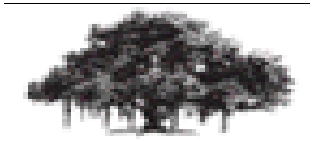
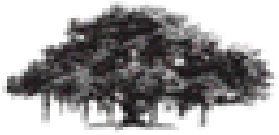


2011 Texas Annual CanSat Competition

CanSat 2011
Post Flight Review

852

Team Gaganyaan



Presentation Outline

2011 Texas Annual CanSat Competition

1. About the Team (Palash Jain)
- 1.1 Team Organization
- 1.2 Acronym

2.Systems Overview (Palash Jain)
- 2.1 Mission Summary
- 2.2 CanSat Overview
- 2.3 Component Summary
- 2.4 Physical Layout

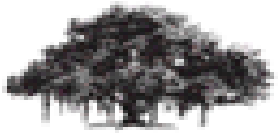
3. Concept of operations and Sequence of events (Jasmeet Singh)
- 3.1 Concept of Operations – Planned vs Actual
- 3.2 Mission sequence of events – Planned vs Actual

4. Flight Data Analysis (Palash Jain)

5. Failure Analysis (Palash Jain)

6. Management (Palash Jain)
- 6.1 CanSat Budget – Hardware
- 6.2 CanSat Budget – Other costs

7. Conclusions (Palash Jain)
- 7.1 What worked/ What didn't
- 7.2 Lessons learned

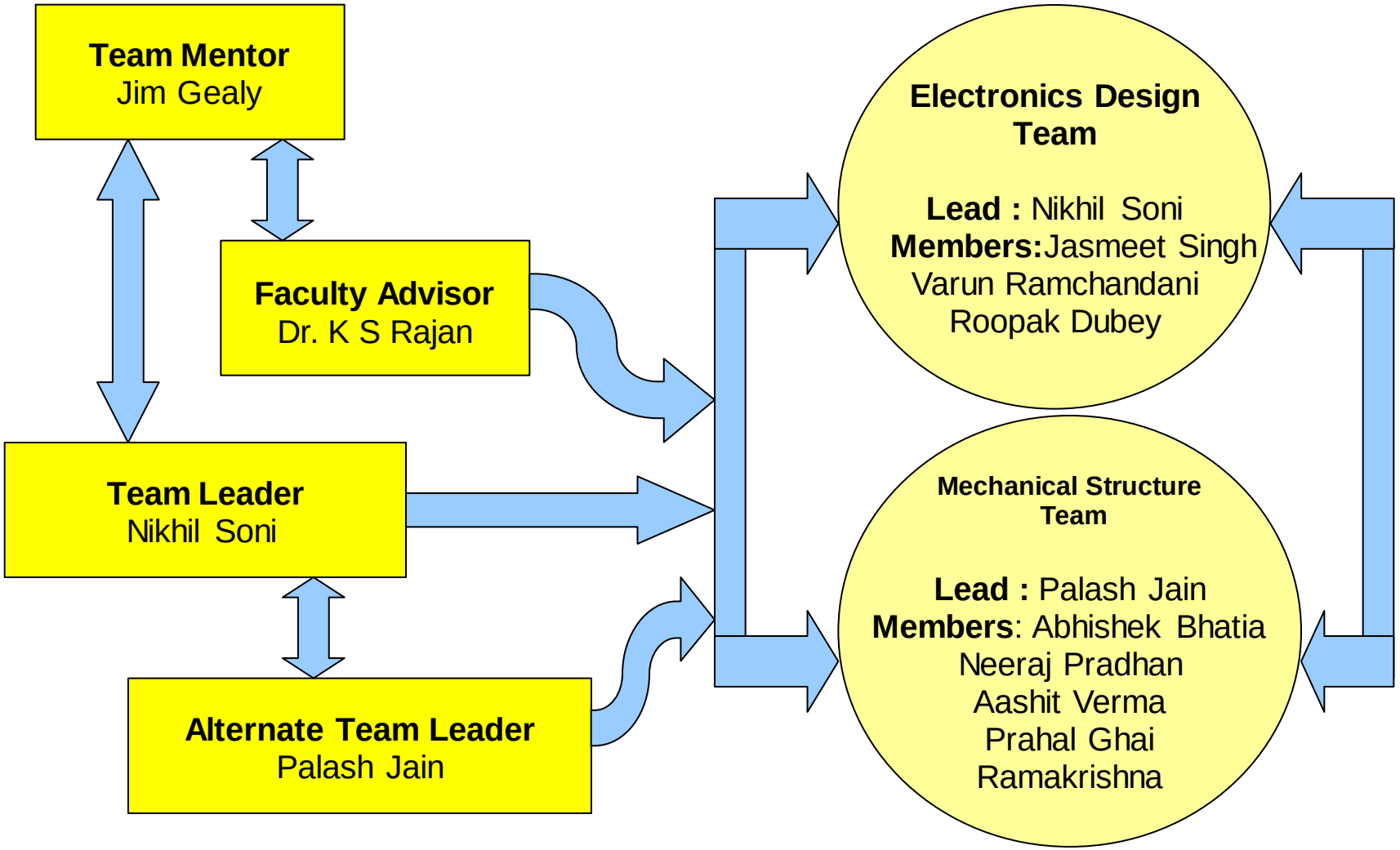


Team Organization

2011 Texas Annual CanSat Competition

No.	Name	Year of study	Position	Contact details
1	Nikhil Soni	3rd yr	Team Leader Electronics Team lead	nikhil.soniug08@students.iiit.ac.in
2	Palash Jain	3rd yr	Alternate Team Leader Mechanical Team Lead	palash.jainug08@students.iiit.ac.in
3	Abhishek Bhatia	3rd yr	Member, Mechanical Team	abhishek.bhatiaug08@students.iiit.ac.in
4	Varun Ramchandani	3rd yr	Member, Electronics Team	varun.ramchandani@students.iiit.ac.in
5	Roopak Dubey	3rd yr	Member, Electronics Team	roopak.dubeyug08@students.iiit.ac.in
6	Neeraj Pradhan	3rd yr	Member, Mechanical Structure Team	neeraj.pradhanug08@students.iiit.ac.in
7	Jasmeet Singh	3rd yr	Member, Electronics Team	jasmeet.singhug08@students.iiit.ac.in
8	Aashit Verma	2nd yr	Member, Mechanical Structure Team	aashit.verma@students.iiit.ac.in
9	Prahal Ghai	2nd yr	Member, Mechanical Structure Team	prahal.ghai@students.iiit.ac.in
10	Ramakrishna Vedantam	2nd yr	Member, Mechanical Structure Team	ramakrishna.vedantam@students.iiit.ac.in

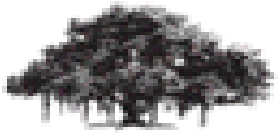
Internal Organization



Acronyms

- **M** Mission
- **S** Sensor
- **MS** Mechanical System
- **DCS** Descent Control System
- **CDH** Command and Data Handling
- **EPS** Electrical and Power system
- **FSW** Flight Software
- **GCS** Ground control station
- **ConOps** Concept of Operations

- A/D Analog or Digital
- ADC Analog digital converter
- CLK Clock
- CPU Central processing unit
- EEPROM Electrically Erasable Programmable Read-Only Memory
- FCC Federal communications commission
- g Acceleration due to gravity
- GHz Giga hertz
- GPS Global positioning system
- Hz Hertz
- ISM Industrial, scientific and medical
- Kbps Kilobytes per second
- Km Kilometer
- MHz Mega hertz
- NiMH Nickel metal hydride
- RF Radio frequency
- SPI Serial peripheral interface
- SRAM Static random access memory
- USART Universal synchronous asynchronous receiver/transmitter
- USD US Dollar
- INR Indian Rupees



Systems Overview

Palash Jain

Mission Summary

Mission:

- The mission of 2011 CanSat competition was Egg Lander.

Objectives:

- Carry Hen's egg intact for the entire duration of flight and recover it safely.
- CanSat carrier descent rate of 3-5 m/s.
- Lander detachment at 500mts. from ground.
- Lander descent rate 4.5 – 6.5 m/s.
- Predict lander coordinates.
- Communication of carrier with our GCS.

Optional Selectable Objective: Lander Impact force calculation

Other Objectives:

- Learn from the whole experience. Analyze failure and success.

CanSat Overview

Key Design Decisions:

- Tough Structure to avoid damage, hence **aluminum** was chosen.
- Simple detachment mechanism, avoid tangling of both parachutes, hence parachutes were placed at opposite ends.

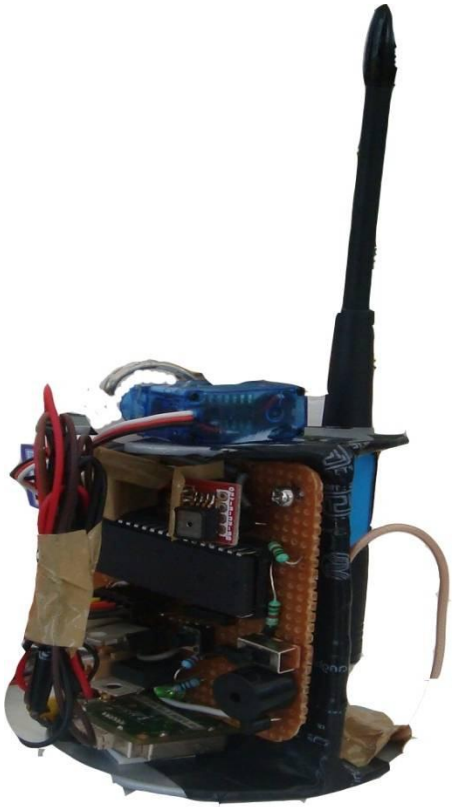
Key Features: 9-gear Servo based detachment mechanism.
Placement of carrier and lander.

GCS Design:

Data received serially via RS232 cable into matlab and plotted in real-time.

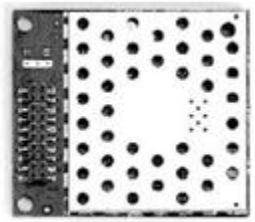
Plotted data –

- GPS Altitude
- NON-GPS altitude
- GPS velocity
- NON-GPS velocity
- Battery Voltage
- Temperature



Components

- **Carrier Components**

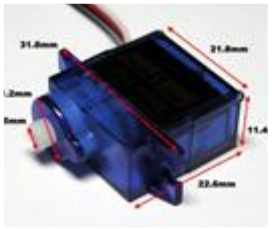


Transceiver
Larid AC4790

Antenna
S467XX-915S

Processor
Atmega 164

GPS



Servo Motor
SG90

Pressure Sensor
MPX6115a

Temperature Sensor
LM 35

Locator Device
JS666

Battery
9V

Components

- **Lander Components**

Processor
Atmega 8

Accelerometer
RKI –1029

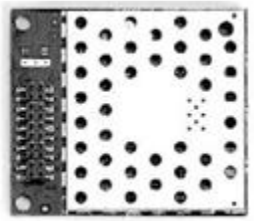
Battery
9V

Pressure Sensor
MPX6115a

Locator Device
JS666

Components

- **GCS Components**

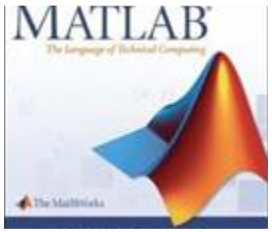


Transceiver
Larid AC4790

Laptop

RS232
Cable

Antenna
S467XX-915S



GCS Software

Component Summary

➢ Electronics subsystem

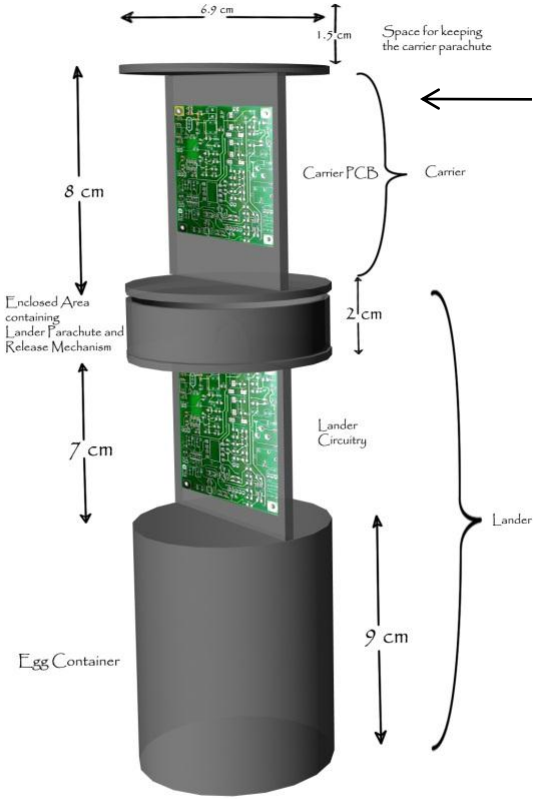
• Carrier

Purpose	Manufacturer	Dimension	Accuracy	Mass	Power/Voltage
GPS	SIRF-LPx7879	27mm x 23mm	5m	10 g	75mW/3.3 V
Pressure	Motorola – MPXH6115a	16.6 mm x 7.2 mm	+-1.5%	25g	2.5 mW / 5V
Temperature	LM – 35		+-0.5 deg C		10 mW / 5V
Computer	Atmega164 Atmel0736 – 4MB	6mmx6mm		14g 0.9g	5V 3.3V

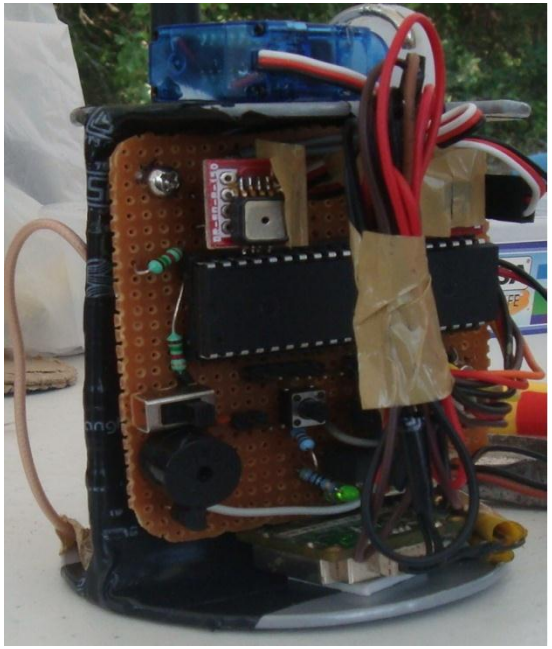
• Lander

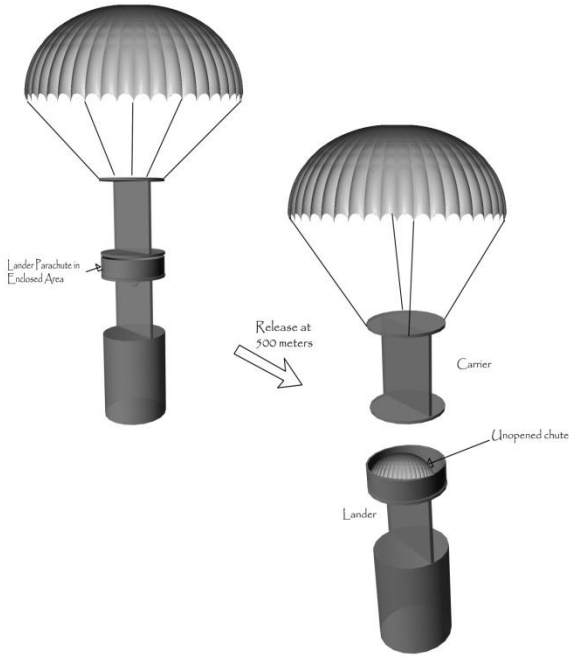
Purpose	Manufacturer	Dimension	Accuracy	Mass	Power/Voltage
Accelerometer	Robokit - RKI 1029	28mm x 23mm	+-1%	15 g	2.5 mW/5 V
Pressure	Motorola – MPX6115a	16.6 mm x 7.2 mm	+-1.5%	25g	2.5 mW / 5V
Computer	Atmega8 Atmel0736 – 4MB	6mmx6mm		14g 0.9g	5V 3.3V

Physical Layout



Selected Cansat Configuration

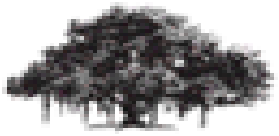




Physical Layout

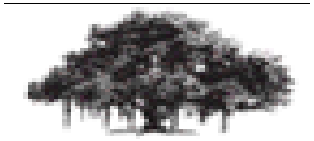
- **Dimensions :**
  - **Carrier –**
    - **Height - 8.5cm, Diameter – 6.9cm**
  - **Lander**
    - **Height – 17cm, Diameter – 6.9cm**
  - **2.4 cm left for the parachutes.**

- **Placement :**
  - Carrier at the bottom, lander above it, so that lander would eject out first.
  - Parachutes placed at the opposite ends.



Concept of Operations and Sequence of Events

Jasmeet Singh



Concept of Operations – Planned vs. Actual

2011 Texas Annual CanSat Competition

1. **Parachute placement :**

   -Planned – fit the chute b/w carrier and lander

   -Actual – chutes placed on opposite ends.

2. **Communication check at launch site :**

   -Planned – Check the communication at launch site prior to launch

   -Actual – While checking a connection came loose, had to resolder.

3. **Recovery :**

   -Planned – follow the carrier and lander as they descent, do not lose sight.

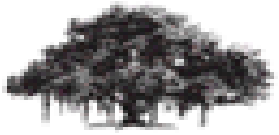
   -Actual – Lost sight of them, ended up losing lander. Carrier recovered though.

Concept of Operations - GCS

- **NOTE- No changes in the GCS ConOps from planned to actual.**

GCS ConOps -

- Receive data serially through USB-TTL RS232 cable.
- Open serial port and read it.
- Operate on the data and put it into corresponding graph plots.
- Indicate communication failure in case if it happens
- Save the data into a file for future analysis.
- Indicate termination upon receiving signal from carrier.
- Save the graphs.



Mission Sequence of Events – Planned vs. Actual

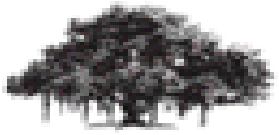
2011 Texas Annual CanSat Competition

Planned Sequence of Events

7:30 am	Leave Abilene
8:00 am	Arrive at Launch Site
9:00 am	Set up tables and Tents
10:00 am	Integrate the whole carrier and Lander
10:30 am	Get CanSat weighed and size verified
12:00 pm	Load hens egg and complete the final communication testing
12:50 pm	Move to Pad4, switch on CanSat and load the CanSat for launch
1:00 pm	Launch
2:00 pm	Locate Lander and Carrier
3:00 pm	Get the egg verified and recover data from memory
3:30 pm.	Complete all formal verifications
Wait for all	other teams to finish the flight
5:30 pm	Leave for Abilene, TX

Actual Sequence of Events

7:30 am	Leave Abilene
8:00 am	Arrive at Launch Site
9:00 am	Set up tables and Tents
10:00 am	Integrate the whole carrier and Lander
10:30 am	Started communication testing.
11:00 am	Communication lock failure
11:30 am	**Communication re-established GPS test.**
12:00 pm	Final testing(connections)
12:15 pm	Lunch
12:45 pm	Weight test and fit-test
1:00 pm	Communication test once more, just to be sure.
1:30 pm	Got the egg and prepared lander.
2:50 pm	Launch
5:45 pm	Left for Abilene



Flight Data Analysis

Palash Jain

GPS Data

<ÿ‘5í#204337,3206.1245N,09908.7486W,10,1467.2,8.8,30,1458.5@_____
<ÿ‘5í#204348,3206.1244N,09908.7487W,10,1447.4,8.8,31,1432.7@_____
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..
..
..
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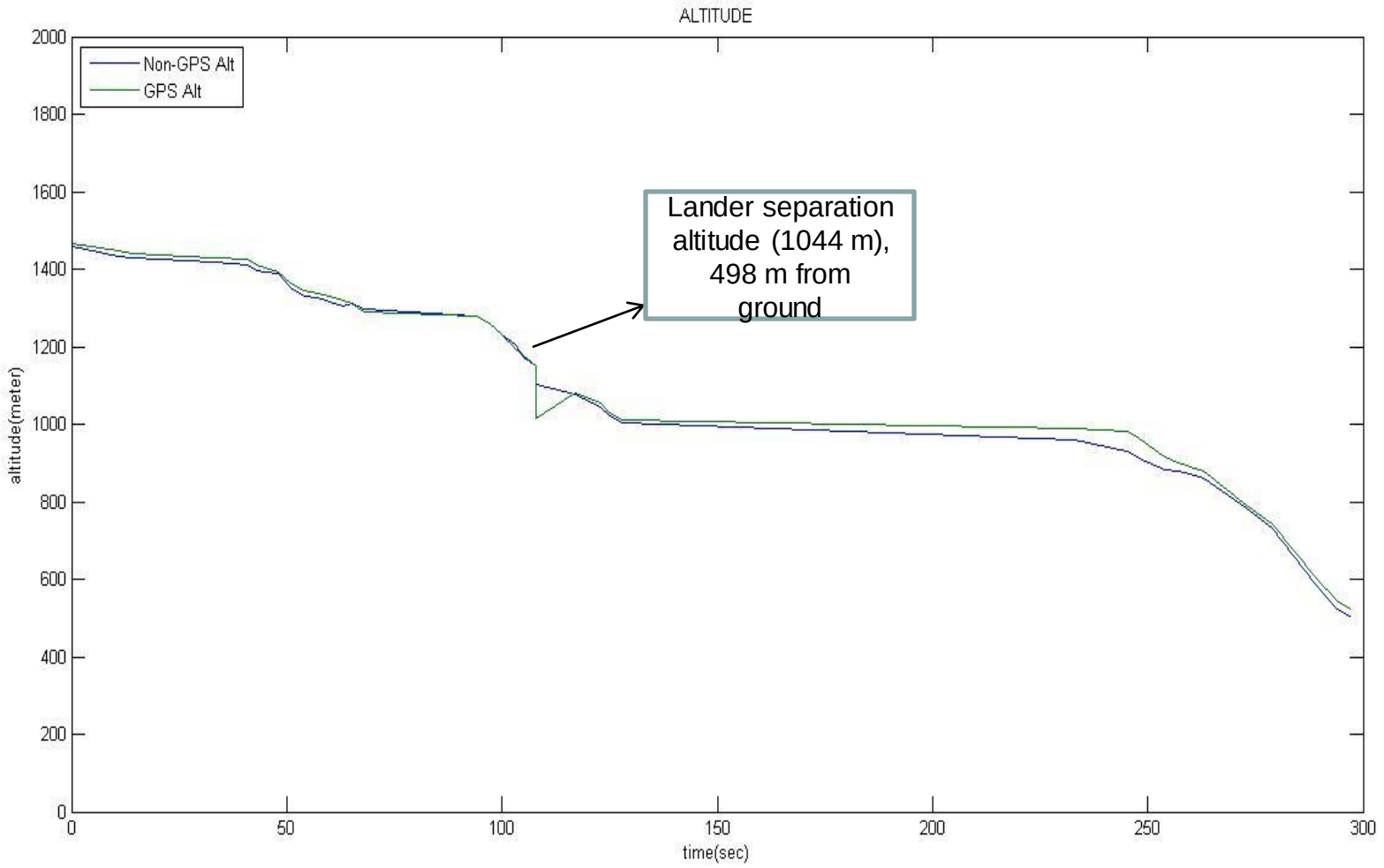
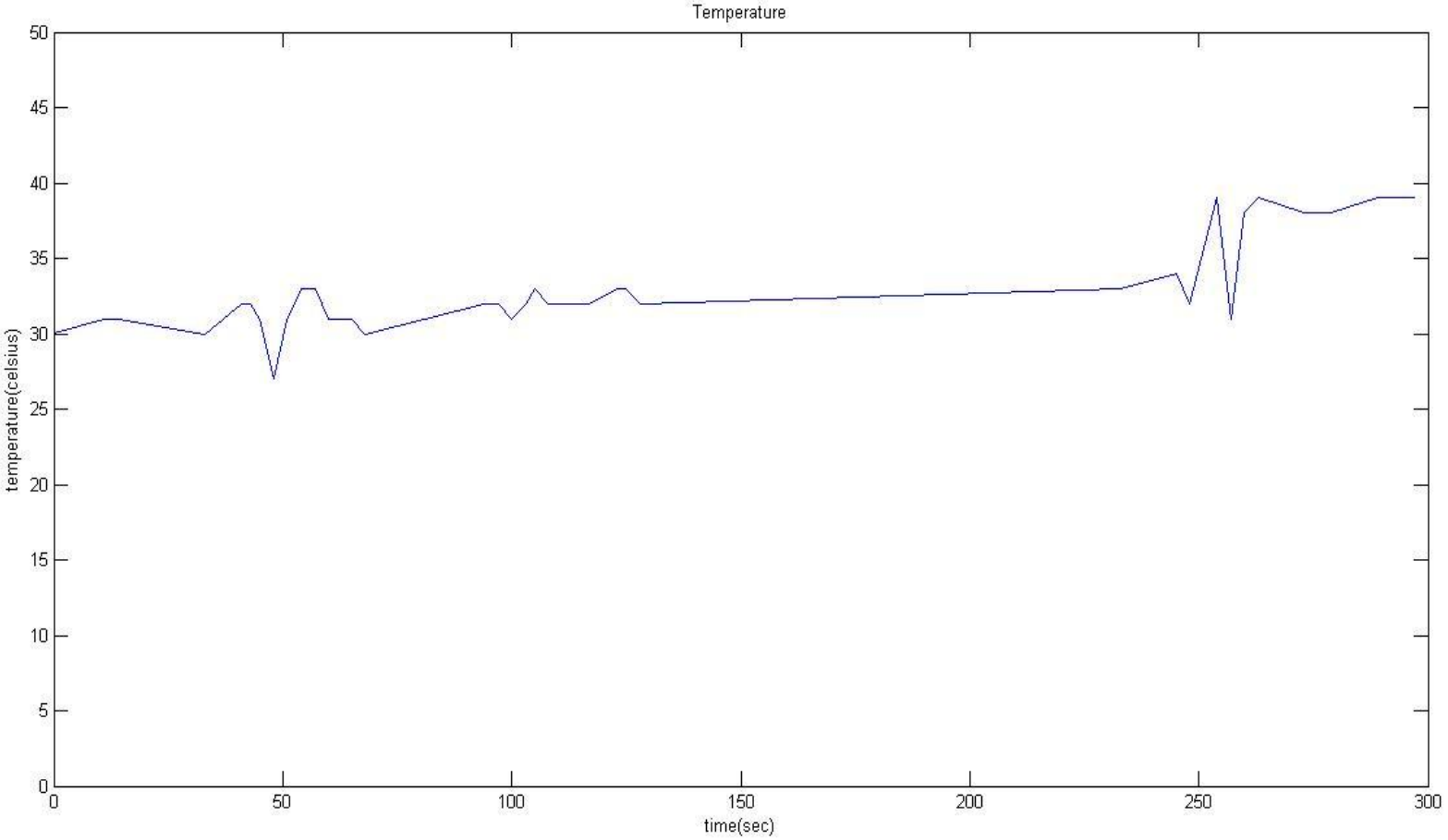
<ÿ‘5í#204720,3206.1333N,09908.7543W,10,880.1,8.5,39,861.5@_____
..
..
<ÿ‘5í#204751,3206.1333N,09908.7543W,9,544.9,8.3,39,524.5@_____
<ÿ‘5í#204754,3206.1333N,09908.7543W,9,524.4,8.3,39,504.5t_____

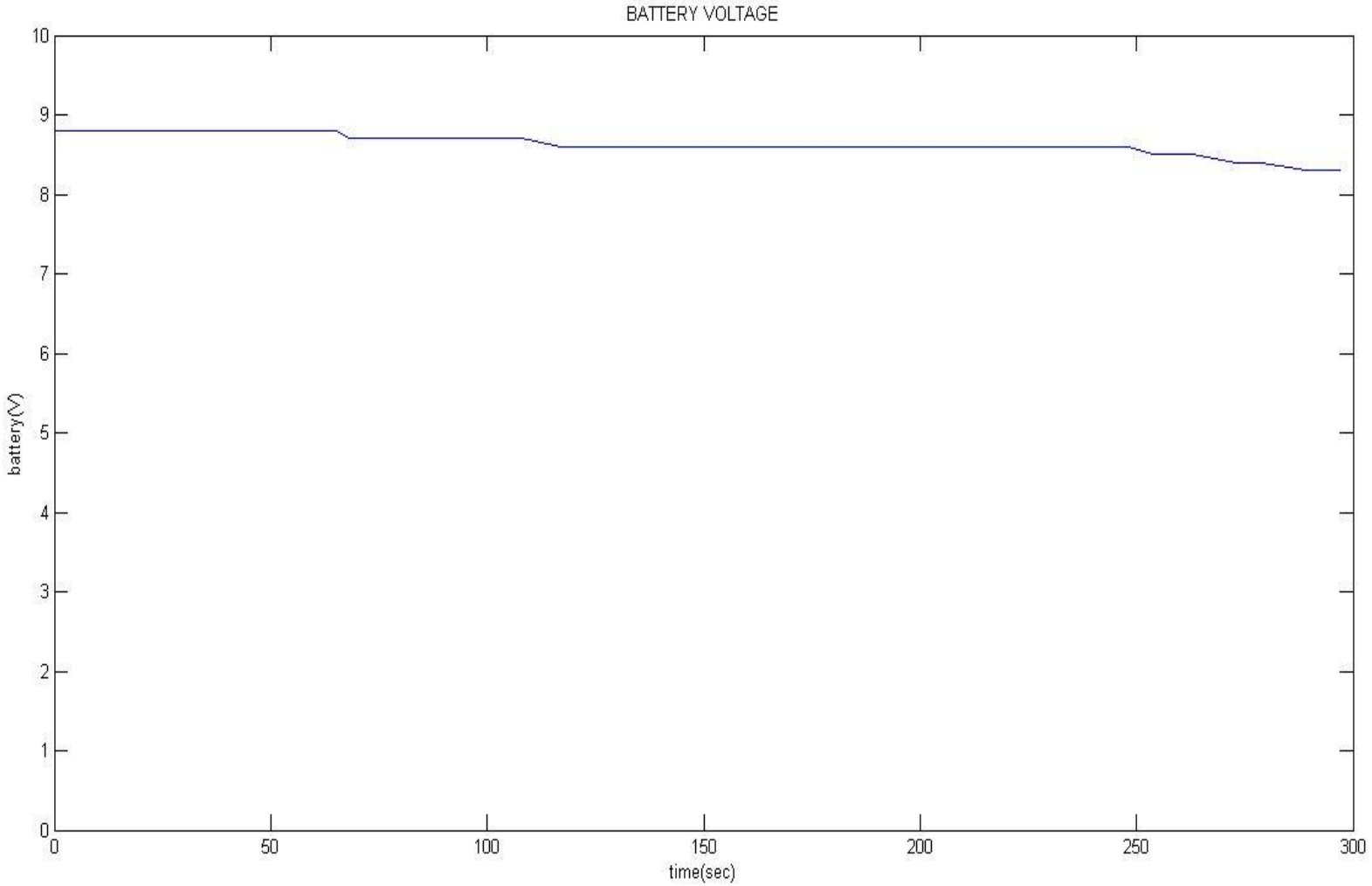
Altitude Data – Both GPS and NON GPS



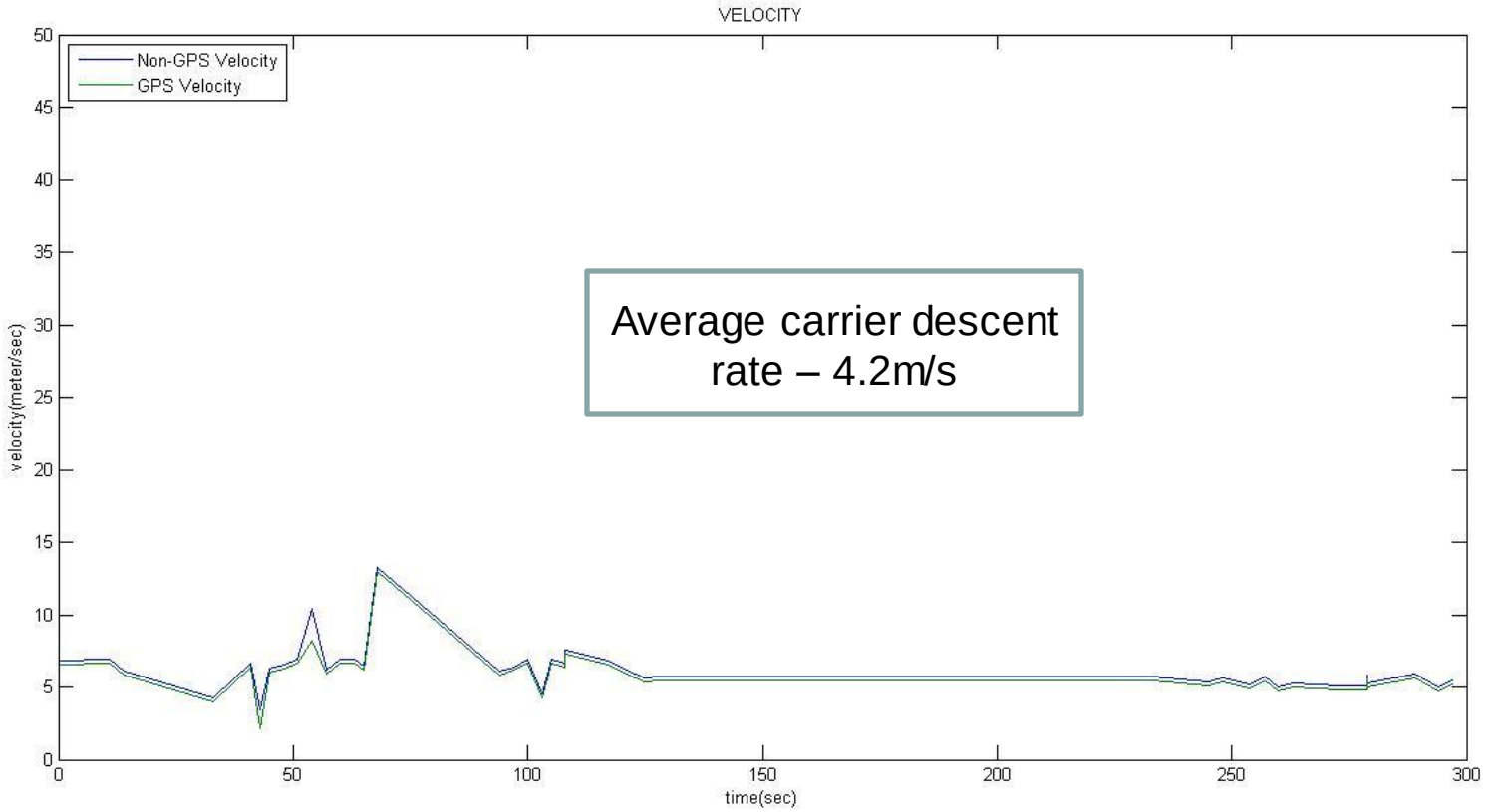
Air Temperature



Battery Data



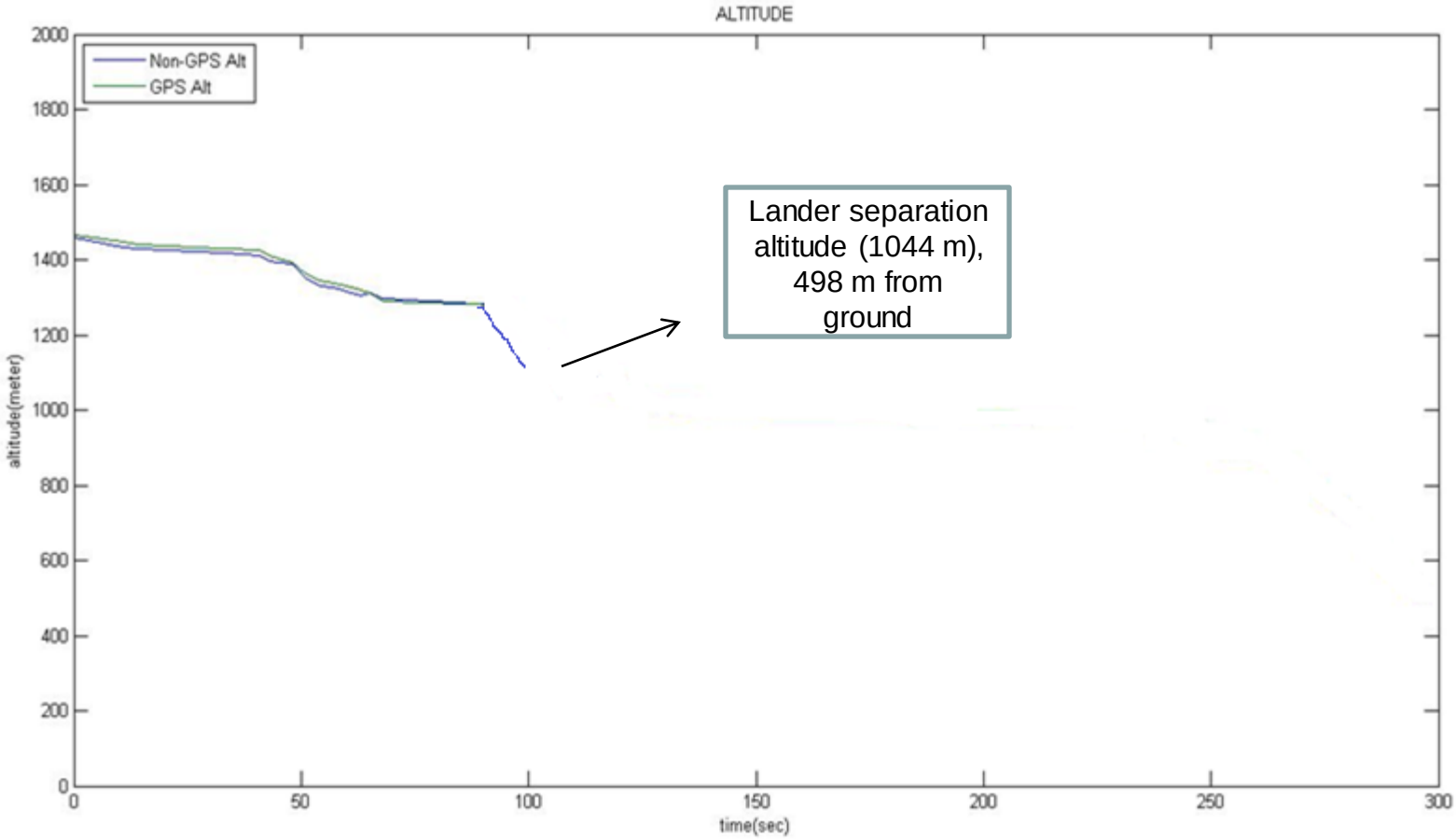
Average Descent rate - Carrier



Average carrier descent rate – 4.2m/s

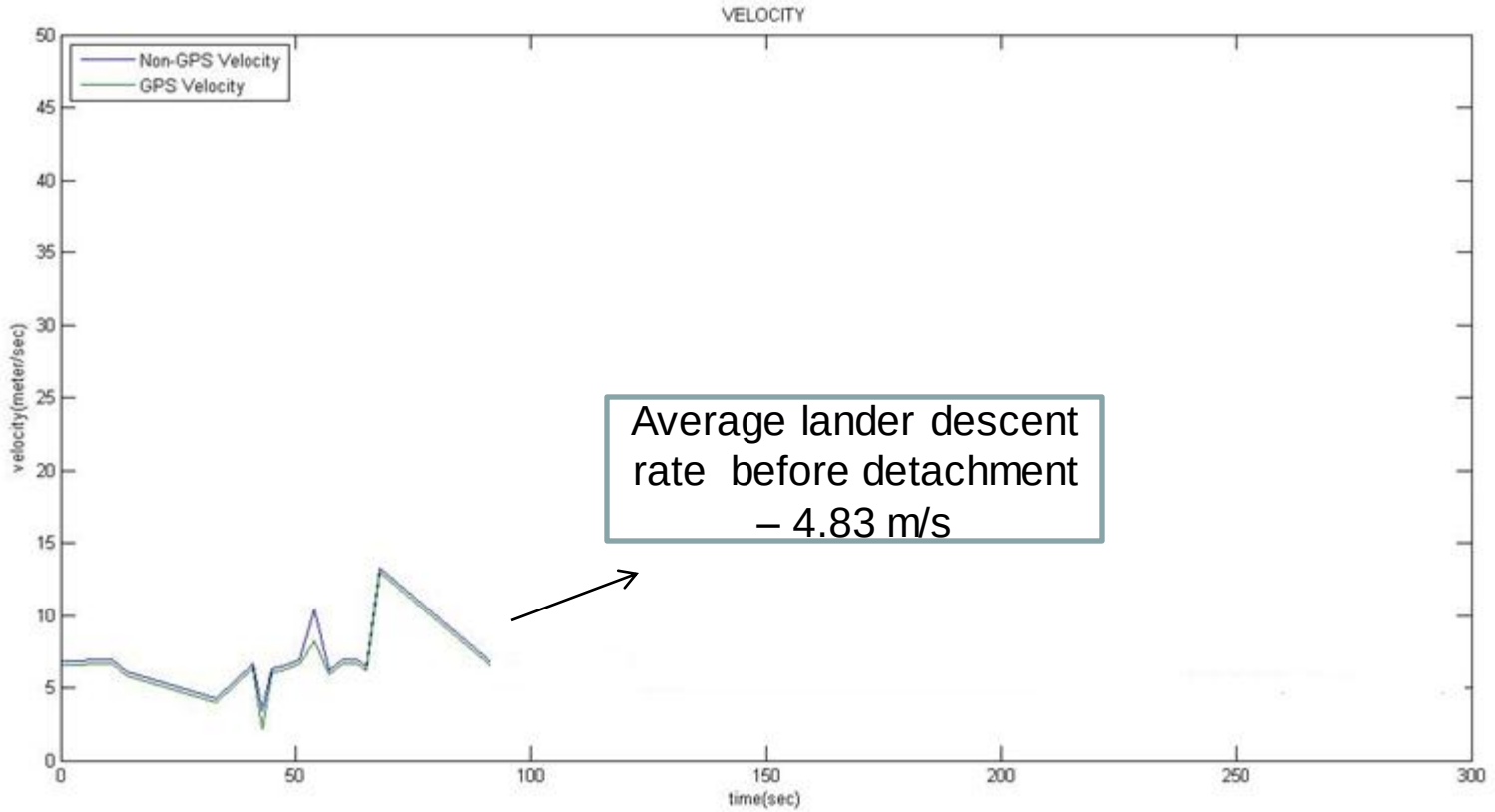
Average carrier velocity = total distance / total time = (1458-504)/229 = 4.2 m/s

Lander Altitude Data



Lander was not recovered so altitude data after that is not available

Average Descent rate - Lander



Average lander descent velocity before detachment : (1458-1044)/85 = 4.83m/s

GCS Role in Analysis

- **Start and indication of termination of communication.**

```
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~Cansat Starting~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
~~~~~~~~~~~~~~~~~~~~~~~~~~Communication Started~~~~~~~~~~~~~~~~~~~~~~~~~~

ch =

<ÿ'5i#204337,3206.1245N,09908.7486W,10,1467.2,8.8,30,1458.5@_______


ch =

<ÿ'5i#204348,3206.1244N,09908.7487W,10,1447.4,8.8,31,1432.7@________

                                    ..................
                                    ..................


ch =

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ch =

<ÿo'5i#204736,3206.1333N,09908.7543W,9,524.4,8.3,39,504.5t_______

~~~~~~~~~~~~~~~~~~~~~~~~~~Communication Terminated~~~~~~~~~~~~~~~~~~~~~~~~~~
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~Cansat Lander~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
```
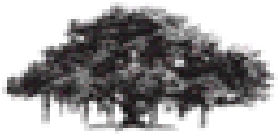
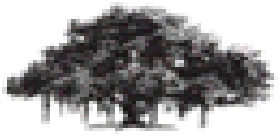



Failure Analysis

Palash Jain



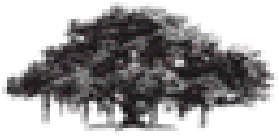
Failure Analysis

2011 Texas Annual CanSat Competition

- **Recovery Failure** – Parachute color – Should have been different than tree color (It was dark green ☹).

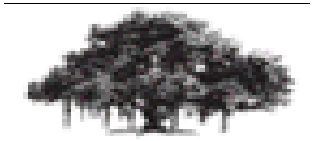
- **Audio Beacon** – Range was just few meters, should have something like a GPS tracker and tracked it down. (In case of lander)

- **Root cause** – Didn't have previous experience with rocket flights. We just tested from 60 mts max.



Management

Palash Jain



CanSat Budget – Hardware and Status of Procurement

2011 Texas Annual CanSat Competition

Component	Quantity	Unit Price (in USD)	Cost (in USD)	Status of procurement	Source
Atmega164A microcontroller	1	8	8 (actual cost)	Procured	http://in.element14.com/
Atmega 8 microcontroller	1	5	5 (actual cost)	Procured	
AC4790 and Antenna **(reused)**	1 each	80$+60$	0.7 (actual cost)	Procured	
Accelerometer **(reused)**	1	20	20 (actual cost)	Procured	
Battery	2	3.5	7 (actual cost)	Procured	
Mini Servo Motor	1	5	5 (actual cost)	Procured	
Circuit Fabrication	2	10	20 (actual cost)	Procured	
GPS Equipment **(reused)**	1	108	108 (actual cost)	Procured	
Memory	2	2	4	Procured	
Pressure Sensor	2	11	22 (actual cost)	Procured	
Structure material and Fabrication	1	60	60 (actual cost)	Procured	
Locator device	2	5	10 (actual cost)	Procured	Local vendor
Rip-Stop Nylon **(reused)**	3	18	54 (actual cost)	Procured	
Miscellaneous		20	20 (actual cost)	Procured	
Total			483.7	Procured	

CanSat Budget – Hardware

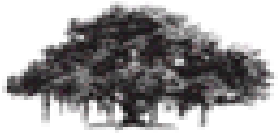
Component	Cost (in USD)	Source
Ground Control Station	1140$ (for laptop(1000$) and AC4790(80$) + antenna(60$)) (AC4790 and Antenna were reused)	http://search.digikey.com/scripts/DkSearch/dksus.dll?Detail&name=AC4790-1000M-ND
Test facilities and equipment and travel expenses	approx. 100$	
Travel to Texas and return	1200$ x 4 = 4800$	
Hotel expenses in TX	59$ x 4 = 236 $	
Total	6176 $	

Project Income:-

- Sponsors –
  - **AMD** - 1250 $
  - **Progress Software** - 1250 $
- Left over from Last year prize money – 1500 $
- University funds – 2500 $

Conclusions

Palash Jain



What Worked / What Didn't

2011 Texas Annual CanSat Competition

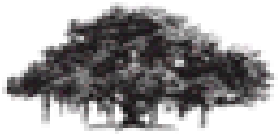
- **WHAT WORKED -**
- **Communication worked perfectly.**
  - Cansat data terminated successfully.
- **Detachment successful**
  - Detachment mechanism worked
- **Carrier recovered successfully.**
  - Carrier locator device is operational.
  - Carrier memory intact and data recovered.

- **WHAT DIDN'T WORK -**
- **Lander not recovered**
  - Don't know anything about the egg.
  - Could recover lander impact force data and other data from lander.

Lessons Learned

- **Think about the real time problems too rather than just focusing on theoretical , technical problems.**
- **Plan each and every event previously and write it down.**
- **Test more.**

- **What we would do differently next year**
  - Brighter Parachutes
  - Better Locator Device perhaps GPS
  - Streamers instead of parachutes for less drift



Questions

2011 Texas Annual CanSat Competition

QUESTIONS ??