Escola de Engenharia
Universidade do Minho

Projeto Aeroespacial

Apresentação intermédia

Grupo de Estruturas

2º SEMESTRE 2023/2024

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EL 1

UAV Repair

Projeto Aeroespacial

UAV Repair: where do we start

Projeto Aeroespacial

1. Cover Removal

(a)

(b)

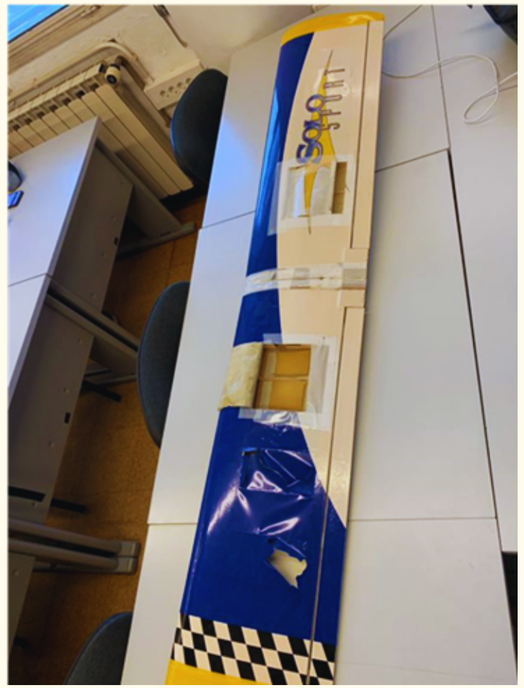
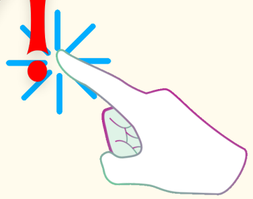


Figure 1. UAV model before cover removal (a) fuselage and horizontal and vertical stabilizers and (b) wing

- Initially, the UAV was fully covered, exhibiting a graphical identity like the majority of the aircraft models.
- Such cover could hide damage in the structure beneath it. Also, removing it could cause additional damage.

PRIORITY!



1. Cover Removal

Figure 2. UAV after cover removal.

- **1st step:** Remove the cover from both wings.
- **2nd step:** Remove the cover from the fuselage and horizontal and vertical stabilizers.
- **3rd step:** Sand the whole structure to remove the glue residues.

2. Ribs replacement

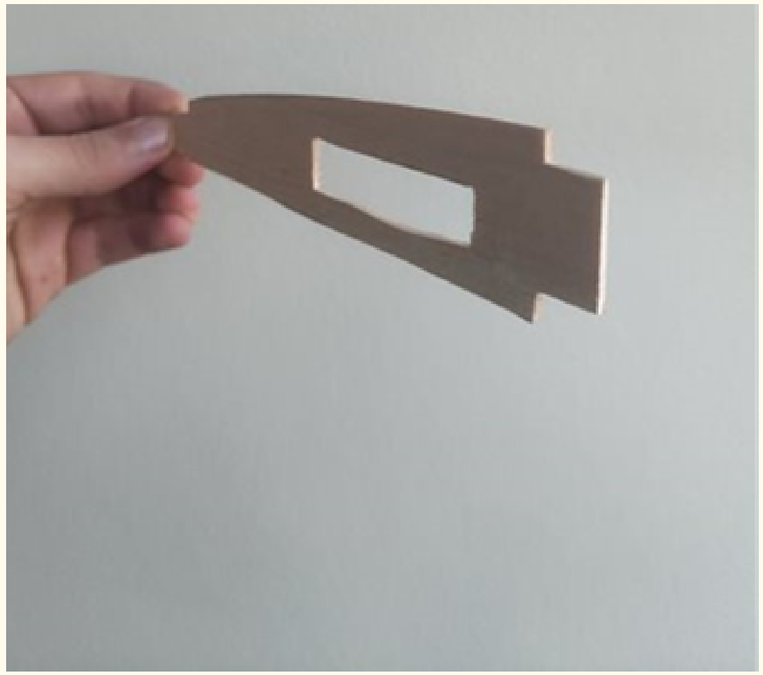


Figure 3 Rib model.

- **9 out of 16** ribs needed to be replaced
- One of the original ribs was used as model and new ribs were cut from a wood balsa board of the same thickness as the original.
- The new ribs were sanded to fit in their places.

2. Ribs replacement

- Using wood glue, the ribs were properly placed within the wing structure.

- After the glue had already dried, the attachment regions were carefully sanded to obtain a clean and smooth surface.

Figure 4. Ribs attachment to the structure using wood glue

3. Repair of the fuselage opening for motor-ruddle connection

- A metal rod connects the servomotor placed inside the fuselage with the ruddle through an opening existing at the back region.

- However, such a fully open design allowed the rod to deflect, as there was no lateral constraint to its movement

BACK COVER

3. Repair of the fuselage opening for motor-ruddle connection

- Using a wood balsa board with a thickness of XX mm, a new piece with the same outer geometry as the back opening of the fuselage was placed there.

- A cut whose width was close to the rod diameter was made. The opening length was determined by positioning the ruddle at two extreme positions: fully up and fully down.

3. Repair of the fuselage opening for motor-ruddle connection

- Such a modification of the original structure allows the connecting rod to move free in the vertical, as the opening length is compatible with the stroke required to allow the ruddle full control.

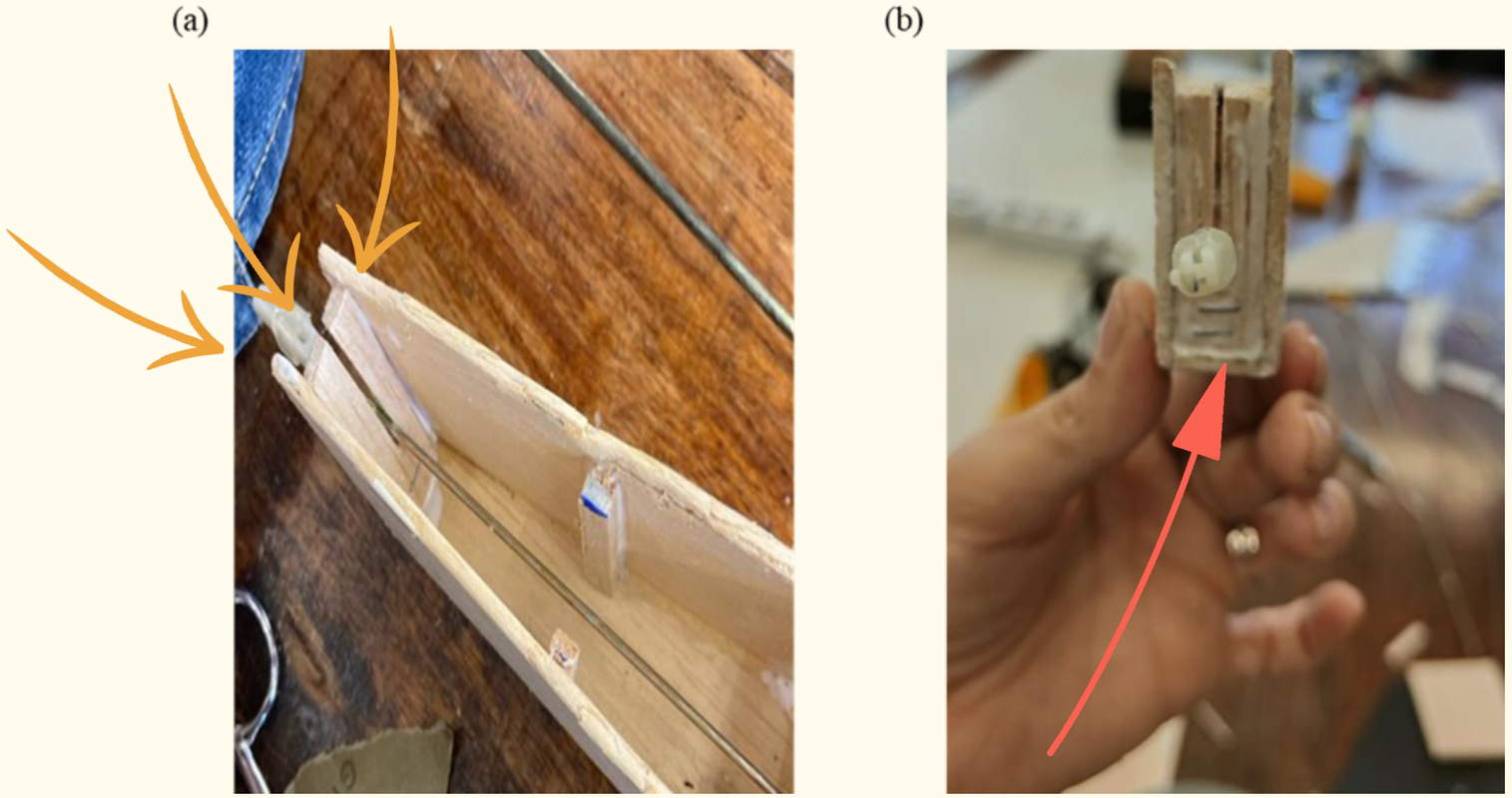


Figure 4. New piece placed at the back of the fuselage with an opening to allow the ruddle control (a) top view and (b) back view.

4. Repair of the fuselage back cover

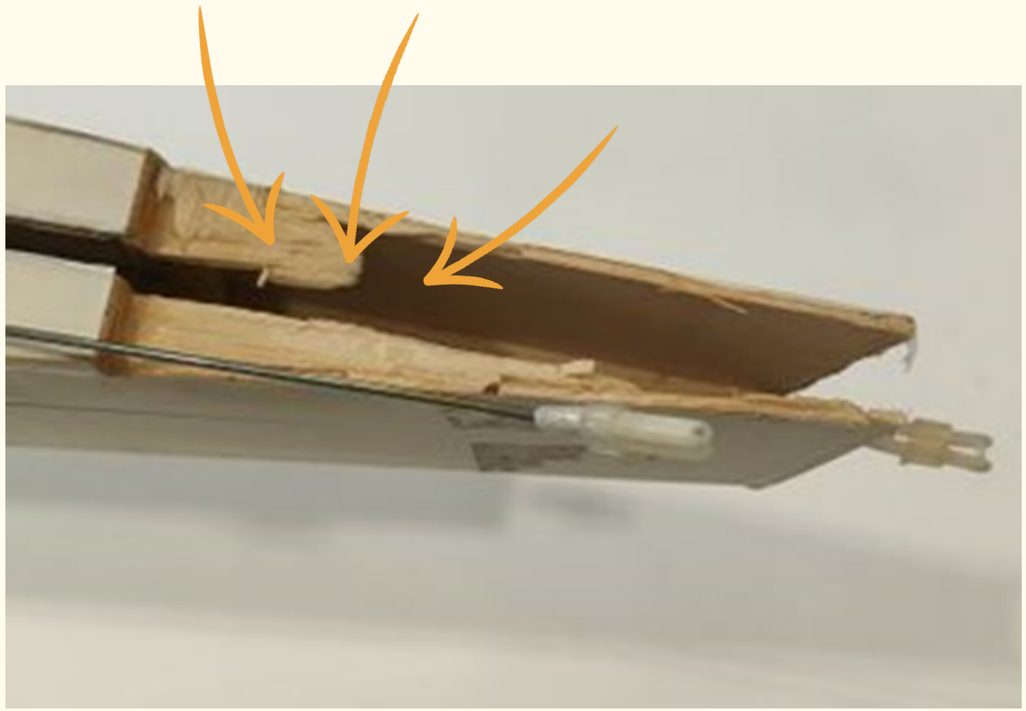
- The fuselage’s back region was severely damaged.
- The top cover was missing.

TOP COVER

Fuselage's back region severely damaged.

4. Repair of the fuselage back cover

- **1st step:** remove the remaining parts of the previously existing cover and properly sand the region to remove residues and smooth the surface.



Fuselage's back region severely damaged.

4. Repair of the fuselage back cover

- **2nd step:** define the design of the top cover to be made, which was drawn on a wood balsa board whose thickness was **XX** mm.

- **3rd step:** make three holes using a drill and a keyway to allow the vertical stabilizer assembly.

- **4th step:** place the cover at the fuselage's back region and attach it using wood glue.

Placement of the top cover at the fuselage's back region

5. Horizontal Stabilizer repair

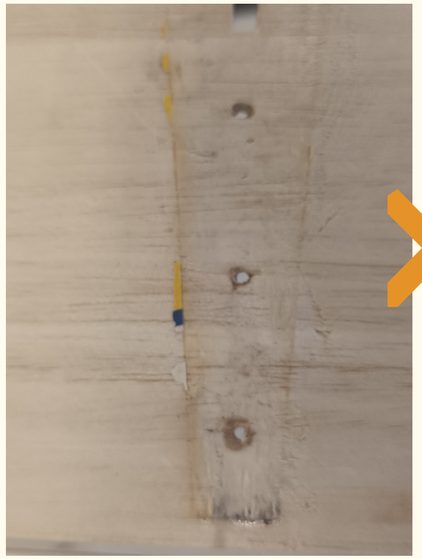
The screw holes that attached the Horizontal Stabilizer to the fuselage were wide and did not guarantee good cohesion between parts.

5. Horizontal Stabilizer repair

Repair Procedure

The holes were previously covered with a paste made from balsa chips and glue.

5. Horizontal Stabilizer repair



It was carefully sanded to make it uniform !

These holes will be reopened when the fuselage is assembled !

6. Hole repair in left wing

An accident occurred with the left wing: localized excess pressure caused a hole measuring around 3x4 cm area.

6. Hole repair in left wing

Repair Procedure

Step 1: transforming the hole of imprecise dimensions into a square-shaped hole, measuring around 4 centimeters per side

Step 2: building a grid placed on the inside of the wing.

6. Hole repair in left wing

The square was filled with a piece of balsa, which edges were completed with wood glue.

The final result exceeded expectations, as the area appears to be reinforced !!

2

UAV Structure Coating

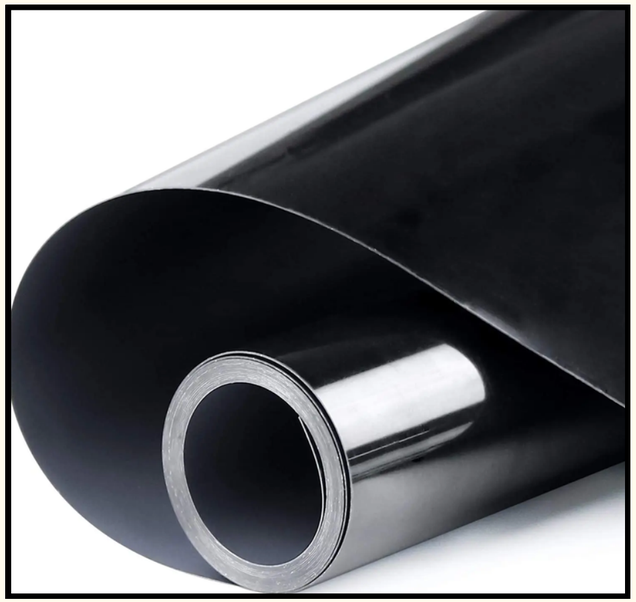
Objectives

1. Understand which coatings are used in UAVs
2. Comparison between coatings
3. Choice of coating to use on the UAV

Understand which coatings are most commonly used in UAVs

OraCover

Vinyl



Comparison between coatings

To be able to compare the various coatings we will have to analyze 5 points:

- **Strength and Durability**
- **Weight**
- **Flexibility**
- **Ultraviolet Resistance**
- **Price**

OraCover

- Strength and Durability
    - It has greater durability and resistance;
    - It offers optimal protection against scratches.
- Weight
    - It has a lower weight per m2;
- Flexibility
    - It has the ability to adapt well to uneven surfaces and complex curves
- Ultraviolet Resistance
    - Designed to maintain their color and structural integrity even when exposed to sunlight for extended period
- Price
    - Tends to be more expensive than vinyl

Vinyl

- Strength and Durability
    - It has less durability and resistance;
    - More susceptible to tears and scratches
- Weight
    - It has a higher weight per m2;
- Flexibility
    - It is a flexible material but not as much as OraCover
- Ultraviolet Resistance
    - Lower resistance to degradation when exposed to direct sunlight for long periods
- Price
    - Tends to be cheaper than OraCover

Choice of coating to use on the UAV

After analyzing the 5 essential points when choosing the coating, we will choose to:

OraCover

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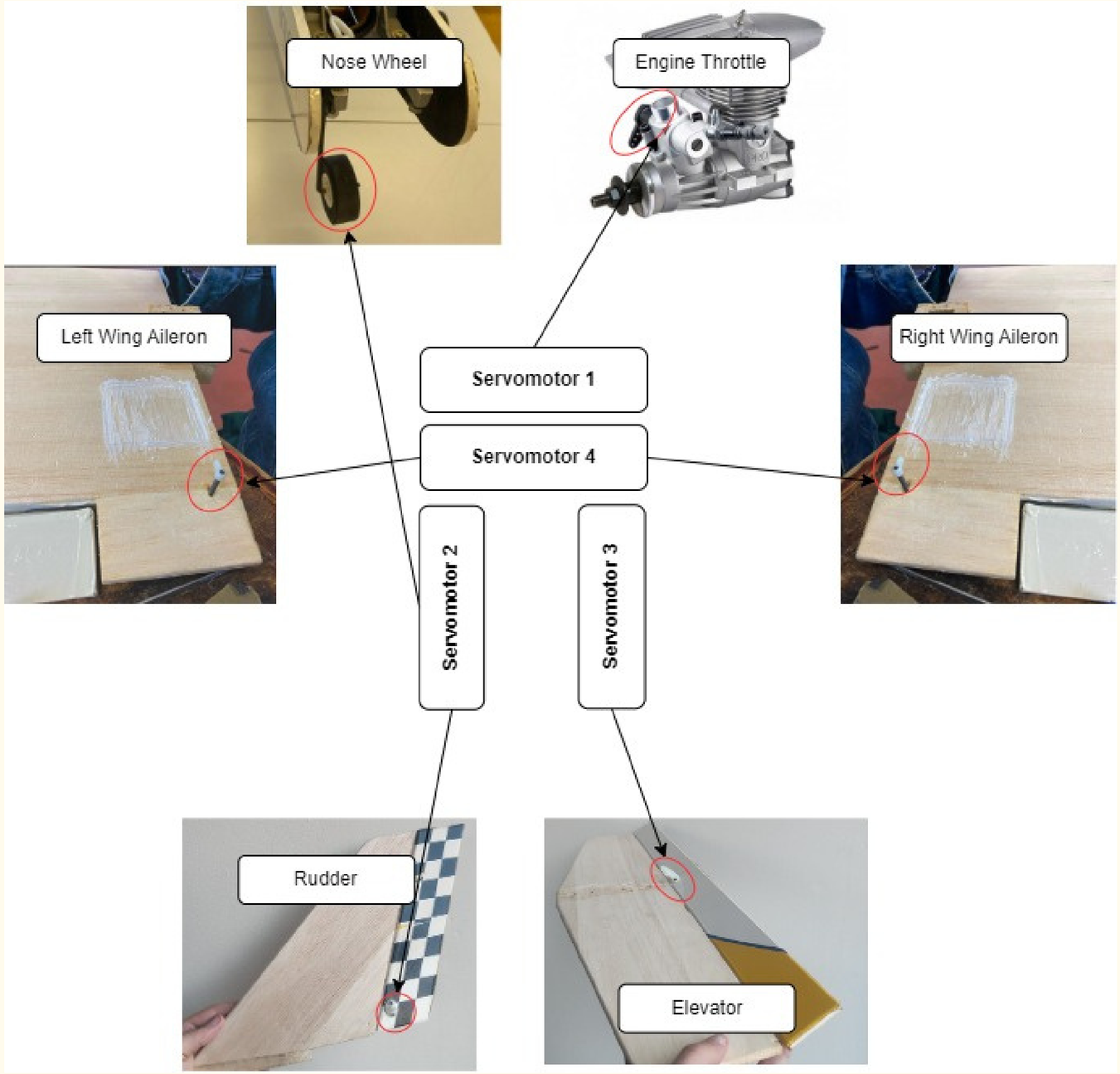
UAVs Block Diagram

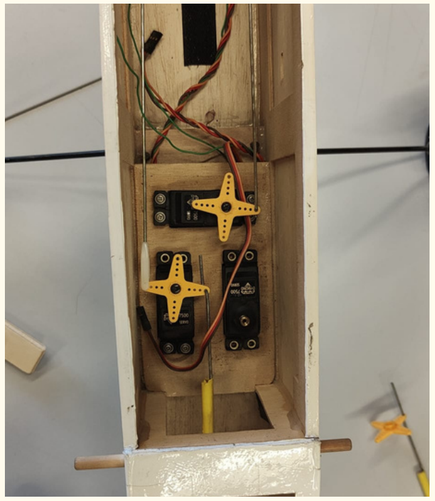
Block Diagram:



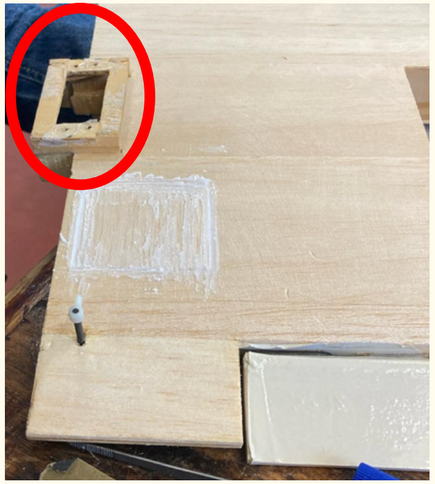
UAV's Block Diagram

Block Diagram Analysis

- Servo Motor 1
  - Local: Fuselage
  - Controls the Nose Wheel direction & the Engine Throttle position
- Servo Motor 2
  - Local: Fuselage
  - Controls the Rudder direction
- Servo Motor 3
  - Local: Fuselage
  - Controls the Elevator Position
- Servo Motor 4
  - Local: Between Wings
  - Controls the Ailerons position from both wings



Servo Motors in the Fuselage



Local where the Servo Motor 4 will be installed

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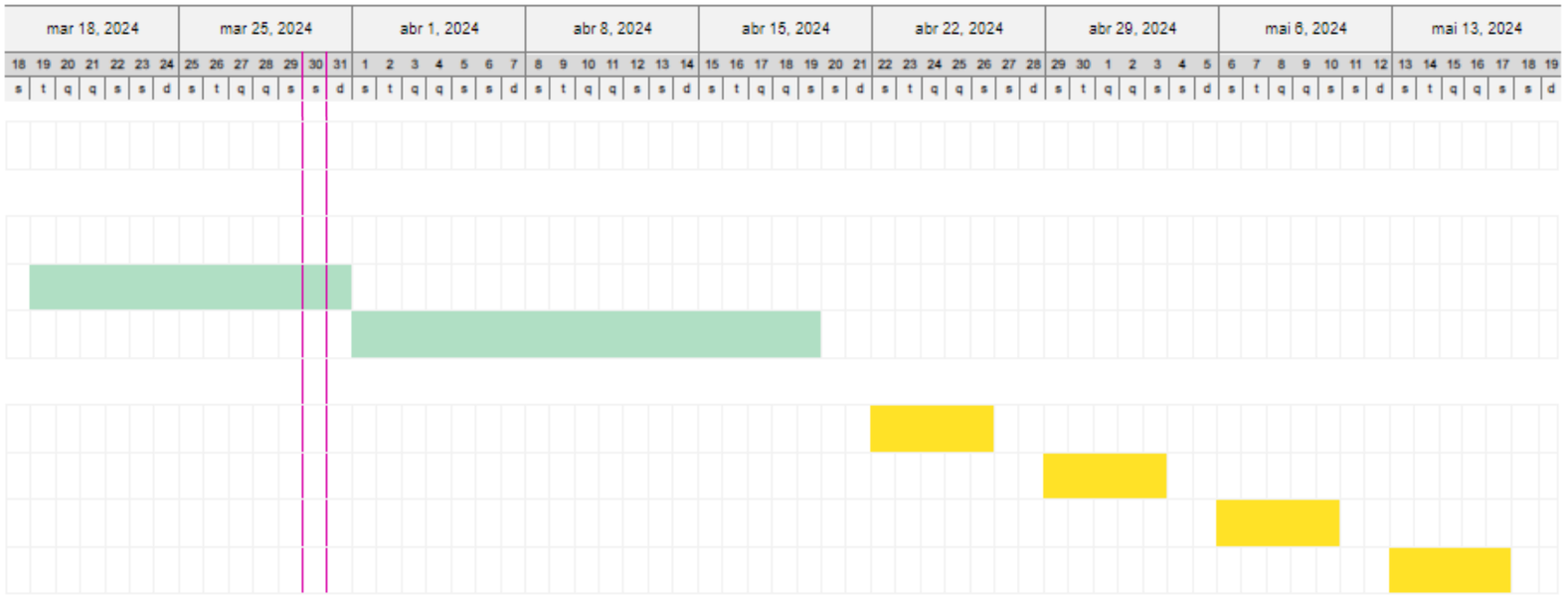
Schedule Update

New Schedule

TASK	START	END
Structure Optimization		
Study of the structural optimization possibilities	27/02/2024	04/03/2024
Topological optimization, regarding the wing's structural components: spars & ribs.	05/03/2024	16/03/2024
Substitution components manufacture	19/03/2024	31/03/2024
Implementation of the new components, on the UAV structure	01/04/2024	19/04/2024
Evaluation		
UAV validation	22/04/2024	26/04/2024
Connect the avionic and motors systems with the UAV	29/04/2024	03/05/2024
Carry out final tests of the entire UAV system	06/05/2024	10/05/2024
Solve any remaining issues	13/05/2024	17/05/2024



- Extension of the implementation of new components on the UAV phase;
- Sync our schedule with the other groups schedule.

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Next Steps

Next Steps

- Apply the oracover on the UAV
- Reinforce and unite the Wings
- Connect the Motor and Avionics to the Strucutre
- Assemble the UAV
- Perform a successful flight

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