FIGHTER UAV COMPETITION
COMPETITION SPECIFICATIONS

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1 Purpose

In parallel with the developments in technology, Unmanned Aerial Vehicles (UAV) develop its fields of activity day by day and gain more and more autonomy. Another application area that requires high autonomy and is one of the trending research areas around the world is to gain the ability to make dog fight with UAVs just like fighter jets. Since the UAVs, which have already taken the observation activities worldwide from manned platforms, cannot approach the level of human intelligence in subjects such as high environmental awareness, decision-making ability and planning ability in dynamic environments, air-to-air combat maneuvers between fighter aircraft can only be performed with manned aircraft. The main purpose of the Combat Unmanned Aerial Vehicle (UAV) competition is to create such an air-air combat scenario between UAVs in a controlled environment and to direct young people who can achieve success in this field in the future, to gain experience and improve their skills.

2 Participation Conditions and Details

- High School and University students or graduates can participate in the competition individually or as a team.
- All the high school student, university student and graduated from Turkey or abroad can participate to the completion.
- The competition consists of one category; Fixed Wing.
- A team can be maximum 10 persons. The team can add one advisor.
- A team member can’t participate with a second team.
- The graduated categories consist of high school and university graduated participant. A maximum of 3 years after the graduation condition is applicate.
- The teams can be created with member from one school or also they can be founded from different academic institute. The team category will be defined by the member with the higher academic level.
- The student need to send a student document showing that they are currently student with the critical design report.
- High school team are mandatory to participle with an advisor. License or master degree team can if they want add an advisor.
- An advisor can only participate with one team.

- The advisor should send to the Teknofest comity an assignment letter signed from the academic institute showing that they are currently in function and send this document with the critical design report.
- If an advisor change is executed, the team need to inform the Teknofest comity by a written document.
- The transportation and housing aid given to the teams qualified for the final stage is limited. Teknofest competition comity will inform the number of participant which will get help.
- The application dead line is 30 November 2022. The registration will be made over http://www.t3kys.com/.
- During the application period the team captain/advisor need to register himself and invite the members via their e-mail. The members need to approve the invitation from "team information". If they don't approve the registration will not be accepted.
- The team need to apply to the appropriate competition after being founded
- All the process of the competition such as application, report submission, paper results, financial aid application, objections, adding or removing member, etc… will be realized over KYS system. The teams need to follow the process over KYS.
- Adding or removing a member is possible until the submission of the critical design report
- All the application, paper submission, form filling operation will be make over KYS system during all the competition duration. The operations are in responsibility of the team captain or the advisor.
- Teknofest competition comity can restrict the number of competitors in the festival zone. If a restriction will be applied the comities will inform the participant.
- Before applying all participants need to read and understand the rules and the participation conditions. The competitors are considered as hereby accept the rules when they apply.

The application form must be filled until **30.11.2022**. The application form requests;

a. Team information and contact numbers,
b. Requested sponsorship needs must be specified.

Applications can be submitted on the official Teknofest İstanbul Aviation, Space and Technology Festival (TEKNOFEST) Technology Competitions website under the Technology Competitions section (www.teknofestistanbul.org/en).

3 Competition Categories

The competition will consist of one category as fixed wing.

If the UAV provides the force required for its flight with the wings, this vehicle is considered in the fixed category, and if it provides the necessary force for its flight from the rotating propellers, this vehicle is considered in the rotating category.

UAVs that carry out vertical landing and take-off and providing the necessary lift for flight through wings are also considered in the fixed category.

4 Details of the Competition Area and Team Workshop Areas

Flight area will be announced before the competition. Electricity access will be provided within the race area. Apart from this, a common tent area will be allocated for the teams to prepare for the competition and exhibit their vehicles.

5 UAV Technical Specifications and Limitations

UAV's will be generally subjected to technical evaluation by the competition committee before the competition for security reasons. Approval for the team to enter the competition will be determined according to the evaluation result. Teams that cannot pass the technical evaluation will not be able to compete. The technical evaluation area will stay open throughout the competition. Teams that have crashed or could not pass the evaluation in their previous try, can be evaluated by request at any time. Teams that did not complete their technical evaluation until the beginning of the round can not participate in that round.

The UAV's must have a fail-safe mode for the cases of fuse and communication breaks (for details, see Security Necessities Article.10). UAV's can be controlled autonomously or manually. Teams can use ready-made products including platform (frame, wing, motor etc.) subsystems while designing and producing the UAVs.

The propulsion systems of UAVs should consist of battery-operated electric motors.

There should be a fuse on the UAVs that switches the engine power line. This fuse can be blade type or button type. Fuses made by using 'jumper' cable connector on the motor power line will not be accepted.

5.1 Physical Limitations of the UAVs

Aircraft to participate in the competition must not weigh more than 10 kg. UAVs will be weighed with the maximum take-off weight during the technical control, UAVs above the limit will not be able to pass the technical control. There is no limitation in terms of size and number of engines.

5.2 Limitations of the UAV Batteries

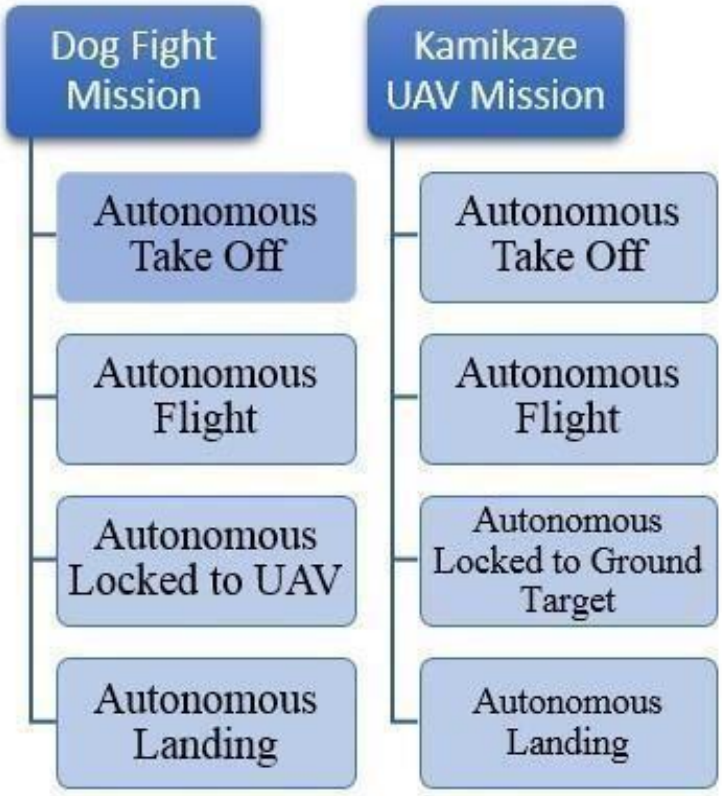
Vehicles that are going to enter the UAV competition must use well-known and safety proven fuel and battery technologies. Also, the batteries must be safely placed in the vehicle. Batteries must be brightly colored to be noticed easily in case of an accident. Vehicles that are decided to

have a dangerous power source by the jury will be forbidden to fly. In case of any crash, teams are obligated to remove their baterries safely from competition and teknofest area.

6 Competition Details

Each UAV participating in the competition will be in the air at the same time and will fight with each other during the competition. Limitation on the number of UAVs that will be in the air at the same time may be imposed by the competition committee during the competition, depending on the situation.

The competition consists of two different missions: "Combat UAV" and "Kamikaze UAV" missions. Competitor teams that want to receive the grand prize must fulfill both of these tasks. Before the start of the competition, competitors can change the zoom ratio of their camera, but not during the competition.



6.1 Fighter UAV Mission

In the competition, the UAVs will target each other and try to lock them over the image. The camera to be used while trying to lock on the image must be fixed facing the front of the UAV during the flight. At the same time, the use of cameras such as stereo, 360°, etc. will not be allowed. Additional sensors should not be used for lock-up (e.g. Lidar, Radar).The tapping will take place virtually, not physically; Therefore, there is no physical damage to the shot UAVs.

The aim of the competition is to successfully lock onto the rival UAVs and/or the markings in the field as many times as possible and avoid being locked by other UAVs by performing aggressive maneuvers.

6.1.1 Shooting Detection

Shooting is performed when the targeting UAV captures the image of target UAV in its camera Field of View (FOV). In order to achieve a lock, the image of the target moving UAV must be held inside the rectangle area in the center of the camera sight for 4 seconds for the fixed wing class. If referee committee detects any lock which is arranged by agreement, the team who tries to lock and the team who is being locked will be banned from the competition.

The size of this rectangle area is as shown in Figure 1. In addition, the image of the target UAV must cover at least 5% of the screen image, in at least one of the horizontal or vertical axes (Figure 1).

When teams develop image processing algorithms, it is not recommended that the limit they accept for packet sending be exactly 5%. Algorithms work with a certain tolerance, for example, an object that actually occupies 4.5% of the video image can be evaluated as a deadlock by the developed algorithm and send a packet to the server. This will be considered as a faulty deadlock package in a subsequent referee review. It is recommended to develop a more tolerant algorithm against this, and the packet sending limit to be 6% or higher.

It must meet the 5% value, which is the condition of locking, for the entire period specified in the packet sent to the server. All frames in a 7-second crash package must meet this requirement. Frame losses may occur due to hardware or communication, in which case there is a 'frame loss tolerance' of 10%. In other words, for a video coming in at 15 FPS, there is a tolerance of up to 6 frames in a 4 second lock.

Definition and rules of the parameters described in Figure 1 are mentioned below.

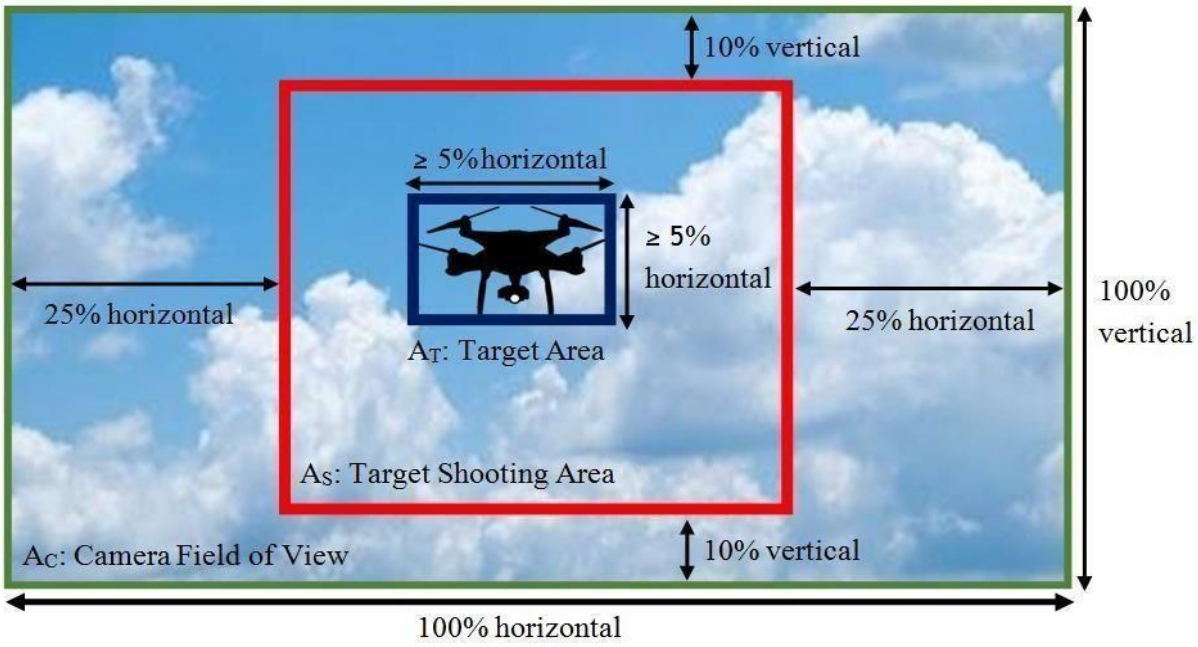


Figure 1: Example Locking Area

Ac: Camera Field of View

As: Target Shooting Area (The area that the target area must be held inside)

Ah: Target Area

For autonomous locking, the UAV must be flying on autonomous mode. Locking detection must be made automatically by the system, without any user intervention. During a manual lock, the user can control the UAV manually. If a UAV enters the Target Shooting Area and shooting detection is made automatically while the user controls the UAV manually, it is counted as a manual shooting. The user can also perform manual shooting by determining the shooting detection and Target UAV Area manually.

Choosing among several alternative targets that are automatically determined on the image during autonomous locking does not disrupt the autonomy of the UAV to follow a certain target. However, manually marking and tracking a region on the image will not count as autonomous locking. Competitors are responsible for notifying the referee board of the methods they will use for locking before the competition. The referee board reserves the right to consider the methods used as valid or not. By participating in this competition, the competitors are deemed to have undertaken to accept the decisions of the referee board.

Each UAV is obliged to document the image during the locking by presenting it to the referee committee after the competition round with video footage. The refereeing committee will confirm

the hits after each competition round by examining the videos and the lock-on data sent to the server. Teams that do not submit the relevant videos to the referees cannot leave the competition area, if for any reason the video is not delivered, it will be considered as not participating in that competition round. In order to vacate the competition area, video delivery must be provided within the given 20 minutes. The video needs to be as a single file transferred to the FTP server. The uploaded video must be able to open with the open-sourced FFPLAY application. You will be able to log in to the server with your team username and password. If this period is exceeded, the relevant team will be considered as not participating in the competition round, also a boundary penalty will be given to the team that does not sent the video in the required time.

Each team is advised to transmit images of the camera they use for locking to their ground station in real time with a minimum resolution of 640x480.

Although it is not mandatory to transmit live video to the competition server during the competition, teams that transmit live video to the competition server will earn points.

Video to be streamed live:

- It should have a fixed frame rate.
- Frame rate should be minimum 15 and communication loss etc. The frames that cannot be obtained due to the broadcasting should not affect the FPS value of the live broadcast transmission.
- Camera image must be transferred. Screen recording transfer is not accepted.
- The image must have a minimum resolution of 640x480.
- The video format must comply with the mentioned standard with a document to be shared later.

Videos that are going to be submitted by the team and that are subjected to evaluation are required to adhere to specific standards.

Evaluation video to be uploaded to FTP server after the competition:

- It should have a fixed frame rate.
- Frame rate should be minimum 15 and communication loss etc. Frames that cannot be obtained due to the error should not affect the FPS value.
- Images other than the original video, such as ground control computer screen recording, desktop recording, cropped desktop recording, should not be shared as evaluation video.
- The image must have a minimum resolution of NTSC (640x480).
- The image must have one of the 4:3, 5:4, 16:9 aspect ratios.
- Blackness, gaps, etc. at the image edges. should not exist.

- Any postprocessing, zoom, drawing, etc. should not be processed.
- The server clock should be written with millisecond precision on the upper right side of the image. Images that do not print a server time or that print a different time will not be evaluated.
- During the lockdown, the lock rectangle must be drawn in red (#FF0000) on each frame.
- During the evaluation phase, time and size limits are not declared by the teams. It will be determined by the analysis of the submitted image by the referees.
- Video naming should not contain special characters ([*], [,], [!], [:] etc.) or Turkish characters.
- Video titles should be "[Competition Number] [Team Name] [Date(dd/mm/yyyy)]". For example; "2_Anadolu_IHA_Takimi_12_07_2022.mp4".
- It is necessary that the video can be opened and played without error with the FFPLAY application.
- Teams are obliged to deliver the video files to the USB memory provided to them without any corruption in the file.
- Videos must be saved in certain formats with certain compression algorithms. (H264MP4-MPG etc.)

A square area to include the target UAV during locking must be defined. This area must be marked as a red square on top of the captured image while UAV is locked and the coordinates of this area must be transmitted in the defined communication protocol. The record that will be analyzed by the jury must include the locking square and the GPS time. Hit detection must be specified, either by changing the color of the locking square or with a text.

The whole locking rectangle and the whole target must be inside the target shooting area mentioned above, but the target UAV must not necessarily be present inside the locking rectangle completely.

The distance between the center of the lock quadrant and the center of the target UAV cannot be more than half of the target UAV width horizontally and the target UAV height vertically.

To gain points, when there is a locking, teams must inform the competition server in the defined communication protocol format and data must be transmitted to the server successfully.

Teams will lose points when they send "Locked on Target" data while there is no locking and when they send area information with the wrong targets. If target covers only a piece of the locking rectangle, final decision is going to be given by Referee Jury.

In order for an autonomous lock to occur, the aircraft must be in autonomous mode before the lock period starts and the target UAV enters the target strike area, and must remain in autonomous flight mode throughout the lock period. If the target UAV(HH) is inside the target strike area but its size is less than 5%, the target UAV(HH) is deemed not to have entered the target strike area. Switching to autonomous mode after the target UAV(HH) is taken to the target hit area does not count as

autonomous locking. However, switching to autonomous mode after the target UAV (HH) appears in the image without being in the hit area before switching to autonomous mode does not constitute an obstacle for autonomous locking.

Teams cannot lock on to the same UAV repeatedly. After locking on to a UAV, at least one other UAV must be locked on before locking on the same UAV.

In order for the locks to be considered successful, they must send the crash package to the contest server no later than 2 seconds after the end of the lock.

Teams cannot lock on a UAV that is on the ground.

6.1.2 Communication

Each UAV must have a point to point communication with its own ground station. For this purpose, a communication format compatible to the Bilgi Teknolojileri Kurumu (Information Technologies Institution, BTK) must be used. Wi-Fi, cellular communication, spread spectrum encrypted communication protocols are recommended. It is forbidden to provide communication over the internet network.

Before the competition, the teams whose signals are interfering with each other will be found by checking the signals and necessary actions will be taken by the jury. In addition, the UAVs which will be used in the competition will be checked by the jury inside the inspection area 1 day before the competition. Teams which fail to pass the inspections are allowed to fix their problems during the competition and request to enter the inspection again. Team which cannot fix their communication status will not be included in the competition. The communication frequency and telemetry ID determined for each team before the flights should not change until the end of the competition. In addition, teams in the common tent are prohibited from turning on video transceiver electronics during the competition.

6.1.3 Competition Server

Each ground station must communicate with the competition server. This communication will be established by an ethernet network switch locally.

In order to enable data transfer between competitor ground stations and the referee server, a system that’s document will be released later will be used.

Competitors must transmit data such as UAV GPS coordinates, altitude information, locking status and locking area location over this system to the referee server with at least 1 Hz (1 data per second).

System server will also share the telemetry information received from each team with other teams in real time.

System time will be shared with all teams over the referee system. Competitors must add the system time to all data that will be transmitted to the server. With this feedback, delay between the competitor systems and competition server will be calculated.

All the data transmitted by the competitors over this system is recorded and the competitors can check the correctness of all the data they transmit. If any team send incorrect telemetry data during the competition, penalty points will be added to that team.

6.1.4 Telemetry Data

The telemetry data transmitted to the server is directly generated by the autopilot in the aircraft; This data must not processed, such as any interpolation, extrapolation or duplication. Otherwise, the teams will be deemed not to transmit data to the ground station.

Detailed information on telemetry data is available in the 2023 TEKNOFEST Fighting UAV Competition Communication Document.

6.1.5 Locking Data

In case of a lock, information related to the lock must be reported to the server with locking package.

Detailed information on locking data is available in the 2023 TEKNOFEST Fighting UAV Competition Communication Document.

6.1.6 Competition Timeline

The competition will be for a total of 5 days, including 1 day of technical inspection and test flights, and 4 days of flights.

Competitions can be held as 1 flight in the morning and 1 flight in the afternoon, taking into account the weather conditions and the availability of the flight area. The number of competitions can be increased in the last 2 days of the competition. The final dates and times of the flights will be determined according to the availability of the conditions at the time of the competition, and the competitors are expected to be ready to fly when requested.

Teams that pass technical controls can make a test flight during lunch breaks, between matches and technical controls. They must coordinate themselves by requesting test flight from the relevant field referee. Since the flight zone in the competition area will be permitted at certain hours, it is forbidden to try a test flight without consulting the referees.

During the competition, there will be competitions of 15 minutes each to be evaluated separately. The number of competitions may be less due to unsuitable flight zone or for unforeseen reasons. Teams take off one by one and land in the order they take off after 15 minutes of flight time. The 15-minute flight time starts after the last team takes off with notification given by referees.

In order to be quakified for point in a round, teams are obligated to complete the round on air. Any teams that land before the round duration completes are not going to be given any points in

that round and take a boundary penalty minus points. In case of mid air crashes and emergency crash landings, points collected by the teams do not lose their validity. In case of emergencies that require landing, landing decision is given by referee committee and final decision on qualification of the round points is going to be given by referee committee. The referee comittee will decide if the crash is valid.

It is forbidden to land and take off again in the same round. Teams are obligated to design their UAVs capable of flying for the entire duration of take-off, round, and landing.

Teams are free to participate in all or any of the competitions at most. Total competition score is the sum of points collected by the teams in the competitions they participated in.

Teams will be given 40 minutes prior to each competition to set up their systems and prepare aircraft for flight. Teams that are not ready for flight within this period cannot participate in the related competition.

At the end of the flight time, the teams will be given 40 minutes to clear the flight area and collect their systems, and the time-out penalty points will be added to the teams that do not clear the flight area during this period.

Teams cannot make arbitrary landing and taking off during the competition round. The team that lands arbitrarily is deemed to be eliminated from that competition.

If teams decide to leave within the 20 minute prepare time or can not take off within the given time, they will take Area penalty minus points.

6.1.7 Manual Mode Switching

The limit for switching to manual mode for a team within a competition round is 3. Teams exceeding this limit will be penalized per each switch.

The situation that the team pilot guides the aircraft with the help of the remote controller is evaluated as manual mode. Semi-auto mode is also considered as manual mode.

Sending a command to the vehicle via the Ground Control Computer (defining the destination point, changing its altitude, changing the cruising speed, giving a descent command) does not impair autonomy and is not considered a transition to manual mode. When the same commands are given by remote control, the autonomy is not broken.

The team pilot must notify the referee when intervenes with the aircraft. In cases where he does not report, the referee may judge this intervene as switching to manual mode.

The numbers of switching to manual mode will be counted by the competition server and the cases of exceeding the limit will be automatically added to the penalty points. Therefore, the correctness of the flight mode information that the teams send to the server is the responsibility of the teams.

Competitors are responsible for informing the referee board about the commands and methods they will use. The decision whether the use in question violates autonomy will be made by the referee board. When a control method not approved by the referee board is detected, they have the right to cancel the points received.

6.2 Kamikaze UAV Mission

In addition to the Fighting UAV mission, there will be a "Kamikaze UAV" mission in addition to the Fighting UAV mission. Competing teams wishing to claim the grand prize must complete the Kamikaze mission in at least one competition round, along with the Fighting UAV mission (autonomous locking mission on any aircraft in the air). The Kamikaze UAV mission can be carried out in the same competition round as the Fighting UAV mission or in different rounds.

Vehicles that take off for a round of competitions can both lock onto each other during the round and perform the kamikaze task. These two tasks are not separate competition categories. During the duration of the competition round, teams can try to lock on to ground targets or air targets, that is, other aircraft.

There will be 1 place target within the competition area and the location of this target will be sent to all competitors through the server. The QR code will be located on the ground plane at the target location. This code will be read during the kamikaze mission.

Teams aiming to perform the Kamikaze UAV mission will be expected to autonomously lock the aircraft to fixed targets on the ground with autonomous take-off, autonomous flight, autonomous landing missions in the same round. No physical impact is expected from the competing teams.

Hit detection is provided by reading the QR code and sending the password contained in it to the server. This password is renewed at each competition round. The location of the target always remains constant. The QR code code can only be detected as it will change from competition to competition, so a single kick can be detected within a competition round. For this reason, a single kamikaze hit detection point can be obtained in each competition. The camera used for locking in aircraft must be the same as the camera used for kamikaze duty. Incorrect hit detections are also valid here.

Figure 2 : Kamikaze Mission

The dimensions of the QR code will be 2.5 x 2.5 m. The code will be closed with 45-degree angled plates on four sides to prevent it from being read during straight flight. The height of the plates will be 2 m.

In the case of descending below the flight altitude limit while performing the kamikaze mission, it will be considered as an out-of-area exit. Situations related to leaving the area are explained in the 'Safety Requirements' heading.

The message contained in the QR code must be sent no later than 2 seconds after the end of the dive. The QR message will be checked on the video delivered at the end of the competition.

Teams that have experienced an accident during lockdown will receive autonomous lock-in points if they have been able to perform the autonomous kamikaze lockdown task before the crash, but will not be considered to have completed the kamikaze mission because they cannot make autonomous landings.

6.3. Special Rules

6.3.1 UAV Registration

Pilots of the teams joining the competition are required to apply from the "UAV Pilot Registration Application" at https://iha.shgm.gov.tr/ address and their application must be approved. In this system, teams without a piloting authorization will not be allowed to fly.

Members who have a pilot authorization are required to register their UAV from the "UAV Manufacturing - Import Registry" at https://iha.shgm.gov.tr/ address. UAVs that do not have an approved registry will not be allowed to fly.

Delays caused by the approval time will not be taken into account.

Teams are required to bring their documents related to their UAVs registry with them on the competition day.

6.3.2 Technical Inspection

The UAV must remain the way it is defined and described in the report. After presenting the report, minor changes to improve flight performance and safety will be inspected by the judges. During the inspection, consistency between the actual UAV and the design from the report will be examined. Direct objections to the Technical Inspection judges during the inspection will not be taken into account.

6.3.3 Judge Briefing

Each referee will be informed about the rules beforehand. Before the competition, judges will give a briefing about the competition rules in a meeting where at least one member of each team attends.

6.3.4 Cheating Prevention Team and Rules

Teams that are discovered to be jamming signals will be disqualified from the competition. There also may be hidden jury members or hidden judges among the audience other than the actual jury and judges. Cheating teams will be condemned and banned from the competition indefinitely.

6.3.5 Objections

Each team has the right to object. Objections must be in a written manner, verbal objections are not going to be taken into account. The objection forms will be given by the number of competitions that each team will participate in before the competition. Objection forms are evaluated by the advisory committee. Objections will be delivered to the related judge in the competition area.

7 Competition Calendar, Scoring and Evaluation

7.1. Competition Calendar

Tarih	Açıklama
30.11.2022	Application Deadline of Competition
7.12.2022	Pre-Design Report Submission Deadline
19.12.2022	Announcement of the Teams that Have Passed the Pre-Elimination According to Pre-Desing Report Results
30.01.2023	Critical Design Report Submission Deadline
13.02.2023	Announcement of the Critical Design Report Results, the Teams that Have Earned the Right to get Financial Aid and Teams that Quality for Final
27.02.2023	Proof of Flight and System Introduction Videos Submission Deadline
6.03.2023	Announcement of Proof of Flight and System Introduction Videos
March 2023 (It will be announced in the later)	Competition Days

The evaluation will be divided into three segments; Critical Design Report, System Introduction Video and competition scoring. Teams that do not submit their Pre-design Reports, Critical Design Reports and Proof of Flight videos **will not be able to enter the competition**.

Report Submission must be uploaded via the KYS system until 17:00 on the day specified in the calendar. TEKNOFEST Competitions Committee reserves the right to make changes in the calendar and hours.

7.1.1 Pre-design Report

Teams are responsible for submitting their Pre-design Reports on scheduled date. In the Pre-design Report; competitors must describe the mechanical, hardware and software design of their UAVs. In order to request support for the competition, the Pre-design Report (PDR) must be submitted and approved. According to PDR results, a pre-elimination will be made. Teams that pass to the Critical Design Report phase after the PDR evaluations will be announced on the scheduled date.

PDR template and scoring content will be announced to the teams after the competition application deadline.

7.1.2 Critical Design Report

Teams that pass on to the Critical Design Report (CDR) phase are responsible for submitting their Critical Design Reports on the scheduled date. Detailed Design Report is for properly documenting their works. The hardware and software design of the UAVs are required to be described in the CTR. Quantity and specifications of the devices used in the vehicles must be included in the CTR. Templates of the CTR are going to be released on the Teknofest website after the application deadline. Teams that qualify for the finals according to CTR results will be announced on the scheduled date.

7.1.3 Proof of Flight Video

The Proof of Flight video is an approximately 5-minute video showing that the UAV that will participate in the competition safely performs landing, take-off, and cruise missions. At least, 3 minutes of this video have to be in autonomous mode. There should be a HUD image on a specified area of the screen so that the mode change is visible. In the video, the take-off, landing, and cruise should be clearly visible. The UAV shown in the proof of flight video and the UAV brought to the competition area must be the same.

Teams that send the videos taken from the camera on the UAV as Proof of Flight videos are required to show the vehicle in the video.

In addition to the Proof of Flight video, there should also be a software demo video that shows locking on the target and demonstrates that the UAV is directed with the data from the competition server. This video will be uploaded separately from the flight evidence video.

In order to participate in the competition, it is required to send a Proof of Flight video. The deadline for submitting proof of flight videos is described on the competition calendar.

7.1.4 System Introduction Video

The introduction of the vehicle prepared in this video under the main headings of mechanical, electronic, software and engineering calculations should show that they are ready to compete. The prepared video should not exceed 10 minutes.

System Summary: In this section, the general characteristics of the vehicle (eg flight time, weight, etc.) should be mentioned and detailed explanations should be avoided.

Development Tests: Separate tests of the mechanical, electronic and software sub-parts developed for the flight of the vehicle prepared in this section should be shown (eg wing load test, flight timethrust calculation, communication distance test, simulation test, etc.). Each test should be supported by data and graphics.

All Mission Test: In this section, tests of autonomous flight and lock-on missions should be shown. It should be shown how the information coming from the server is evaluated and how the autonomous locking software works. In this test, it should be explained that vehicles are ready compete, supported by data.

Teams should upload the System Description Video to the team's own Youtube channel and then send the link to the referee committee via the KYS system. The relevant video does not have to be publicly available on Youtube. However, videos that cannot be accessed via the link will not be evaluated. The video must be at least 720p quality.

7.2 Competition Scoring

Scoring of the competition is formed of two parts. The first part is report scoring, and the second part is mission scoring.

7.2.1 Report and Video Scoring (30%)

On the table below, scoring types and point amounts are specified. Report points will form the 20% of the Total Score.

Scoring Type	Score
Critical Design Report	%15
System Introduction Video	%15

Table 2 : Report and Video Scores

7.2.2 Mission Scoring (70%)

Scoring types and amounts are given in the table below. In the sum of all competition points, the points of the competitors will be limited as -400 for the cases where the penalty points exceeded 400, and the points of the competitors will be limited to -300 for the situations where the penalty points that can be taken in a competition exceed -300.

As a result of the competition, the score of the team with the maximum total mission score will be scaled as 100 points, and the total mission score of the other teams will be scaled using the same scaling ratio.

Scoring Type	Score
Successful autonomous lock	600
Successful manual lock	200
Kamikaze Mission Points	500
Not transmitting a telemetry package (for each second)	-0.2
Autonomous landing	100

Autonomous take-off	50
Real-Time Video Transfer	50
Incorrect hit detection	-30
Manual Mode Limit Exceeding (For every exceeding change)	-10
Area Penalty	-150
Out of Boundary Penalty	-200

Table 3 : Mission Score Types and Amounts

The score is determined by lock quantity, not by second. Vehicles have to track another vehicle for a minimum of 4 seconds in order to successfully lock. Before the hunter can lock on to the same vehicle again, it has to lock on to a different vehicle.

In order for a lock to be considered as an autonomous lock, the target UAV must be taken into the locking rectangle in autonomous mode and remain in autonomous mode during the follow-up. Switching to autonomous mode after the target UAV is manually placed in the locking rectangle does not count as autonomous locking.

During autonomous locking, selecting a target among a few targets that are detected automatically for UAV to follow and engage is applicable. On the other hand, selecting a region to follow is not going to be counted as autonomous locking. Teams are obligated to reveal their methods that are going to be used for locking to referee jury ahead of competition. Referee jury preserves their right give the finqal decision on any method to accepted it as autonomous locking or not. By joning this competition, teams declare that they are going to accept any decision given by referee committee.

Competitors must fly autonomously for at least 75% of the duration of the relevant competition in order to receive autonomous flight points. During the competition, it is possible for them to switch to manual and return to autonomy with a total autonomous flight time of 75%.

During autonomous flight, it is possinble to send to UAV to a specific target or region by using map of control interface, changing mods or snding commands that are not invalidate autonomy. Controlling the UAV actively by using a joystick or any other control tool is not going to be counted as autonomous flight. Teams are obligated to inform referee committee on the control methods that they ar going to use and commands that they are going to send. Decion on accepting the control methods as autonomous or not is going to be given by referee committee. Referee committee preserves its right to cancel any points taken in case of finding out a control method that is not approved prior to round.

The penalty for going out of the border is taken for being out of the border for more than 10 seconds once or for being out of the border for less than 10 seconds for the 4th time.

7.2.3 Total Score

The maximum score that could be obtained from the competition results is 100. It will be calculated with the formula below.

$$Total\ Points = Scaled\ Total\ Task\ Score * 0.7 + \text{STV} * 0.15 + \text{CDR} * 0.15$$

7.3. Autonomy and Lockout Evaluation Method

While evaluating whether the takeoff, flight and landing are autonomous, the packet sent to the server is referenced and its flow is as follows:

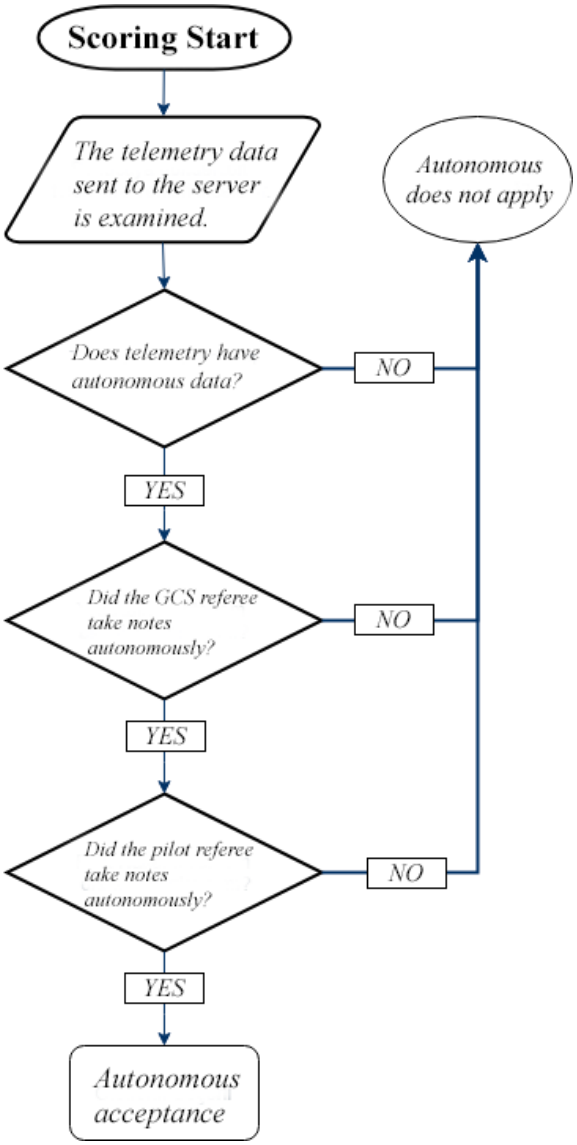


Figure 3: Autonomous scoring flowchart

8 Prizes

Teams that complete the autonomous take off, landing, flight and autonomous locking successfully in at least one of the competition rounds, will earn the right to enter the prize ranking.

Teams that entered in top three places will be given the prizes listed on the table below. Table indicates the total amount of prize, which will be given to the teams that earn the right to a prize. There will be no individual awards. First, second and third place prizes will be divided among all members of the team and will be transferred to each member's specified account.

Within the scope of the competition, the advisor of the winning team is paid. 3.000,00 TL will be paid to the advisors of our ranked teams. If the consultant does not come to the competition area, the consultant award will not be given. In addition, the finalist teams will be awarded the best team spirit, the most original software, the best design and the best system architecture.

	Fixed Wing Category	**Advisor**
First	500.000 TL	3.000 TL
Second	350.000 TL	3.000 TL
Third	250.000 TL	3.000 TL

Table 4: Prizes

Best Team Spirit Award

It is the award given to the teams that aim to finalize the tasks undertaken in the competition area and the business plans in the area in the best way, and to the teams that reflect their energies in the best way, regardless of whether they achieve this goal or not. Firework as a team, effort in the field, skills, communication within and between teams, etc. Assessment will be made on the basis of their status. The specified award is for prestige and does not have a monetary value.

Most Original Software Award:

Software evaluations are made by the Competition Evaluation Board along with the report stages. The transmitted software; They will determine the team with the most original software by voting, considering the evaluation criteria in terms of functionality, reliability, domestic and nationality of the original domestic software product, infrastructure and system architecture compatible with the latest technology, and its effect on increasing our national competitiveness within the scope of the national technology move. The specified award is for prestige and does not have a monetary value.

Best Design Award:
Competitor teams that do not use ready-made airframes in aircraft design and production, but make their own designs and fly at least once, will be evaluated for this award. The specified award is for prestige purposes and has no monetary value.

Best System Architecture:
The compatibility of the subsystems with each other, their redundancy, the compatibility of the selection criteria of the devices used with the competition concept, the teams that have worked in the areas of original subsystem development will be evaluated in this category. The specified award is for prestige purposes and has no monetary value.

8.1 Minimum Success Criteria for Prize Ranking

Teams that have successfully completed autonomous take-off, landing and flight and autonomous locking missions in at least one of the competition rounds to be organized will be eligible to be included in the prize ranking. Autonomous takeoff, landing, flight and lockout must be shown in the same competition round.

8.2 Honorable Mention Prizes

Competitors are required to perform autonomous landing, take-off, flight and locking in at least one of the competitions. The first three places of the competition are determined among the teams that satisfy the prize criteria. If the teams satisfying the prize criteria are not enough to fill the first three places or none of the teams provide the criteria, teams that do not provide are evaluated for the empty places, regarding their scores. Although the teams that did not meet the award criteria can be ranked in this way, they receive an honorable mention to be determined by the Advisory Board instead of the competition award.

For example;

If only 2 teams among the 20 teams provide the prize criteria, these two teams will be ranked as first and second place according to their scores. Since there is no other team satisfying the criteria, other teams are evaluated for the third place. The team that has the highest score among other teams is determined as the third place winner. Even if this team has a higher score than the first and second place winners, since it could not satisfy the prize criteria, it is placed after those teams. First and second place teams get the announced first and second place prizes, but the third place team that does not satisfy the criteria gets the honorable mention prize.

9 Safety Requirements

All the UAVs will be checked for safety, before test and competition flights. If a team cannot pass the safety check, the team will not be allowed to fly.

Minimum requirements for the safety check are given below:

1. Determination of the vehicles consistency with the technical drawings from the competition final report that the team prepared.
2. Checking the vehicle safety in terms of construction and visual.
3. Determination of whether the components are attached safely to the UAV. Determination of whether all the connections are tight and with safety wire, liquid adhesive and/or nuts. Connection materials must be selected as to prevent breaking off connections.
4. Determination of the propeller structure and connection unity.
5. Examination of all electronic wiring to ensure that enough thick wires and connectors are used.
6. Radio range control, motor start and stop.
7. Determination of whether all the control mechanism of the UAV have enough sensitivity or not.
8. Examination of the overall integrity of the load system.
9. All the UAV radios must be capable of automatically switching to fail-safe mode during signal loss.
10. The fuse must be mounted on the exterior surface of the UAV, in an easily accessible location.

During the competition, team UAVs cannot go out of the specified flight area.

A UAV going out of this area for 10 seconds will result in the team's being disqualified from the related competition and needs to terminate flight(fail-safe mode).

Judges can disqualify a team that goes out the flight zone multiple times. This only applies to the current competition round.

In case of a communication loss, manually or autonomously flying UAVs must have seperate flight safety systems. If the telemetry data sent to the server does not return within 10 seconds after being warned, or if there are more than 3 breaks under 10 seconds, the relevant team will be penalized and the aircraft will be landed.

It is at the discretion of the referee board to award the autonomous landing/take-off points of the teams that take off/land dangerously.

If flight mode is manual:

- In case of communication interruption for 10 seconds, the UAV should terminate the flight.

Flight termination for fixed wings must be performed as described below:

- Throttle cutting
- Full pitch up
- Full right rudder
- Full right or left aileron

If flight mode is autonomous:

- Must enter return-to-home mode

10 General Rules

- Objection cases consist of two headings: Report Objections and Final Stage Objections. Report objections are received via KYS within 48 hours after the report results are announced. The objections of the teams that cannot make their objections in accordance with the regulation in the link https://teknofest.org/tr/competitions/objection/ within the period announced by the TEKNOFEST Competitions Coordinator will not be accepted. The objections of the teams are sent to different referee committees and re-evaluated.
- Final Stage Objections can be made during and after the competition. Objections to be made after the competition must be made within 48 hours after the rankings are announced. Objections made other than in violation of the specification and rule violations will not be accepted. For evaluations based on quantitative criteria, no objection will be received and no final or presentation evaluation will be made. These objections should be sent to iletisim@teknofest.org in the form of a petition with their justifications. Objections made in accordance with the rules will be examined by the TEKNOFEST Competitions Coordinator.
- Report Evaluation results after it was announced then every from the team official objection of persons and reasons in writing to transmit required. objections www.t3kys.com at is taken.
- The objection process must be made until the date that the competition committee will transmit after the competition results are announced. Otherwise, objections will not be considered.
- Appeals must be made by the team advisor or team captain. Objections that are not submitted within the specified process will not be considered.

- The advisor’s task; to students own education and training so that they can plan about helper be academic, social and cultural on matters path to show, mental, social and emotional aspects helping to prepare the appropriate environment for the student's personality to develop as a whole, etc. task and services. The role of the advisor in the team is to provide the academic support needed for the project. its members to your problems solution to be able to produce for path is to show.
- Consultant terms; Teachers/academics working in education/training institutions as consultants or engineers/experts who continue their careers in the relevant field, etc. Individuals can take part in the team as consultants.
- The subject of the competition is the result of the effort of the competitor/competitors in the team, the intellectual work reflects the characteristics of the team members and the Consultant will not be accepted as the owner of the work. The project idea has to be created by the team members, and the consultants only need to give direction at this stage. If the project owner is determined to be a consultant, the application will be deemed invalid.
- In their report, our teams that have benefited from the previous year's reports on our website should indicate on the relevant page that they are quoting. State the explanation after the quoted sentence required. QUOTATION FORMAT: "Excerpt Sentence (s) made " (Year, Competition Name, Category, Team Name) EXAMPLE EXAMPLE: " The lack of determination of the earthquake victim's whereabouts in the debris is the most important problem that slows down the debris removal and earthquake victim search efforts." (2021, Technology Contest for the Benefit of Humanity, Disaster Management, Team X)
- Each competitor is obliged to take the necessary safety measures and to show the care expected of her/him towards her surroundings while competition.
- The Turkish Technology Team (T3) Foundation and the organization committee reserve the right to make any changes in this specification in order to ensure fair results, in order for the competitions to be held within objective criteria, to better meet all kinds of needs of the competitors, to ensure safety measures and to make the competition conditions work.
- T3 Foundation and the organizing committee reserve the right to cancel the competitions if, as a result of the evaluations to be made after the application process, there are not enough applicants with the necessary technical knowledge and skills to participate in the competitions.

- TEKNOFEST Safety and Security Specifications are communicated to all competitors, their delegations and relevant persons. All teams that will compete within the scope of the organization are obliged to meet the safety conditions specified in the TEKNOFEST Safety and Security Specifications, specific to the competition they compete in. In this respect, it is the competitors' responsibility to take additional measures arising from the systems used, except for those in the said safety instruction.
- T3 Foundation and the organization committee, the teams that are determined not to meet the conditions specified in the TEKNOFEST Security and Safety Specifications, in order for the organization to take place in a safe environment. competition female leaving right hidden amount. of the competitors, of their delegations and relating to of people during the competitions born violations as a result may occur from damages T3 Foundation and organization officials is not responsible.
- Regarding the competition, the competitor accepts all kinds of written or visual promotions, publications, social media and internet broadcasts to be made before or after the competition by the T3 Foundation and/or TEKNOFEST. and commits. In addition, the competitor is entitled to the rights of processing, dissemination, reproduction, representation, visual or auditory means and the right to transmit to the public on the designs, codes and scientific and artistic work produced or contributed to the production of T3 Foundation / TEKNOFEST without any time limit. e , within the framework of the T3 Foundation 's open source policy. relating to your work It accepts, declares and undertakes that it consents to be presented to the public and used and developed by the relevant persons by reference. T3 Foundation reserves the right to make changes on the work when necessary and to make all intellectual property available to the public (limited to what it shares with the T3 Foundation) as and when it deems appropriate.
- Regarding the rights on the part of the competitor's work that it has transferred to the T3 Foundation, the Industrial Property Law No. 6769 and other legal provisions regulating Intellectual Property Rights legislation in the framework of Turkish Patent and Trademark Authority or WIPO (World Intellectual property Organization) before Provided that T3 Foundation obtains written permission, it can make a registration or protection application, T3 Foundation and T3 Foundation will not prevent its use by applying any prohibition against third parties who benefit within the scope of open source code policy, not apply for protection

measures within the scope of legal legislation, allegation of violation accepts and undertakes that he/she will not make a request for the cessation of use.

- The ideas shared in the previous year's reports should not be used directly. Necessary legal actions will be taken against the teams that are found to have used the idea directly, and it will be ensured that they cannot apply to the competitions organized within the scope of TEKNOFEST for at least 2 years.
- TEKNOFEST suffer any damage due to the competitor's violation of the intellectual property rights of any product, such damages will be covered by the relevant team (including the consultant).
- A Certificate of Participation will be given to all finalist teams entitled to participate in the competition.

ETHICS

- Festival in the field or competition process along (report steps, evaluation process etc.) society immoral a situation, verb, word, etc. behavior exhibited as soon as it is detected, the legal process against the person(s) who committed this act will be promptly initiated and the team will be barred from participating in any organization and event operating within the Turkish Technology Team Foundation for at least 2 years. The points to be considered in the language used in all communication with the TEKNOFEST Competitions Committee are as follows;
  - Rude and discourteous promise and from behavior should be avoided,
  - Insult, threatening and bad from the words should be avoided,
  - e-mail , facebook , skype , messenger , whatsapp , twitter etc. as social media with tools Directly targeted insults should be avoided,
  - Petition and in your objections, spelling to the rules and to the style Caution to be made required.
- Situations, verbs, words, etc. that will affect the functioning and motivation of other teams in the festival area. behavior should not be exhibited.

- Accommodation of your services given country and around social peace of mind eyelash before should be treated. Otherwise, the initiation of legal proceedings against the person will be carried out by the relevant institutions.
- In the project and product development process, the necessary equipment and materials are backed up/stored in advance, taking into account all kinds of negativities, and part replacement in case of a possible negativity. your team under the responsibility whether other a from the team product supply failure to provide required.
- In the festival area and in all kinds of services provided by TEKNOFEST, attention should be paid to the fact that it behaves in accordance with the requirements of the service in an impartial manner, without discrimination of language, religion, philosophical belief, political thought, race, age and gender, and without causing behaviors and practices that prevent equal opportunities.
- Taken not to use or allow TEKNOFEST and other company-institution-organization goods and resources to be used for purposes other than their purposes and service requirements, and not to waste these goods and resources.
- To support the works carried out to facilitate the operation of the festival, to meet their needs in the most effective, fast and efficient way, to increase the service quality and to increase the festival satisfaction.
- It affects or seems to affect the impartial and objective performance of the contestants in the festival area. and themselves, to their relatives, to your friends or in a relationship located person or should be careful about all kinds of benefits provided to organizations, financial or other obligations related to them and similar personal interests, and take the necessary measures to avoid conflicts of interest.
- Avoiding waste and extravagance in the use of TEKNOFEST, buildings and vehicles, and other public goods and resources, shift time, public goods, sources, labor and possibilities while using effective, efficient and frugal behavior is required.
- TEKNOFEST team members can be accountable for their responsibilities and obligations during their performance, and be open and ready for institutional evaluation and audit, take the necessary measures to prevent transactions or actions and corruption that are not in accordance

with the objectives and policies of their institutions, and train their personnel on the principles of ethical behavior, it is necessary to monitor whether the principles are followed and to guide ethical behavior.

- Set members' duties in its place while bringing binding the institutions they work with by exceeding their authority. statement, commitment, promise or in attempts absence, deceptive and real female statement not giving required.

Responsibility Statement

- T3 Foundation and TEKNOFEST are not responsible in any way for any product delivered by the competitors or any injury or damage caused by the competitor. T3 Foundation and organization officials are not responsible for the damages caused by the competitors to third parties. T3 Foundation and TEKNOFEST are not responsible for ensuring that teams prepare and implement their own systems within the framework of the laws of the Republic of Turkey.

Turkey Technology Team Foundation herein in the specification each kinds change doesn't do that right hidden amount.