July 11, 2007

MAV07 General Rules

Definition of a Micro Air Vehicle

Micro Air Vehicles (MAV) are flying air vehicles controlled from the ground and capable of flying with various degrees of autonomy.

« Flying air vehicles » are vehicles capable of sustained flight out of ground effect while requiring the Earth's atmosphere as a medium of interaction to achieve lift. As such, pogo sticks and similar momentary ground-contact vehicles are not considered to be flying air vehicles.

Maximum weight and dimensions

In order to enter the competition, the maximum distance between any two points belonging to fixed or moving parts of the vehicle should not exceed 500 mm (flexible antenna excluded). Furthermore, the maximum mass of a ready-to-fly MAV should not exceed 500 grams, including payloads defined in the mission description (such as the paintball weight for the outdoor mission).

For technical demonstrations only, the maximum dimension should not exceed 1 meter and the maximum flying mass should not exceed 2 kilograms.

MAV with moving or variable geometry or area must comply with the specifications of maximum dimension when the surfaces are in maximum and minimum extended mode.

Safety requirements

Any form of propulsion is acceptable if the design is deemed safe in preliminary review by the flight director. In particular, the use of pyrotechnic devices, inflammable gas or liquids is not allowed.

Each vehicle must be equipped with a termination mechanism that can render the vehicle ballistic upon command of the flight director.

Definition of a team

Each team consists of 4 people maximum. A main system operator (also referred to as 'team leader') is responsible for conducting the mission. In the following, all decisions taken by the team will be only taken into account if announced by the team leader only.

The team leader is permitted three helpers. For each team, a 'pilot' is in charge of manually controlling flying vehicles and should be ready at any time to recover control in case of problem.

A single pilot is allowed per team. The pilot may be the main system operator or one of the helpers.

All team members should remain within the launch zone during the working time. If one or several team members leaves the launch zone, the tasks will not be scored during that time.

Number of vehicles

Each team is allowed to successively use a maximum of three MAVs: a first vehicle plus 2 spare vehicles, to complete the mission, but only one ground station is allowed to operate the different vehicles within the working time slot allocated.

For safety reasons, a single MAV can be airborne at a time. A maximum of 2 additional spare MAVs can be used within the working time to replace the first prototype when decided by the team. Spare MAVs should be visually identical to the first prototype.

“Visually identical” means that the overall configuration, number and relative positions of lifting and non-lifting surfaces, number of rotors and propellers, launching device, payload, are the same. Slight differences in size and weight between vehicles are acceptable.

Points are awarded per task and not per MAV. If more than two MAVs successively complete a given task, the highest task score will be retained.

Pre-flight control

Each MAV presented by a team is controlled before the flight in order to :
- measure its maximum size and its total weight,
- check that the maximum size and weight requirements are satisfied,
- control that spare vehicles are visually identical to the first vehicle presented.

The controller then issues a clearance for flight if all conditions are met. Each vehicle should be in a ‘ready-to-flight’ configuration when controlled. No additional part must be added to any flying vehicle after the control.

If spare MAVs are used, the maximum dimension that applies for the overall scoring is the maximum dimension of all vehicles, even if some tasks have been performed by a smaller vehicle.

Preparation time

5 minutes max. of preparation are allocated to each team. During preparation time, the team can switch on the ground station and proceed to a check-up list: radio and video transmission, data link, GPS reception, etc.

Preparation time can be shortened on request from the team. Working time then starts when the first vehicle is airborne. Otherwise, the working time starts at the end of the preparation time (5 minutes) even if take-off has not yet occurred.

GPS coordinates for targets 1 and 2 are given in WGS84 format (decimal degrees) at the beginning of the preparation time.

Working time

Each team is initially allowed a working time of 20 minutes to perform the outdoor mission and 10 minutes to perform the indoor mission.

The stopwatch is triggered when preparation time is over or earlier if preparation time is shortened on the team's request.

All tasks scoring are ignored after 20 minutes for the outdoor competition and 10 minutes for the indoor competition. The timer will make several announcements such as: "working time starts now", "5 minutes left", "1 minute left", "end of working time", unless specified as unwanted by the team.

"Pass" requested by teams

One "pass" can be requested by each team for any reason, such as technical problems.

If the "pass" is requested before the working time has started, a new full working time slot will be awarded at the end of the flying order.

If the "pass" is requested after the working time has started and before 5 minutes of elapsed working time, a new reduced working time slot will be awarded at the end of the flying order: 15 minutes for the outdoor mission, 7 minutes for the indoor mission. All scores are then reset to zero.

A "pass" can be used only once and is no longer admissible after 5 minutes of elapsed working time.

Other re-flight opportunities

The team is entitled to a new full working time period (20 minutes for the outdoor competition and 10 minutes for the indoor competition) if any of the following conditions occur and are duly witnessed by an official of the contest:

- the MAV in flight collides with another vehicle in flight. Should the flight continue in a normal manner, the team may demand that the flight in progress be accepted as official, even if the demand is made at the end of the original working time,

- the MAV is perturbed by any well established electronic interference. Should the flight continue in a normal manner, the team may demand that the flight in progress be accepted as official, even if the demand is made at the end of the original working time,

- the flight has not been judged by the fault of the judges or timekeepers,

- in case of an unexpected event, outside the team's control, the flight has been hindered or aborted.

For all cases described above the team may demand that the flight in progress in which the event occurred will be accepted as official. In order to be valid, the re-flight request has to be expressed during the working time. Note is made that in the event the team continues to

launch a MAV after clearing of the hindering condition(s) he is deemed to waive his right to a new working time.

In case of re-flight, all scores are reset to zero.

Flying order

Teams are called following a predefined flying order. When called by the director of flights, approximately 30 minutes before the scheduled working time, each team is invited to come to the control and to setup in the launch zone.

Weather conditions

The outdoor flight session will be conducted under daylight conditions in winds gusting up to 10 m/s (20 knots). In case of precipitation, the director of flights will decide if the outdoor competition should be interrupted. The outdoor flight session will be delayed only in case of mild and heavy precipitation (above approx. 1 mm/hour).

If weather precludes outdoor flights, the director of flights can decide to revert to a “rain day”.

Levels of autonomy

Vehicles may be teleoperated or fully autonomous. They must compete based on their ability to sense the semi-structured environment of the flight arena, which may extend beyond line of sight.

Only three levels of autonomy are considered for the mission :

- auto 0 : a pilot manually controls the vehicle by direct visual contact (“RC mode”).

- auto 1 : a pilot manually controls the vehicle through a remote on-board video camera. (“camera mode”).

- auto 2 : no direct manual control is performed (“hands off mode”).

Manual control (either ‘auto 0’ or ‘auto 1’) can be performed through a radio transmitter or a joystick, keyboard, mouse, etc.

Entering new waypoints coordinates through keyboard/mouse is still considered as “hands off mode”.

In order to be scored according to a given level of autonomy, a task needs to be completely performed, that is from the position when the previous task has ended up to the point when the task is considered to be achieved. Therefore, for instance, conducting a manual flight between target 1 (Task 1) and target 2 (Task 2) and switching to autonomous mode over target 2 is not considered as autonomous mode for Task 2.