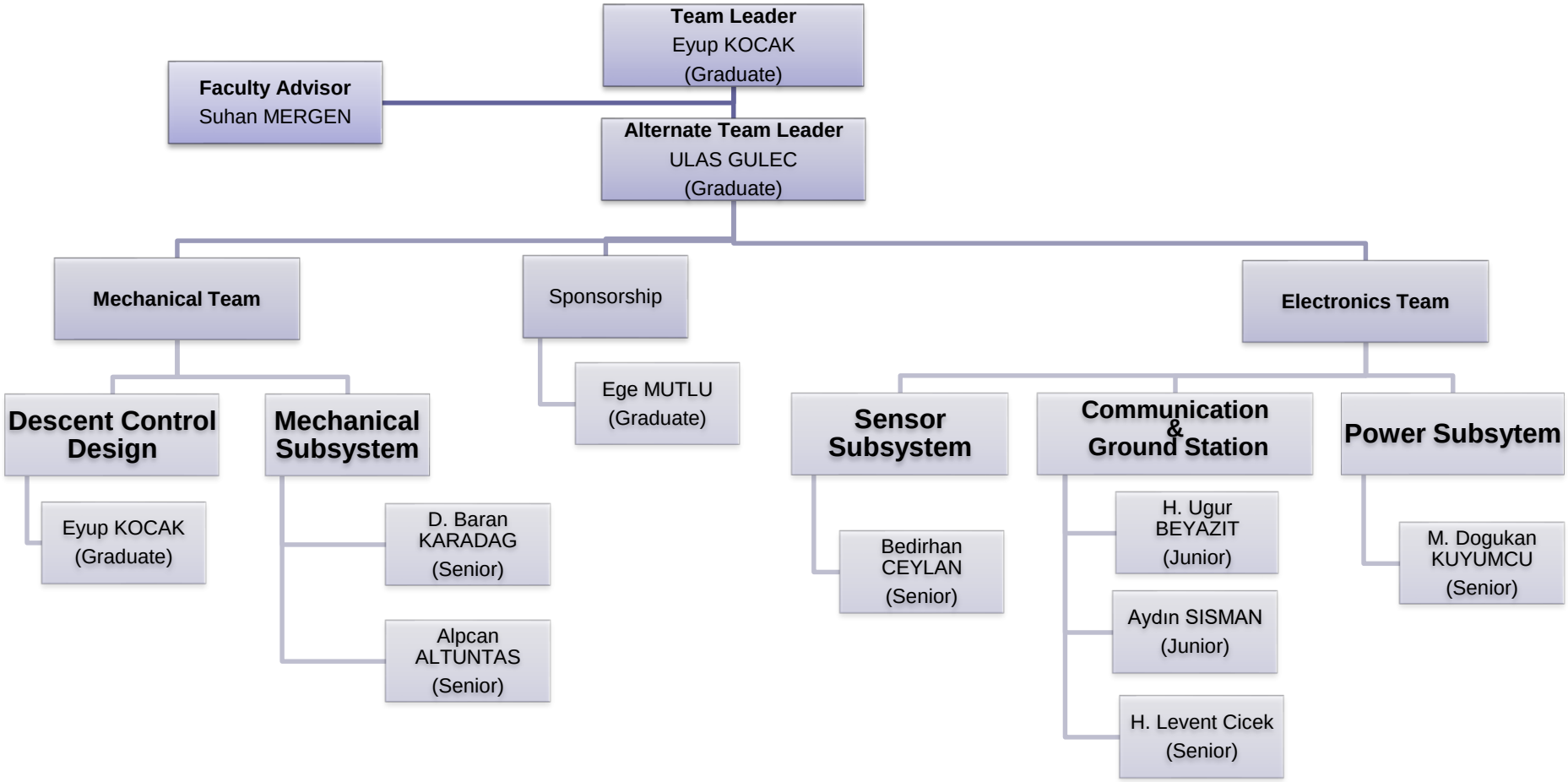
CanSat 2019
Post Flight Review (PFR)

2806

CanBee

Presentation Outline

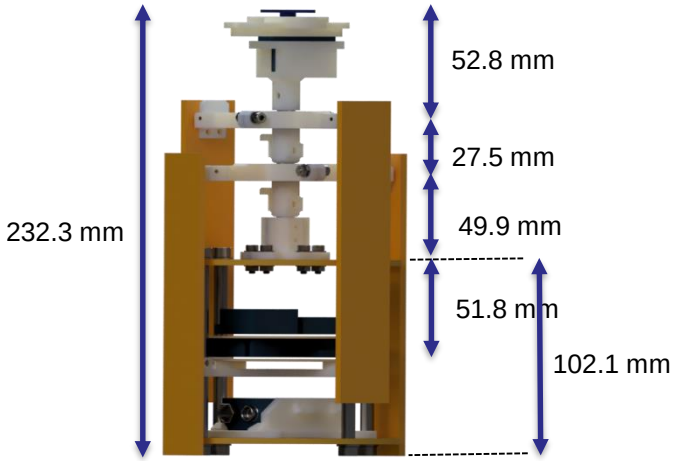
Team Organization

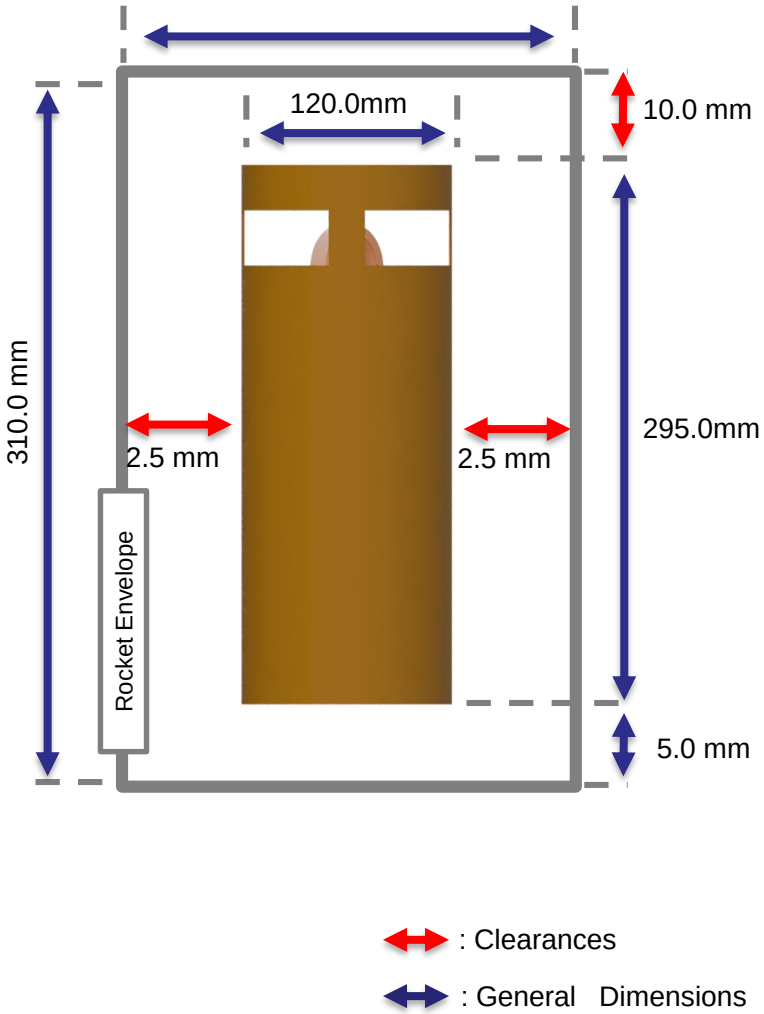


System Overview

Bedirhan Ceylan

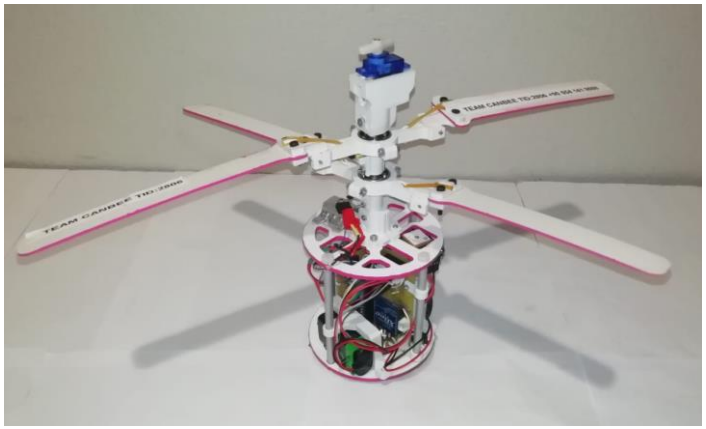
System Overview



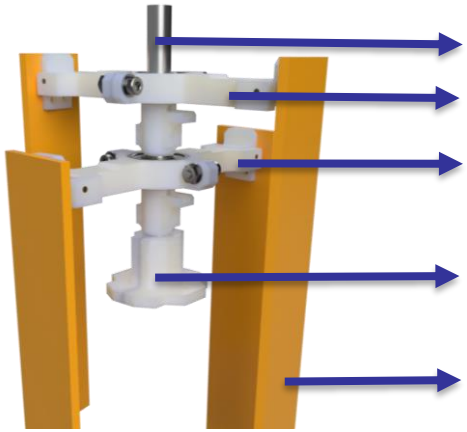


Payload Design Description

Prototype Payload



Propeller

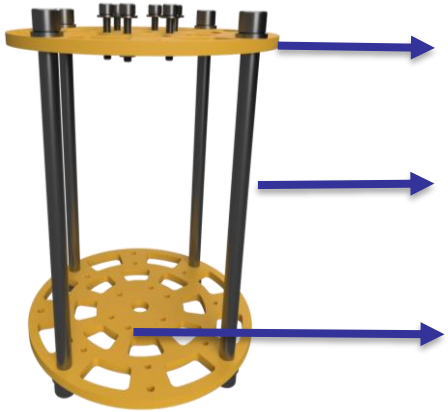


Operation of Payload

Stowed configuration

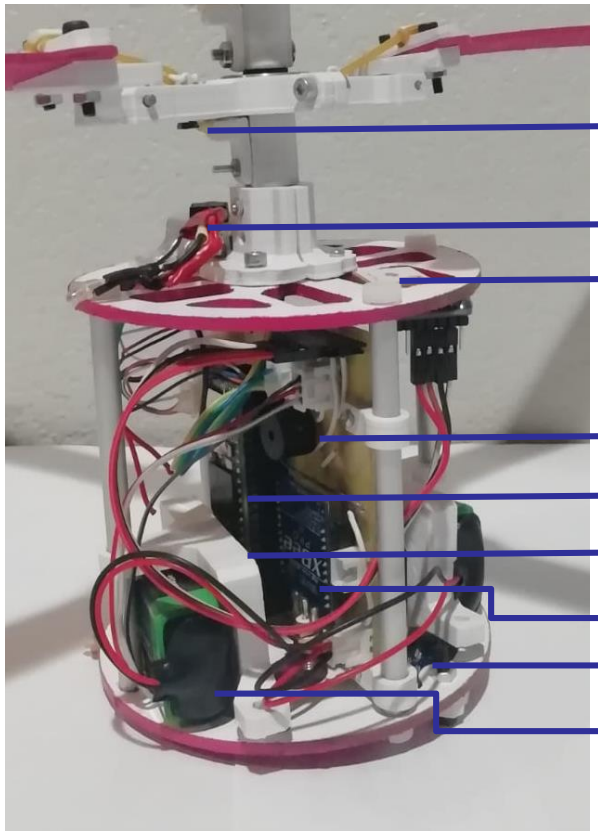
Propellers are triggered with rubber bands

Chassis

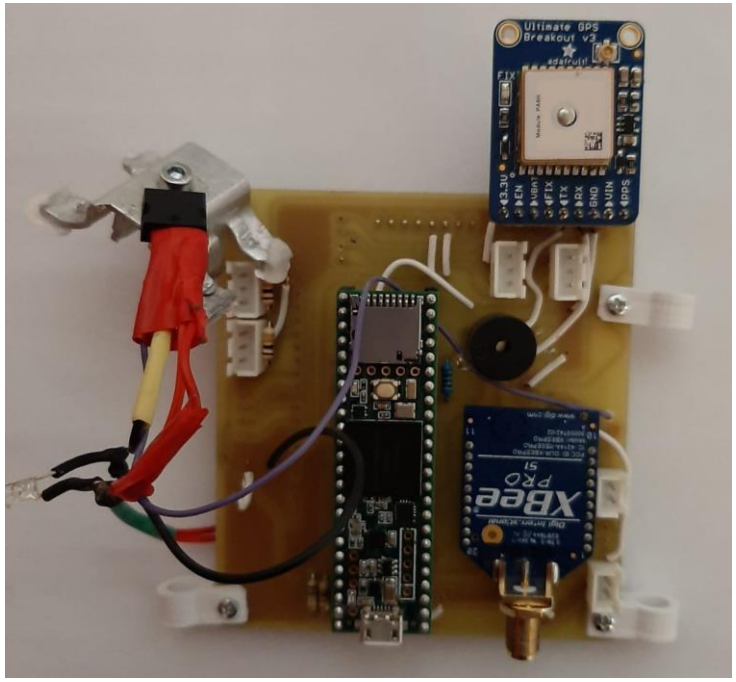


Payload Design Description

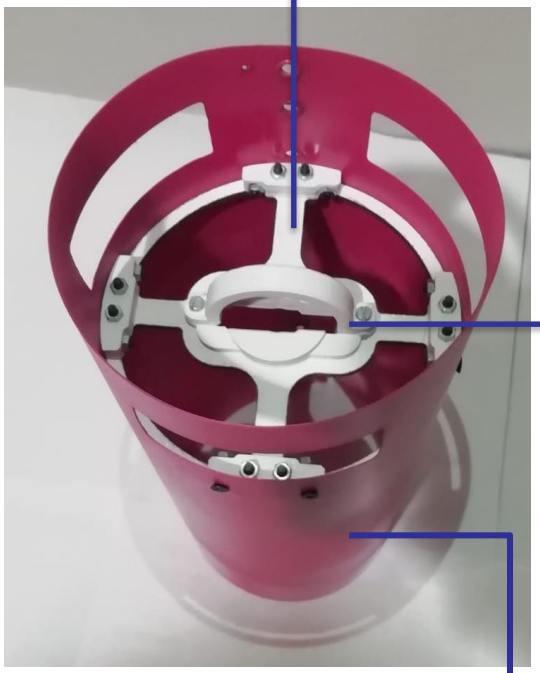
Prototype Payload



Electrical Circuit



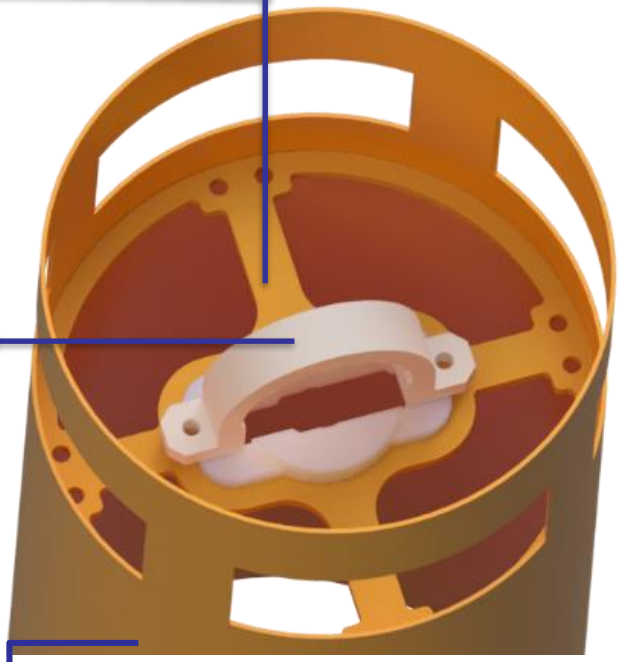
Container Design Description



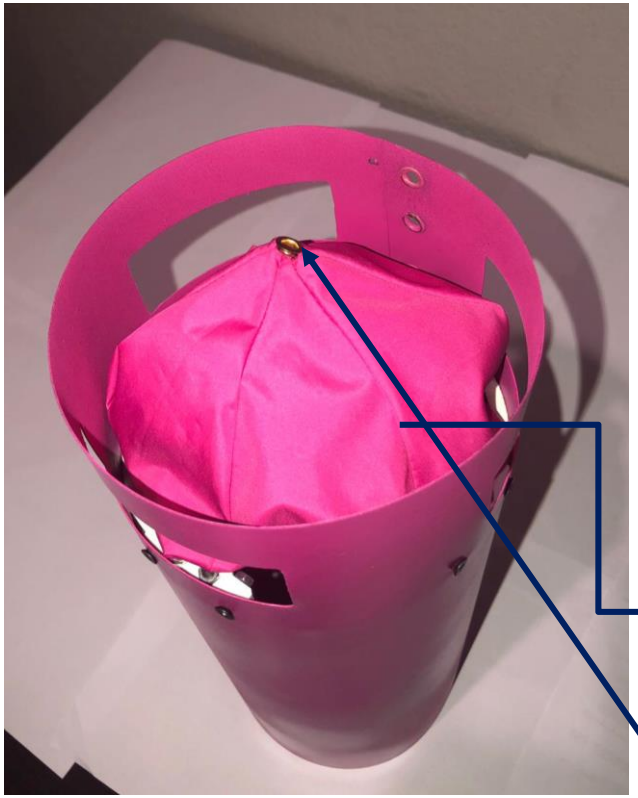
Release Mechanism

Parachute Hinge

Container



Container Design Description

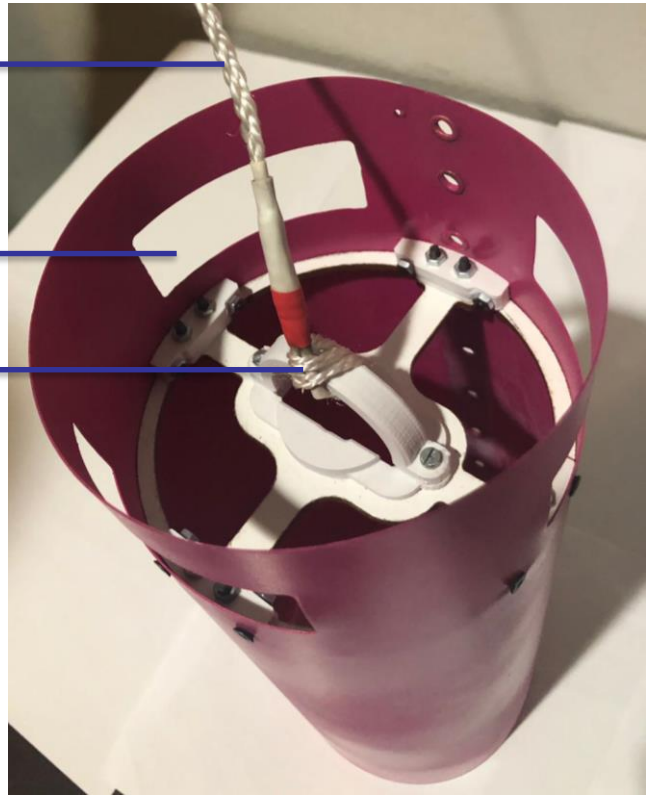


Parachute Rope

Parachute Opening

Parachute Opening

Parachute



Air flows that enter through the container openings triggers the deployment of the parachute.

Concept Operations and Sequence of Events

Bedirhan Ceylan

Comparison of Planned and Actual Con-Ops

	Planned	Actual	
1	Cansat preparation and power on	Done	Pre-Launch
2	Start of Telemetry transmitting	Done	
3	Launch	Done	Launch
4	Separation of the Cansat from rocket	Done	Descent
5	Descent of the container with the parachute	Done	
6	Release of the science probe from the container	Done	
7	Deployment of the propellers	Done	
8	Start of the camera recording	Done	Landing

Comparison of Planned and Actual Con-Ops

	Planned	Actual
9	Termination of the camera recording	Done
10	Landing	Done
11	Termination of the telemetry transmission	Not done
12	Activation of the buzzer	Done
13	Recovery of the science probe	Done
14	Recovery of container	Not done
15	Telemetry data saved to USB	Done
16	Recovery of the MicroSD cards from science probe	Done

Landing

Recovery

Comparison of Planned and Actual SOE

	Planned	Actual
1	Arrival at launch site (10:30 am)	Arrived at 11.00 am
2	Telemetry check (10:50 am)	Checked at 11:20 am
3	Cansat assembly & testing (11:00 am)	Tested at 11:50 am
4	Registration and delivery of Cansat (12:00 pm)	Delivered at 12:00 pm
5	Preparation of Cansat for Launch (01:45 pm)	Done at 01:45 pm
6	Powering on the Cansat and telemetry check (01:55 pm)	Done at 01:55 pm
7	Transporting the Cansat to the Rocket (02:00 pm)	Done at 02:00 pm
8	Ground station data transfer (02:10 pm)	Started at 02:10 pm

Comparison of Planned and Actual SOE

	Planned	Actual
9	Launch (02:15 pm)	Launched at 02:11 pm
10	Landing (02:18 pm)	Landed at 02:13 pm
11	Recovery of the Cansat (02.40 pm)	Recovered at 02:55 pm
12	Checking GCS data (02:45 pm)	Done at 03:00 pm
13	Submitting the collected data to Jury via USB (02:50 pm)	Done at 03:10 pm
14	PFR preparation (05:00 pm)	Started at 05:00 pm

Flight Data Analysis

Bedirhan Ceylan

Container Seperation Altitude

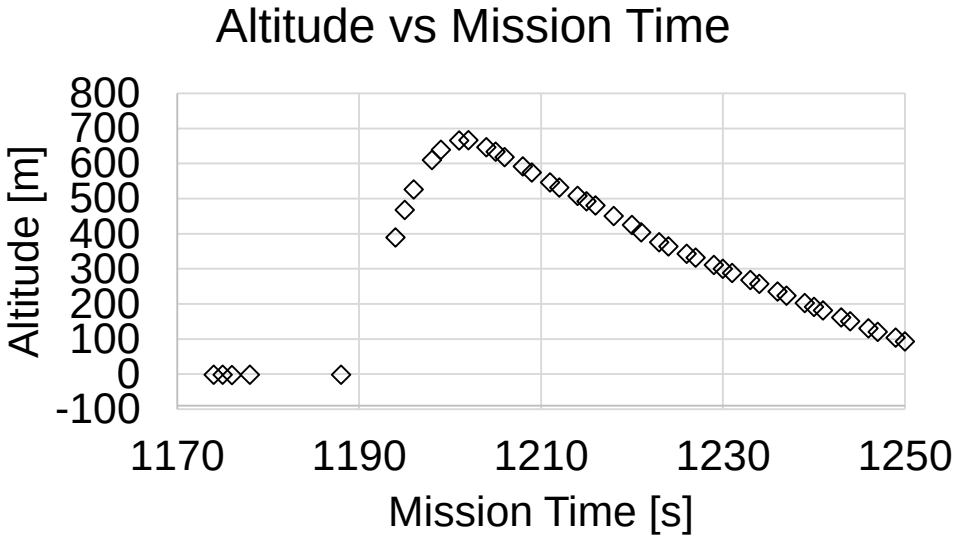
- Seperation altitude of the container is indicated as 450 meters in the competition requirements.
- Seperation altitude is set as the first measured value after 470 meters with the consideration of time interval between each measurement data.
- Releasing Altitude is set by the prediction of descent velocity of the container which is around 20 m/s.
- Next measurement after 470 meters is 450.5 meters which is the altitude to trigger the servo mechanism and release the payload from the container.

```
boolean ayrilma=false;
double releasingAltitude=470;
double releasingMargin=50;
```

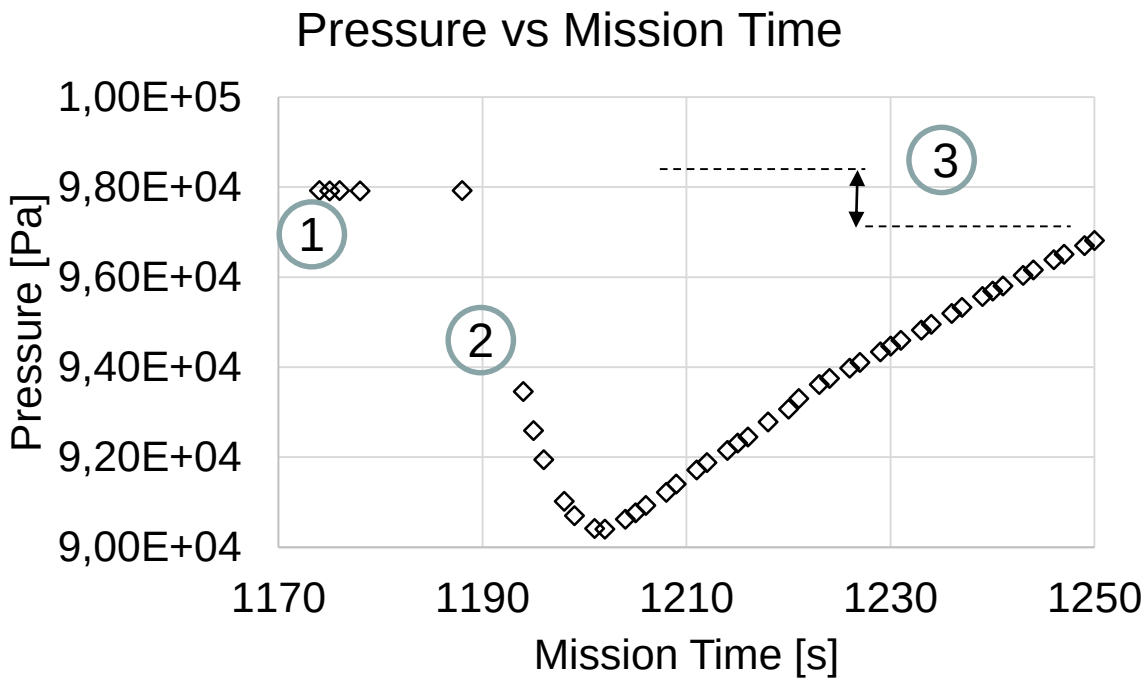
```
if(alt>(releasingAltitude+releasingMargin))
  {
    ayrilma=true;
  }
  if (alt<releasingAltitude && ayrilma==true)
  {
  Serial.println("Ayrilma gerçeklesti");
  releaseServo.write(-90);
  camera();
  ayrilma=false;
  }
```

Container Seperation Altitude

- First angular velocity measurment is taken at altitude of 424.7 meters which is the following measurement of 450.5 meters.
- This proves that seperation of the container occured at an altitude of 450.5 meters.



Payload Pressure Sensor Data Plot

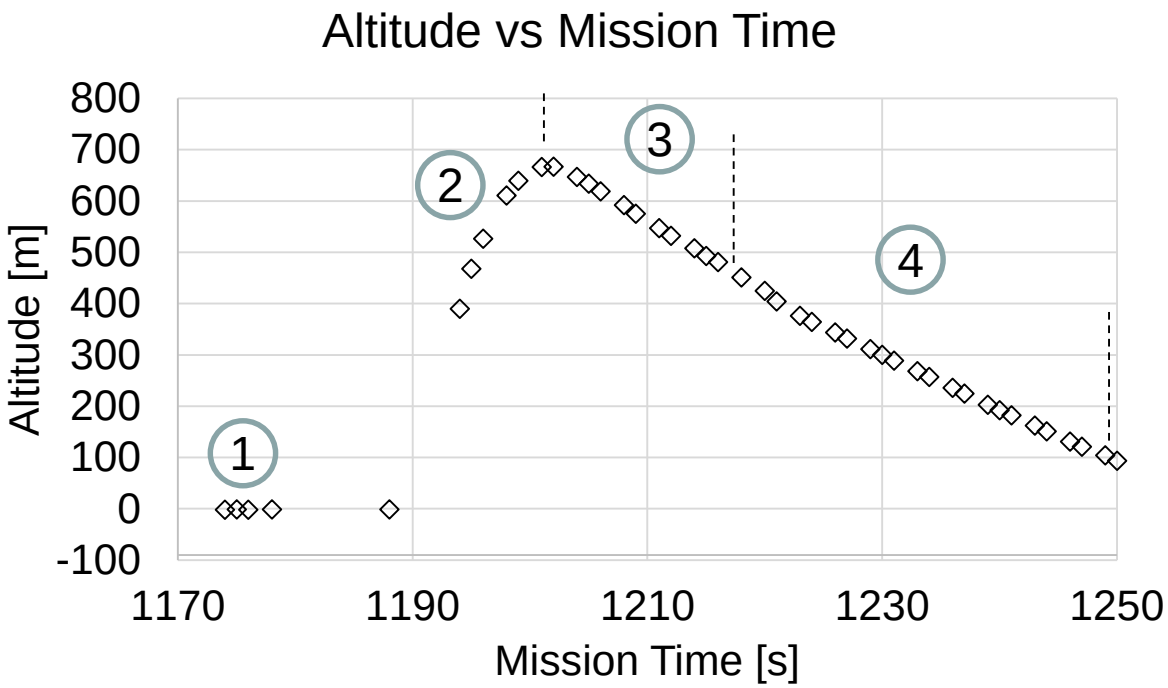


1. Pressure level is constant at ground position.

2. Pressure level decrease while payload rising.

3. Pressure measurment is stoped at 60 meters, so last pressure data is taken as 959.74 mbar at 63.8 meters which is different when compared to the ground level pressure.

Payload Altitude Plot



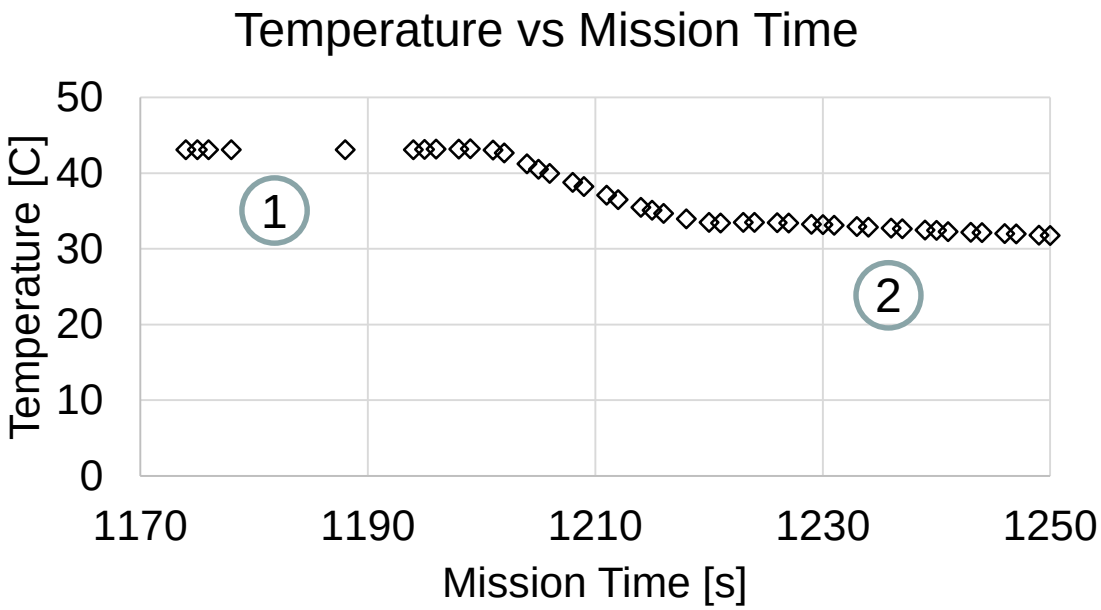
1. BMP 180 starts to measure relative altitude.

2. Seperation from rocket.(666.8 meters)

3. Descent with container and parachute.(666.8 meters to 450.5 meters)

4. Descent with auto-gyro propellers.(450.5 meters to 93.5 meters)

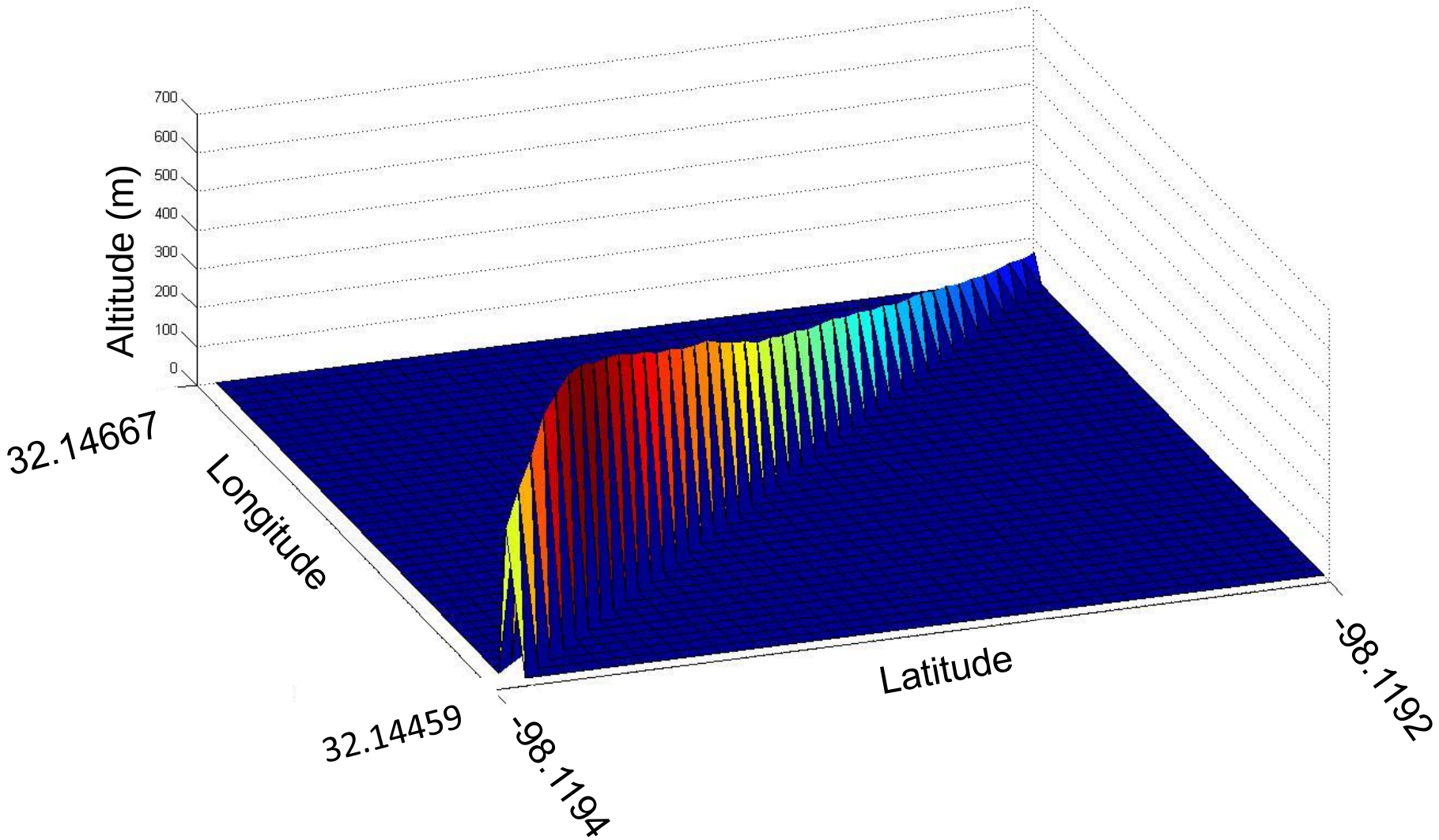
Payload Temperature Sensor Plot



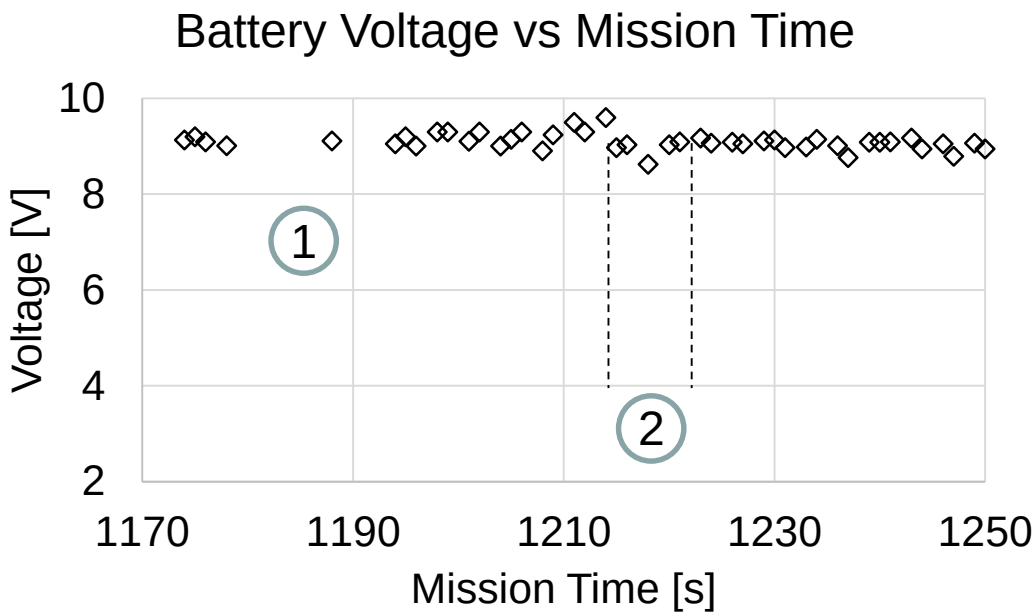
1. Temperature is higher when payload is placed in rocket.

2. Temperature starts to decrease after seperation from rocket.

Payload GPS Plot



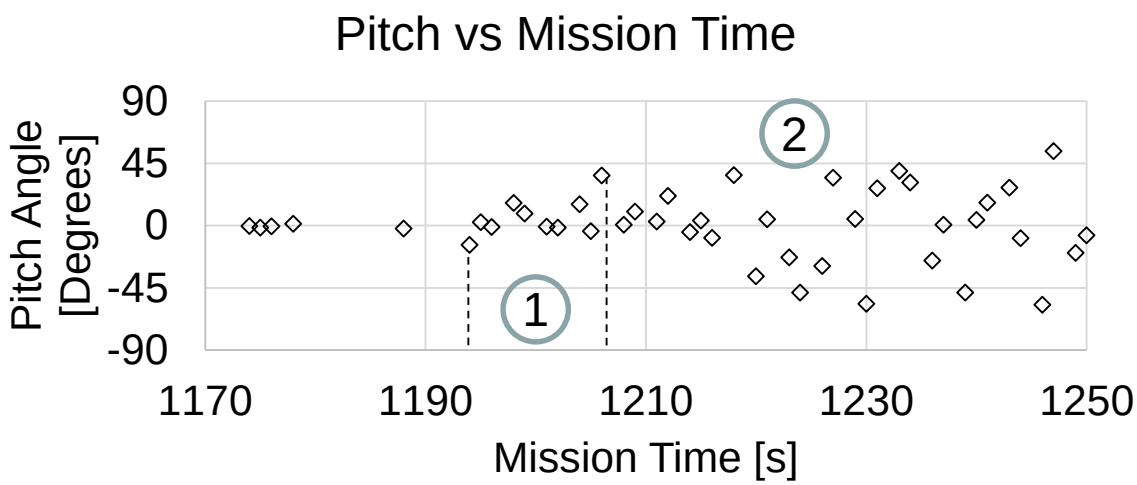
Payload Battery Power Plot

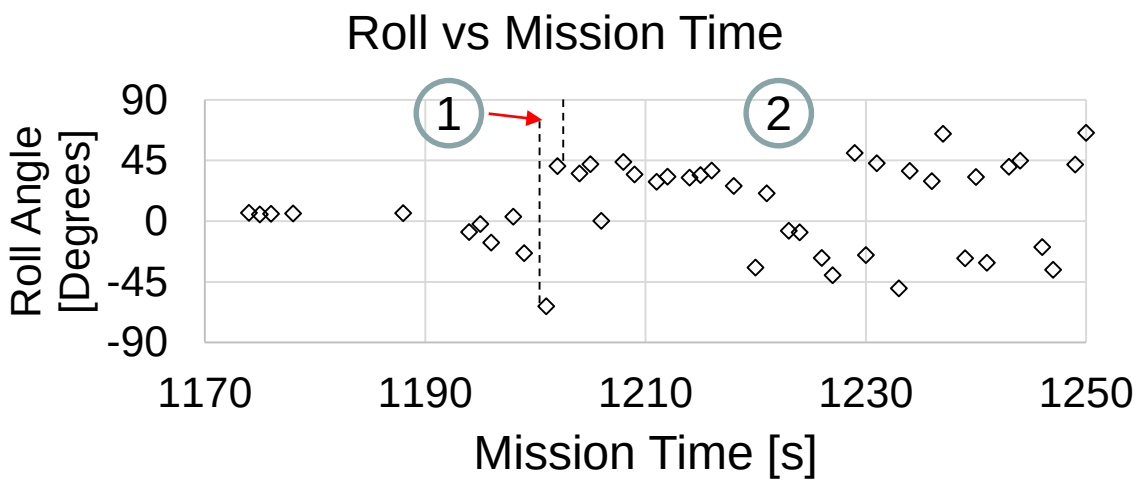


1. Battery voltage oscilliated around 9 Volts due to current need of Xbee at each data transmission.

2. Battery voltage level drops instantaneously when seperation from container occurs.(Mission Time:1218sec)

Tilt Sensor Plot





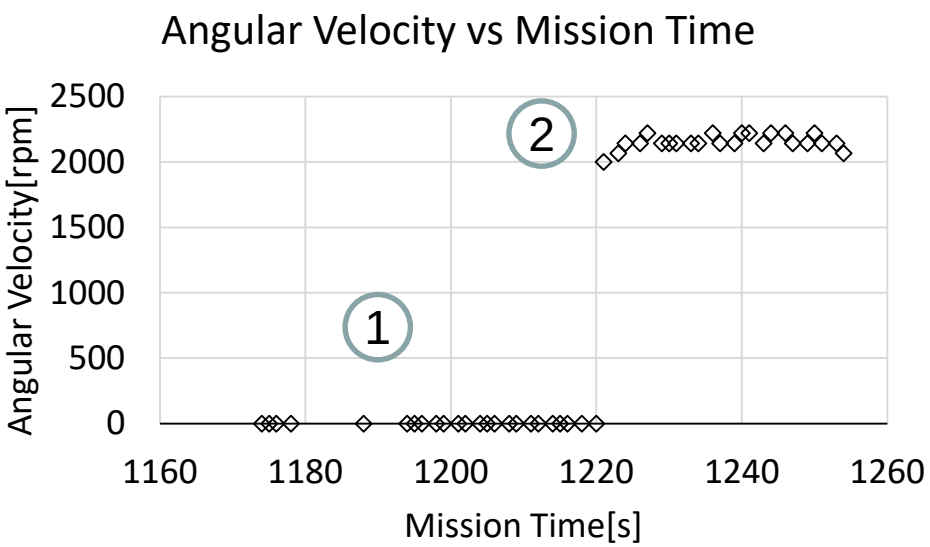
1. Cansat seperates from the rocket at the mission time 1202 seconds when payload turns upside down and angles change correspondingly.

2. Until seperation, pitch and roll values stay at a positive region due to a single directional wind.

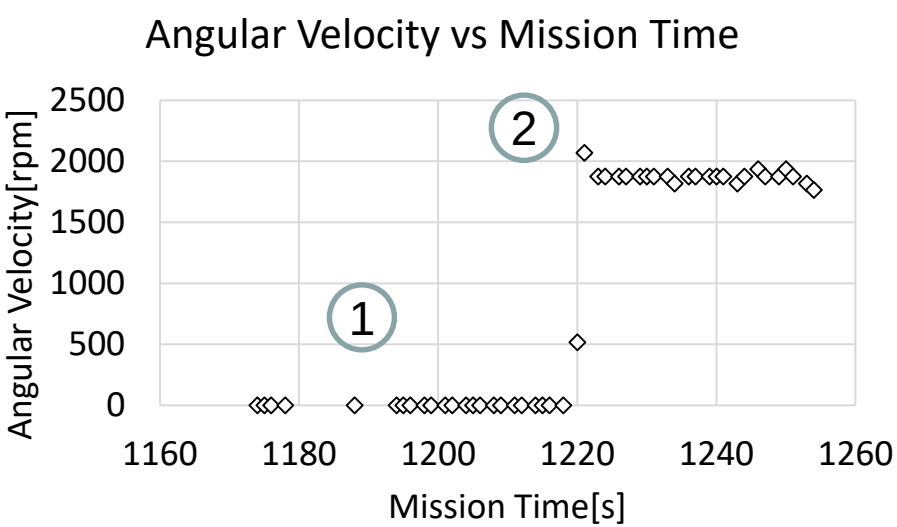
3. Pitch and Roll values start oscilliating in high angular degrees just after the seperation from container (Mission Time: 1218sec).

4.Oscillating in both positive and negative angular degrees shows that payload descends with a circular motion.

Auto-Gyro Blade Spin Rate Plot



1.Angular velocities are started to be measured when payload seperates from container. (Mission Time:1218sec)



2.Angular velocities are measured as different values due to length difference between two propellers.

Camera Video

1.Camera starts recording just after the seperation of payload from container and stops before landing.

https://youtu.be/q5_2LmZNCo0

!!! The buzzer can be heard clearly at the last seconds of the video!!!

Failure Analysis

Bedirhan Ceylan

Identification of Failures, Root Causes, Corrective Actions

Failure: Low Frequency Telemetry Data

Root Cause: We were using a 2.4 GHz adhesive antenna during our tests, which provided us perfect radio communication at required frequency. Which is also shown to the jury during the pre-check.

Unfortunately just before the check in at the launch site, antenna cable broke apart. Consequently, we had to switch it to a duck type antenna. Which performed poorly during the testing phase.

Corrective Action: Using a compatible 2.4 GHz antenna will do.

Identification of Failures, Root Causes, Corrective Actions

Failure: Lost Connection at the last 90m

Root Cause:

1. Low Frequency Telemetry Data

2. Uncanny Accident: Our CanSat hit a metal bucket in the field, then broke apart.

Telemetry frequency was around **0.16 Hz** and the average decent velocity at the last 100m was around 15m/s. Which means, we were getting telemetry data roughly around every 90m. We recieved the last telemetry data at 93m. Hitting the metal bucket broke apart the satellite and all the electronical systems stopped working.

Corrective Action: The bucket should be removed from the field :). Field conditions should have been taken to account. Additional mechanic protection should be used.

Identification of Failures, Root Causes, Corrective Actions

Failure: Lost Connection at the last 90m

Root Cause:

1. Low Frequency Telemetry Data

2. Uncanny Accident

Identification of Failures, Root Causes, Corrective Actions

Failure: Lost Connection at the last 90m

Root Cause:

1. Low Frequency Telemetry Data

2. Uncanny Accident

Identification of Failures, Root Causes, Corrective Actions

Failure: Lost Connection at the last 90m

Root Cause:

1. Low Frequency Telemetry Data

2. Uncanny Accident

Identification of Failures, Root Causes, Corrective Actions

Failure: Buzzer was not working at the ground.

Root Cause: Same as above.

Since the probe broken apart, we could not show a sounding buzzer to the check-in desk but the buzzer can be heard in the camera recording just before the hit.

Corrective Action: Field conditions should have been taken to account. Additional mechanic protection should be used.

Lessons Learned

Bedirhan Ceylan

Discussion of What Worked and What Didn't

Subsystem	
Pressure, altitude and temperature measurement	**Worked.**
Pitch and roll angle measurement.	**Worked.**
GPS Data collection.	**Worked.**
Buzzer	**Worked.**
Parachute	**Worked.**
Auto-Gyro	**Worked.**
Seperation	**Worked.** (@450.5m)
SpinRate Measurement	**Worked.**

Discussion of What Worked and What Didn't

Subsystem	
Radio Comms and Telemetry	The link was set up. Did not meet the requirements (0.16 Hz) 205 Packets were collected.
Mechanical Integration.	Could not be remained.
Voltage Measurement	**Worked.**
Camera	**Worked.**
Flight Software	**Worked.**
Writing Flight Data to SD Card	**Worked.**

Conclusions

No1
We can control the design but we can not control the environmental conditions. We should have taken the environmental conditions into account.

No2
Bad things can happen, we should have had the spares of all the parts right with us.

No3
Always look for alternative references for the verification. (*Like numerical simulation for this project.*)

No4
We worked hard for the project. We spent most of our nights sleepless and at some point we lost our insight. Which resulted lack of engineering judgement. Which costed lots of time.