only one team per individual university may register for the competition.

2.3. The participating teams will be chosen by the organizer. This will partly happen on a "First Come First Served"-Base but also on the perception and opinion of the organizers whether a team will be able to meet the requirements and standards of the competition.

2.2 Later Changes to the Registration

2.1. Teams may sumbit changes to the information they have provided in their registration up to six months before the competition. This enables to teams to rebrand or change their starting numbers.

2.2. If in the opinion of the organizer, a competitor is likely to not meet the requirements or standards of the competition, they are allowed to reject them after the registration process.

2.3. In case of withdrawal from the competition, the team must notify the oganizers as soon as possible. Withdrawals must be entered until six months before the competition. Any non-existing or later withdrawals may be penalized by the organizers with point deduction or ban from future events.

2.2.1 Participation Fee

2.1. A participation fee of 300€ per team will be required to participate in the competition.

2.2. The fee will go into the prize money pool and will be distributed to the participating teams according to the prize money table, which will be determined by the organizers.

2.3. The fee is required as a sort of deposit to ensure the team's commitment to the competition and their timely arrival.

2.4. The payment of the fee is due after 6 months after registration and will be handled by the organizers.

2.5. Teams who fail to pay the participation fee will not be allowed to participate in the competition.

2.3 Expenses

2.1. The organizers will not support or reimburse the teams for travel, accommodation or any other expenses.

2.2. The competitors may search for private, university or company sponsors to cover any of their expenses.

3 Competitor Organization

3.1 Just Culture

3.1. The teams and the organizer commit to adopting a so called "Just Culture". This is important to ensure the safety of the competition and its participants.

3.2. The team leaders commit themselves to learning about Just Culture and to educate their team members about it.

3.3. Participants who notice safety related issues in their team or within the competition are able to report them anonymously to info@student-airrace.com. This will not bear any negative consequences for them nor their team.

3.4. Student AirRace is also seeking to provide the teams with workshops about this topic.

4 Practice during development

4.1. During development, testing practice of their UAVs the teams are required to meet all the laws and requirements of their flight location.

4.2. There is no maximum limit on how much time the teams invest into flying before the competition. However a minimum flight experience on the competititon UAV and for the pilots must be documented. More can be found at Section 8.2.

4.1 Team Documentation

The following rules are not meant as a way of annoying the teams or making their lives hard. The competitions success is in the hands of the competitors. In order to grow the competition in a sustainable manner we need to keep certain aviation and safety standards. Furthermore those rules are supposed to teach you standard aviation processes and help you learn and grow. In case you have any questions on how to approach those flight documents, the organizing team of Student AirRace will gladly assist you. Safety and the success of this competition is in all of our hands.

4.1. The teams are required to document all flights conducted with their prototypes in physical and/or digital flight books. They must note at least location, flight time, pilot flying as well as observations, abnormal events or incidents during the flight.

4.2. The teams are required to document their pilots personal flights and flight time on aircrafts comparable to or on the competition aircraft (e.g. Racing Quadrocopters) for each individual flight and in a cumulative manner. These documents will be checked according to 8.2. at the competition.

4.3. The teams must keep up to date records about the equipment installed on the UAV. This includes all electronic and mechanical subassemblies on the UAV. Changes must be clearly marked and recorded.

4.4. Teams are required to keep up to date records of any damages or problems on the UAV. Even if the aircraft might still be flightworthy. Any repairs will have to be documented, stating the reason of the repair and a short overview of the process of the repair.

4.2 Feedback for the organizer

4.1. The teams are asked to inform the organizers about any obstacles or issues they run into, which might be caused by too strict or too lenient regulations. The organizers will gladly receive any feedback and integrate it into the regulations.

4.2. Teams are required to inform the organizers about any incidents, which lead to loss of the UAV, damage to ground structures, injury, or death.

5 Final Competition Logistics

5.1 Logistics

5.1. Each team can ship a maximum of one twenty (20) ft shipping container to the location of the competition beforehand. The container will be placed right next to the teams reserved location in the paddock.

5.2. The teams are responsible for shipping expenses and on time delivery of the containers. Shipping of the containers is possible from three months before the final competition takes place.

5.3. The organizers will not accept any other types of shipment unless different agreements are in place beforehand.

5.2 Paddock

5.1. The paddock is where the teams are allowed to work on their UAS.

5.2. Each team gets their own spot "Team Home" within the paddock (ca. 7m x 7m) where they can put up a small tent, flags etc. Their shipped containers will also be right next to their spot.

5.3. Under no circumstances may any UAS fly within the paddock without prior approval by the organizer. This will lead to heavy penalties up to disqualification.

5.4. The organizer will provide the teams with power within their team home.

6 Final Competition Organization

6.1 Scruteneering

6.1. *The organizers will randomly weigh vehicles.*

6.2. *Do bench checks and flight test checks.*

6.2 Team Briefings

6.1. At each day of the competition, there will be a team briefing.

6.2. For specific roles, such as pilots there may be additional mandatory briefings.

6.3. Each team briefing must be attended by the team members which will be present at the flightsite during the flights to the briefing.

6.4. One point can be deducted by the organizer for each member which is missing during the briefings.

6.3 Parc Fermé

6.1. Parc Fermé begins at the moment the Team starts the Thrust-Stand-Event for the first time during the competition days. It ends with the completion of all three competition flights.

6.2. While Parc Fermeé is active teams are not allowed to work on the UAVs. Only the following works are allowed to be carried out:

- Balancing of propellers
- Cleaning of any parts of the aircraft
- Exchange of batteries for a 1:1 replacement
- Charging of batteries
- Reading logs and taking measurements
- Tightening of any loose screws
- Adjustment of minor software parameters.
- Repair of accident damage and 1:1 replacement of broken parts as long as the crash is deemed by the organizer to not have happened on purpose.

6.3. Work on safety related systems may be done after submitting a written request to the organizer and getting it accepted by the organizer.

6.4 Protests

6.1. Teams are allowed to launch a protest against any decisions, rules or penalties imposed by the organizer.

6.2. They must do so within 6 hours of the decision.

6.3. The protest must be sent to the organizer in written form, this can happen digitally. It must state the decision, the reason for protest and contacts from the team.

6.4. Along with the protest the team will be deducted 10 Points from their final score. If the organizers agree with the protest, the teams receive those points back.

6.5 Spare parts

6.1. *How many spare chassis or even spare UAVs is each team allowed to have?*

6.2. *How many spare parts or parts of different specification (e.g. different propeller pitches) is each team allowed to have?*

7 Final Competition Disciplines

7.1 Mandatory Disciplines

7.1.1 Scoring

7.1. Each team must compete in each of the mandatory disciplines, mentioned below.

7.2. A team can achieve a maximum of twohundredeleven (211) points which can be collected during different mandatory events.

7.3. At the end of the competition and after the deduction of any penalties, the team with the most cumulated points is declared as the winner of the main event.

7.4. If two teams achieve the exact same amount of points, also known as a dead heat, after all points have been awarded the winner will be declared by who has scored more points in the effeciency discipline. If both of them have also equally scored equally in this discipline this process repeats for the safety, design maturity and innovation & sustainability disciplines in the hereby mentioned order. If this doesn't deliver any result the organizer will make a decision.

7.5. The following table shows how the total points are distributed across the individual disciplines.

Discipline	Points	Awardment Process
Hotlap Races	75	Time measured by organizer
Landing Challenge	36	Time measured by organizer
Effeciency	25	Time measured by organizer
Safety	25	Jury Decision
Design Maturity	25	Jury Decision
Innovation and sustainability	25	Jury Decision

7.2 Comparability between runs

7.1. To ensure comparability between the runs, the organizers are going to set limits on the metrological conditions during which the runs can happen. If the organizer is calling the conditions to be fine for takeoff the takeoff time window rule applies.
The organizers will monitor the following conditions at the track during the flights:

- Precipitation
- Temperature
- Windspeed
- Humidity
- Air Pressure
- GNSS Connectivity and satellite number at fixed position on site (GPS only)
- Frequency jamming

7.3 Race Course Layouts

7.1. The Race course layout will be build within a rectengular shaped zone. This rectangle has sidelengths of 1500m and 500m. The maximum height during the flight is limited to 100m Above Ground (AGL).

7.2. No point within the race course layout is going to be further away than 1000m from the Ground Station. Also every point of the racecourse layout will be able to be flown within Line Of Sight of the Ground Station.

7.3. Race courses consist of an assembly of different predetermined race course elements which are published with the regulations.

7.4. The official assembly of race course layouts for the three hotlap sessions will not be published until shortly before the competition, in order to prevent the teams from overfitting their aircraft to one specificn racecourse.

7.5. Race course assembly kits are published in Annex A.

7.6. The race courses are marked with the help of 12m high pylons or flags.

8 Flight Operations at the final competition

8.1. During the flights, the teams must assign different roles within the team at the track, which are defined in the latter regulations.

8.2. Each person which fullfills a required role must be able to fluently communicate to the organizers in english.

8.3. A minimum of four (4) persons are required at the track to be allowed to conduct the flights.

8.4. A maximum of ten (10) persons by a team are allowed at the track. For clarification: This does not affect the amount of persons each team is allowed to have in the paddock.

8.1 Required roles during Flight

8.1. **PL: Pilot**
The pilot is the person responsible for flying the UAV.

8.2. **AO: Airspace Observer/Spotter**
The AO stands next to the PL and has an unobstructed view of the airspace around the drone. They talk to the PL directly in person. The PL and AO are allowed to communicate via intercom if they stay right next to each other.

8.3. **FE: Safety Engineer**
The safety engineer is the one who was responsible for the safety report. Their task is to constantly monitor the situation and warn the others if they are getting into any problematic situations.

8.4. **FOL: Flight Operations Lead**
The FOL makes the tactical decisions during the flight. They request for Takeoff Permission from CL (Competition Lead). They manage contingency and emergency procedures. They are essentially the boss of the teams operation.

8.5. All of the roles and the names of the responsible team members, as well as backup per position will need to be entered to the organizer 30 days prior to the competition.

The following seems like way too much information. I'd like to see some of those roles filled for profesionalism and as a guide for the teams. However this makes the rules unnesecarily complicated.s

8.2 Optionsal roles during Flight

8.1. **FE: Flight Engineer**
The Flight Engineer reads the data which is streamed down by the Aircraft in real time. They monitor battery temperatures, voltages, vibration sensors etc. and can give advise to the pilots.

8.2. **AOGX: Additional Airspace Observers/Spotters**
Not yet defined number of Airspace and Ground Observers according to the terrain and track layout. According to the terrain it might be useful to place additional oberservers on the field to have an external look at whether the air or ground situation changes. They can be equipped with radios and talk to FOL.

8.3. **PCX: Pit Crew**
The pit crew is there to make changes on the eVTOL which are permitted by the rules within the time limit. They also get the AC ready for the flight and make sure it is transported away afterward. Only they are allowed to touch the aircraft during the flights.

8.3 Requirements for the pilots

8.1. Each team must have at least three different designated pilots. The names of those pilots must be sent to the organizer at least 30 days before the competition.

8.2. Each pilot must have flown and documented at least twenty (20) hours on comparable UAVs (e.g. Racing Quadrocopters) in the past 12 months .

8.3. The pilots must be able to fluently communicate with the organizers in English, in order to be able to follow safety relevant commands during flight.

8.4. The pilots may have have to perform a flight test check in front of the organizers at the competition. This is just a quick test flight with any multicopter UAS to demonstrate the pilots basic flight skills.

I'd like to cut Pit Stops from the regulations. Since we do not have an external shutdown, we shouldn'table put the team members under the pressure of having to swap the batteries that quickly. This could result in injuries and make everything more complicated.

8.4 Pit stops

8.1. The teams may exchange batteries during the time window.

8.2. Those battery swaps are only allowed to happen on the landing pad.

8.3. The time will continue to run down during the swaps.

8.4. Teams may only enter the flight test area after the aircraft has landed and the kill switch has been activated.

8.5. Depending on the situation the organizers may add additional time to the clock in order to compensate for the time lost due to the suspension.

8.4.1 Further Rules to be moved around

8.1. The team must take off vertically from the designated landing pad.

9 Disciplines

9.1 Thrust Test Stand

9.2 Hotlap races

Disciple Outline

- There will be a total of three (3) hotlap races on different tracks during the competition. The following rules apply to a single race.
- Each team will be given a fivteen (15) minute time window during which they can conduct their flights.
- Each team is only allowed to set a maximum of five timed (5) laps during their time window.
- Each laptime will be logged by the organizer. It counts as the time from which the aircraft passes the start/timing line until the aircraft has crossed the timing/finish line.
- The points will be awarded in order of fastest hotlap achieved by each of the teams during their time window.

German has had some good ideas about adding a landing challenge after the hotlap races. They are already considered within the point distribution. I'm scared to make it too complicated though.

9.2.1 Hotlap Race Rules

9.1. The following rules apply in combination with the later specified Race Procedures.

9.2. The lap time will be recorded according to the Hotlap Race Procedures outlined in the following Race Procedure sections.

9.3. Teams are required to pass through every gate on the course. Missing a gate will result in the lap time being invalidated.

9.4. If a gate is defined as a pole, teams must pass the pole on the side specified by the organizers. Failing to do so will result in the lap time being invalidated.

9.5. Teams must ensure their drones remain within the flight perimeter, or geocage, at all times. Any drone found to be flying outside the geocage may be disqualified or face penalties.

9.6. Each drone will be able to fly their hotlap individually, with no other drones operating simultaneously. This is to ensure safety and avoid interference during the race.

9.7. The start gate can be crossed at any velocity. Teams are allowed to have a run-up, provided it does not exceed the boundaries of the location.

9.8. A lap can be aborted at any time at the team's discretion. If a lap is aborted, the time will be reset and will start again once the team's drone crosses the start gate for a new lap.

9.9. Each team is allowed to pass through the start gate for a total of five times. However, they may conduct practice laps without crossing the start gate.

9.10. The points will be awarded in order of fastest hotlap achieved by each of the teams during their time window. Only the fastest lap of the competitor will be counted. Even if their second fastest lap should be faster than the one of another compeitor.

9.11. If two or more competitors achieve the exact same finish time, their points will be added together and divided equally across the them.

9.12. Teams are expected to follow all additional rules and guidelines provided by the organizers. Dangerous flying will immediately result in disqualification.

9.2.2 Hotlap Race Procedures

Start of a Hotlap Race

9.1. Each team gets a certain time slot during which they are allowed to conduct their hotlaps.

9.2. The organizer will ensure that the time is only started if a set of weather conditions is met. Afterwards there is no going back. This is comparable to the process ski jumpers undergo during their competitions.

9.3. The start of the session is called by the organizer. Afterfwards the clock is started and a fivteen (15) minute timer begins to tick down. The teams must conduct their hot laps within this time frame.

9.4. The teams are free to conduct flights however they'd like to during this time as long as all other rules are adhered to. This is up to their strategy. One team may fly three slow training laps and one racelap. Another team may set three race times or wait on the ground for exactly the right wind conditions.

Suspension of a Hotlap Race

9.5. The session can be suspended by the organizer in case of unexpected events such as uninvolved people or aircraft entering the flight test area. A sudden change of weather which exceeds the limits set by the organizer may also lead to a suspesion of the session.

9.6. In case of a suspension the clock will be stopped.

9.7. The pilot must abort the lap immediately and slow the UAS down. Further actions will be discussed together with the organizers depending on the situation.

9.8. The pilot must stay away as far as possible from uninvolved people as possible at any point in time.

Resumption after suspension of a Hotlap Race

9.9. The clock is started from where it was stopped beforehand.

9.10. Depending on the situation the organizers may add additional time to the clock, and/or allow the competitior to charge their battery to a certain level in order to compensate for the suspension.

Finish of a Hotlap Race

9.11. The finish of a session is called after the fivteen (15) minute time window is over. After this the teams are not allowed to start a new lap.

9.12. Teams may finish the current lap in progess if it does not take longer than two minutes.

9.13. Teams may communicate their wish to prematurely end the current Hotlaprace to the organizer. For example if there's still time left but the battery charge is not enough to conduct another safe lap.

9.14. In case of a ground colission from which the team is not able to safely recover the session is also ended.

9.15. The organizer may call an early end for a session if they deem a contiuation of the flight as unsafe. The session will not be retaken.

9.16. If the team doesn't manage to land at the landing pad, even though a safe landing is possible after the end of the race a penatly is applied by the organizers.

9.3 AI races

- There will be a total of three (3) hotlap races on different tracks during the competition.
- Each team will be given a fivteen (15) minute time window during which they can conduct their flights.

- Each team is only allowed to fly a maximum of three timed (3) laps during their time window.
- Each laptime will be logged by the organizer. It counts as the time from which the start lights turn off until the aircraft has crossed the timing/finish line.
- Teams can earn up to 25 Points during the competition. The exact point distribution is subject to change and will be affected by many factors such as the number of participants. The teams will be notified as soon as there is more information available.
- The points will be awarded in order of fastest hotlaps achieved by the teams during their time window.
- If two or more competitors achieve the exact same finish time, their points will be added together and divided equally across the them.

10 Reports

10.1 Technical Report

10.1.1 Innovation and sustainability

10.2 Safety Report