Description of indoor competitions – PRELIMINARY VERSION

Introduction
The Summer-IMAV2011 indoor rules have been created to stimulate a higher level of autonomy compared to previous years. The main bottleneck for indoor autonomy is reliable indoor positioning. To help teams solve their positioning problem, they are allowed to use *external aids* in both mission environments at the cost of autonomy points (factor A_n). Examples of external aids are visual references, radio positioning beacons, etc.

Additionally, a distinction is made between autonomous flight control and autonomous mission control without any user intervention. Teams with hands-off operation will be able to score more points. See Table 1 for more details. There will be two indoor competitions: the Pylon Challenge and the Exploration Challenge.

To promote autonomy, RC-only control is no longer part of the competitions. Teams with an innovative RC-only platform can request a demo slot.

Location
To be announced.

Scoring
The total score for each indoor mission is given by:

$$S_{total} = \sum_{n=1}^{N} \left(\left(A_n - e_n \right) \cdot M_n \right) \cdot \left(2 - \frac{L}{L_{\max}} \right)^k$$

Where:
A_n is the autonomy level of the MAV when attempting mission element n,
e_n equals 0 or 2 when using external aids during mission element n,
M_n is the number of points scored for mission element n,
L is the largest dimension of the MAV,
L_{max} is the maximum allowed dimension, and
k is the exponent of the size part of the equation.

The maximum allowed dimensions for the indoor missions are:
Rotary wing: L_{max} = 70 cm
Flapping wing: L_{max} = 70 cm
Fixed wing: L_{max} = 80 cm
k = 3

For both missions:
The level of autonomy is taken into account per mission element. Thus teams are not penalized for the entire mission if they cannot perform all mission elements at the autonomy level they were aiming for. The autonomy factor (A_n) is shown in Table 1.

Table 1: Autonomy factor (to be announced)

Levels of autonomy:	*Factor A_n)*
Video based (beyond line of sight)	1
Autonomous flight control (with user intervention)	6
Autonomous mission control (without user intervention)	12
Using external aids (visual markers, etc.)	-2

Teams have to announce before their flight at what level of autonomy they will attempt each mission element. During their flight they will report to the jury what they are doing so the jury can establish the actual level of autonomy during the mission elements and award the appropriate points. Teams need approval for using their external aids.

Competition slot: preparation and flight time
Teams are not assigned a preparation time and a flight time but rather a competition slot. In this slot they set up their equipment and possible external aids, prepare flight, fly the competition, and clear the flight area.

Pylon Challenge
Slot time: 20 mins.
Flight time of an attempt: 3 mins.

Teams have to fly their MAV in figure 8s around two poles that are 10m apart. Each completed figure 8 will be awarded 1 mission point. Points will not be awarded for a lap when the MAV flies above pole height (4 m).

Flight time starts when the team announces their start, and the team has then 3 minutes to fly as many laps as possible. A crash voids the flown attempt and the team can try as many attempts as their time slot allows.

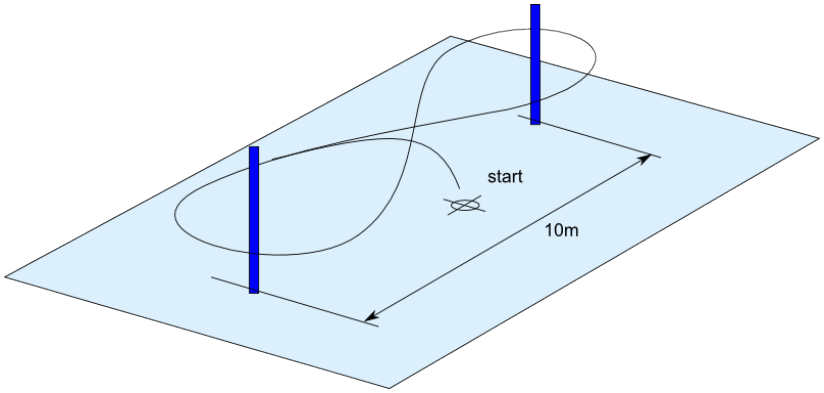

Figure 1: Indoor Pylon Challenge

Exploration challenge
Slot time: 20 mins.

The exploration challenge is shown in Figure 2. It consists of the following mission elements:

Take off: The MAV will take off in the start zone behind the wall and score 1 mission point.
Fly over wall: when starting in zone 1, the MAV has to fly over the wall to score 1 point.
Enter Building: The MAV can enter the building through the door (1 point) or through the window (2 points).
Identify coarse pattern: The coarse pattern has to be identified (1 point). See table 4 for specification of the patterns.
Identify fine pattern: The second pattern to be identified is a photograph of a face (2 points).
Pick up object: The challenge is to pick up an object inside the building that needs to be transported outside the building. 1 point is scored when the pick up object is successfully transported outside.

Exit building: The MAV can exit the building through the door or window (0 points) or the chimney (2 points).
Release object: Outside the building is a release zone where the object can be released (1 point).
Precision landing: Finally the MAV can demonstrate its precision landing capabilities on a small platform (1 point).
Heat resistance: Next to the landing platform a heat lamp is positioned simulating the sun. The MAV is required to stay 20 second on the platform and then successfully take off again. (1 point).

Pilots / operators may not leave their start zone while flying but they are allowed to leave the start zone to pick up the MAV and start again when inside the start zone. The MAV should be placed in the restart zone.

One of the mission elements involves the picking up of a physical object with the MAV. Teams have to supply their own pickup object. Teams are free to choose the pickup object including attachment and release mechanism. The only constraint is that the pickup object must be big enough to contain a 5x5cm square. Figure 3 shows an example pickup object.

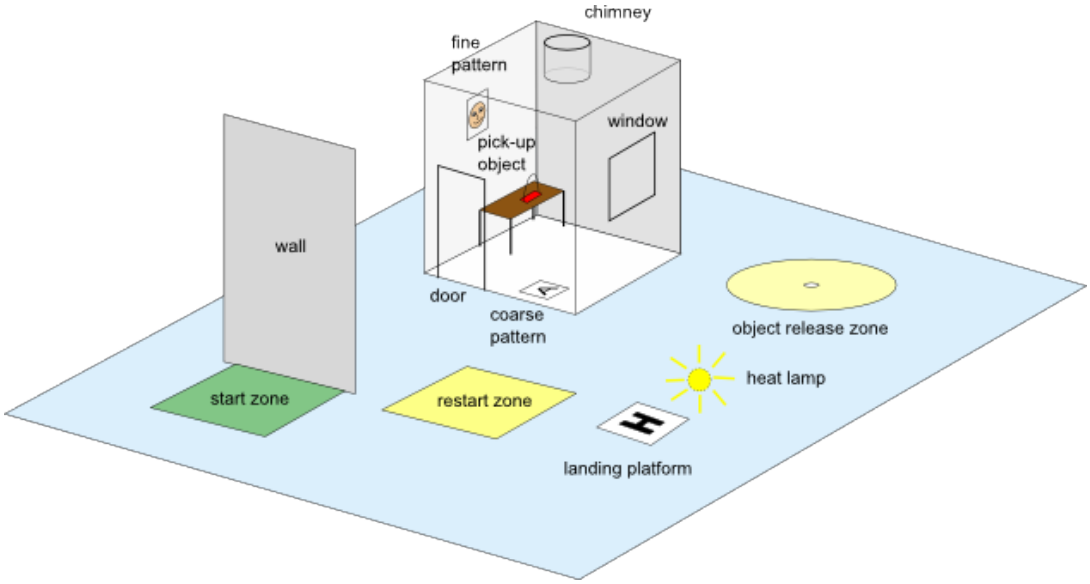

Figure 2: Indoor Surveillance Challenge

Table 2 shows the mission points per mission element. In the case of multiple attempts for the same mission element, the best score counts. The pickup object may not be manually manipulated during the mission.

Table 2: Indoor surveillance challenge mission points

Mission element:	*Score M_n*
Take off	1
Fly over wall	1
Enter building through door / window	1 / 2
Recognition of course pattern	1
Recognition of fine pattern	2
Bring pick-up object outside building	1
Exit through chimney	2
Place object in zone	1
Land on small platform	1
Heat resistant take-off	1

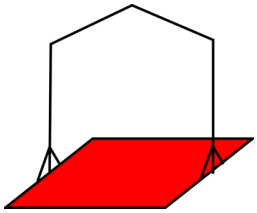

Figure 3: Example of the pick-up object