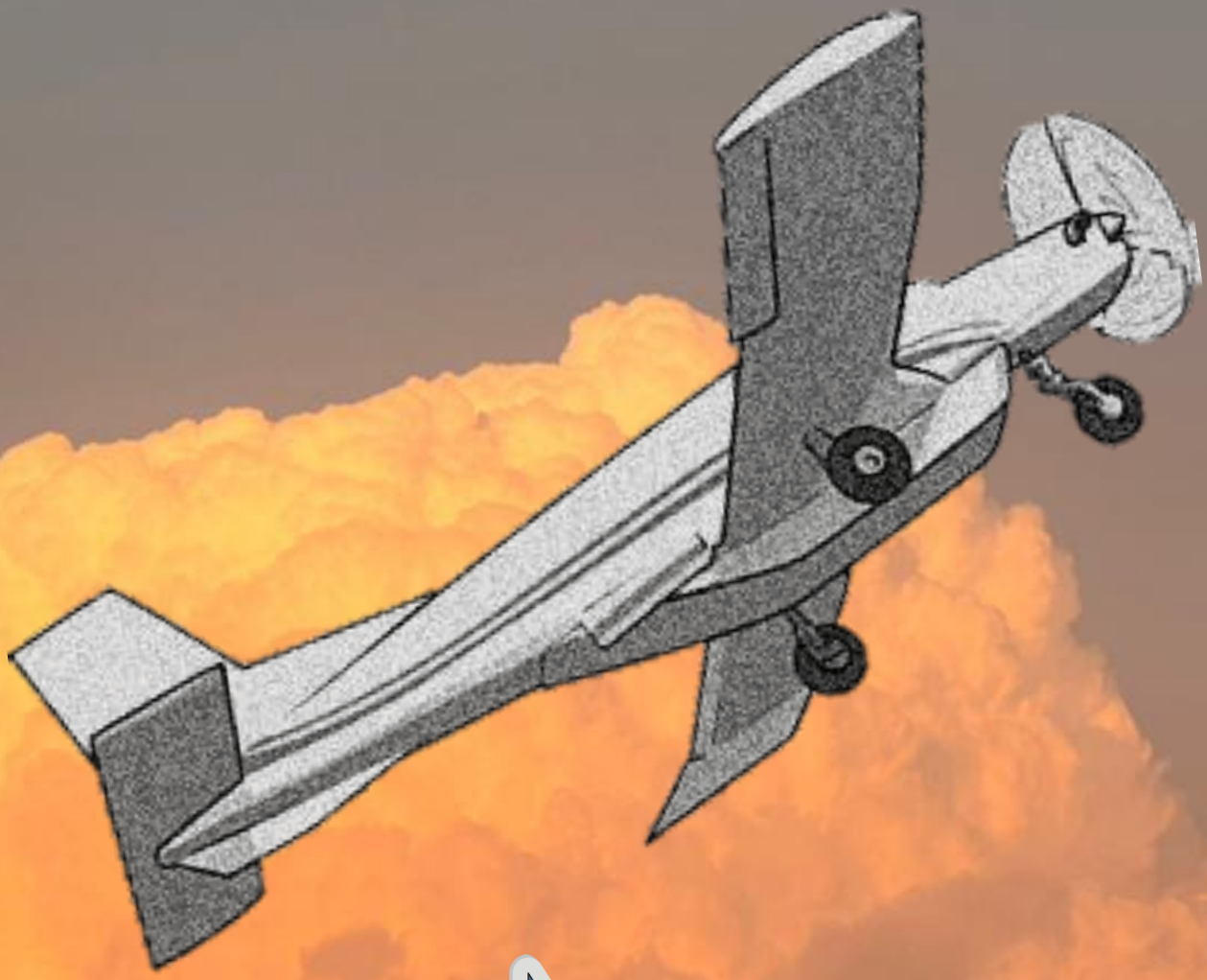
UDC DBF-2023

Where Ideas Take Off



UDC

Unmanned Aerial Systems Development Center

Cairo University - Faculty of Engineering

Aerospace Department

Unmanned Aerial Systems Development Center

AERONAUTICAL ENGINEERING

Medical Supplies Delivery

Delivery of medical supplies is one of the common uses of UAVs nowadays, they are used to deliver the supplies to the medical facilities, people residing in remote areas and those affected by natural disasters.

These types of missions are very sensitive and requires fast solutions, so using a UAV would be a perfect choice as they have the advantage of speed and effectiveness over conventional modes of transportation, which rely on adequate infrastructure. Thus, UAV's use has the potential to improve medical care, particularly in remote areas, by shortening total amount of time required to complete lab testing, enabling on time delivery of lifesaving medical supplies, and minimizing rural prescription care costs.

So that our aim in this year's competition is to focus on these types of Aerial solutions that having a great positive effect on people's lives and health.

An example of these aerial solution companies is "Zipline". They started delivering blood and medical products in Rwanda in 2016 and has since expanded to food, retail, agriculture products, and animal health products. Zipline has two platforms — one for long-range delivery and the other for precise home delivery.

Here is a Video for more information: https://www.youtube.com/watch?v=jEbRVNxL44c&t=412s

Flight mission

In this year's mission, you are required to design a UAV with minimum possible weight that is capable of carrying a medical supplies box attached to a parachute. The UAV will complete the first lap of the course carrying the box. On the second lap, the box will be deployed with the parachute using a mechanism you will design, After that the UAV will make its third and final lap before landing.

The mission sequence will be as follows:

1. Take-off with the box.
2. Perform one complete lap around the course.
3. Drop the box.
4. Perform one lap without the box.
5. Landing

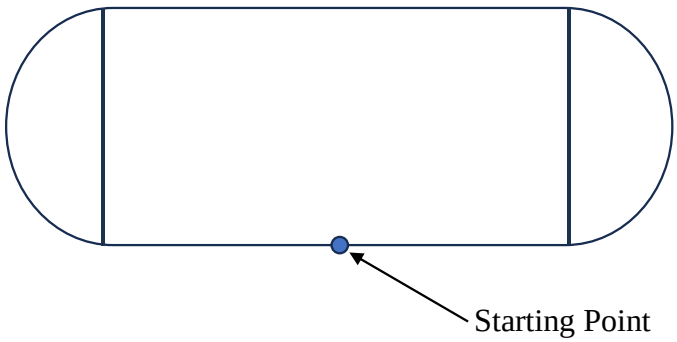


Figure 1 Flight Course

Notes

- As a measure of the parachute efficiency, a 5G shock sensor will be attached to the box to sense the impact. If the sensor is triggered then the parachute isn't efficient enough. (The sensor will be provided for all teams)
- Each team will design their Propulsion System.

Important Rules

- Teams will design their own parachute.
- The box must contain real medical supplies.
- medical supplies should not have any liquids or sharp edges (medicine or needles), an example of the supplies you can use is: band-aids, bandages, etc…
- Tape and magnets are not allowed, instead you can use any other locking type.

- An arming fuse circuit is provided by the competition organizer and all aircrafts have to (include/contain) this circuit.
- Each aircraft must contain RX-battery and a switch connecting between that battery and the RX (RX is the Receiver).
- The arming fuse and the switch have to be accessible from outside the aircraft.
- Propulsion system components (Battery and ESC) has to be securely fastened using Velcro-straps.
- Aileron's servo motor has to be attached to the wing using servo holder provided by competition organizer.
- All payloads must be secured sufficiently to avoid any shift in the A/C CG outside the design limits and possible loss of control.

Payload

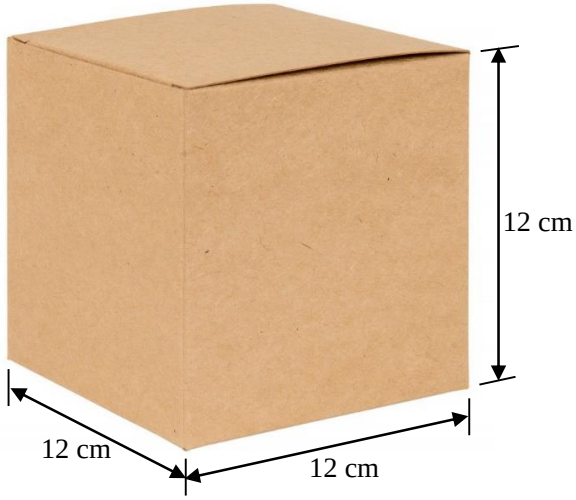


Figure 2 Medical Supplies Box

Figure 3 Shock Sensor

➢ This website can help you design your parachute (recommended). However, you are free to choose another method/reference for the parachute design, but you have to state your resources in your report.
https://www.webpages.uidaho.edu/dl2/on_target/tv.htm

UAV Specifications

- The UAV can be of any configuration, except quadcopter, rotary wing, or lighter-than-air.
- The UAV will be hand launched (no landing gear will be used).
- The UAV will have only one motor.
- Your design must be suitable for hand-launching.
- Your design must be suitable for the parachute so it doesn't get stuck to the frame or the components.
- Your design must be free of hard, sharp edges that may inflict serious injuries to people or damage to property.

Constraints	
MTOW (Maximum Take-Off Weight)	2.5 kg
Maximum Span	160 cm
Maximum Airfoil thickness	4.5 cm
Box Dimensions (L x W x D)	12 x 12 x 12 cm

Technical Inspection

Each competing aircraft will have to go through a technical inspection before any flight test to verify safety, and adherence to competition and mission rules. The tech inspection checklist is as follows:

- Verify all components adequately secured to the vehicle.
- Verify all servo motors are working properly and connected in the right way.
- Verify all control surfaces are well-connected to the lifting surfaces.
- Verify the arming fuse and the switch are accessible from outside the aircraft.
- Verify the motor mount, wings and tail are well-connected to the rest of the structure.
- Motor Mount Test.
- Wing tip test will be done to make sure that there is no large deformation in the wing.

Useful Data

How to make a Y-connection for aileron's servos:
https://www.youtube.com/watch?v=SBaWLQgd7Kg&t=230s

Items Provided by UDC Lab

- Propellers
- Batteries
- Brushless Motors
- Speed Controllers
- Receiver
- Switches
- Arming fuse circuit
- Servo holders
- Machines for manufacturing (Hotwire and Laser cutter)

Points grading

There will be a total of 400 points for the whole competition divided between the report and the mission

Segment		Points
Theoretical Section (100)		
Report		100
Practical section (7)		
C_1	Payload fraction coefficient	$C_1 = \frac{\left(\frac{W_{Payload}}{MTOW}\right)_{Your\ Team}}{\left(\frac{W_{Payload}}{MTOW}\right)_{Best\ Team}}$
C_2	Successful takeoff coefficient	0 or 1
C_3	Successful payload deployment coefficient	0 or 1
C_4	Successful parachute activation coefficient	0 or 1
C_5	Successful landing coefficient	0 or 1
C_6	Shock Sensor coefficient	0 or 1

$$Total\ Score = Report\ score\ x\ Mission\ score$$

$$Mission\ Score = 2C_1 + \frac{1}{2}C_2 + \frac{1}{3}C_3 + \frac{1}{3}C_4 + \frac{1}{2}C_5 + \frac{1}{3}C_6$$

- Note That

$$W_{Payload} = W_{Box} + W_{Parachute}$$

Design Report

Cover Page

- Must include the team's name.

Executive Summary (10 Points)

- Summary description of selected design and why it best meets the mission.
- Describe key mission requirements and associated design feature.

Management Summary (10 Points)

- Describe the organization, the role of each team member.
- Milestone chart showing planned and actual timing of major elements (If Available).

Preliminary Design (20 Points)

- Configuration Selection.
- Weight Estimation.
- Airfoil Selection.
- Aircraft Sizing.
- Provide estimates of the aircraft lift and stability characteristics.

Detailed Design (30 Points)

- Document dimensional parameters of final design. (Dimensions / Weights / CG Travel Line).
- Isometric view and 3-View drawing with most important dimensions.
- Exploded View.

Manufacturing (30 Points)

- Describe the process, materials, and machines used.
- Describe any joints used in your aircraft design.

Good Luck