’04 ARLISS PROJECT
TOHOKU UNIVERSITY TEAM

The Mission with the Dual Wheeled Rover

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Introduction

We have challenged "*Run -Back*" approach since ARLISS 2002.

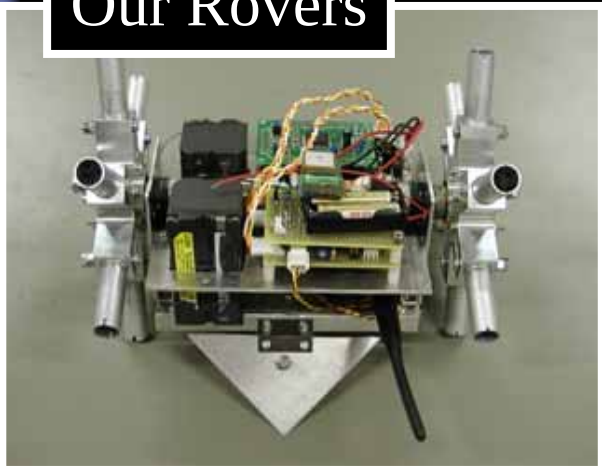
→ The payload is a ***Rover***.

Run - Back Advantages

After landing …

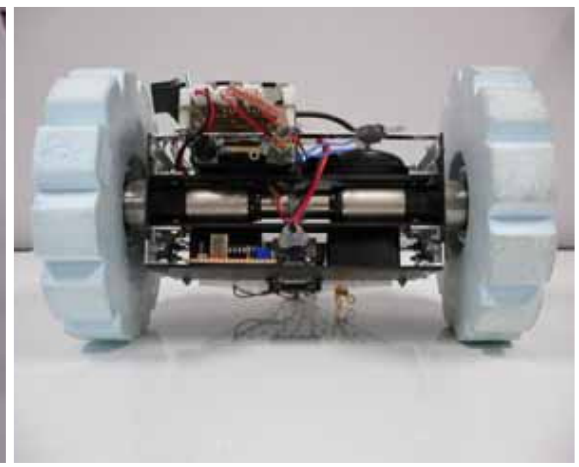
- Unlimited time for moving is available.
- There is no big disturbance for the payload.

Our Rovers



2002

2003



2004

2002 : The parachute was not open and the rover was broken at landing.

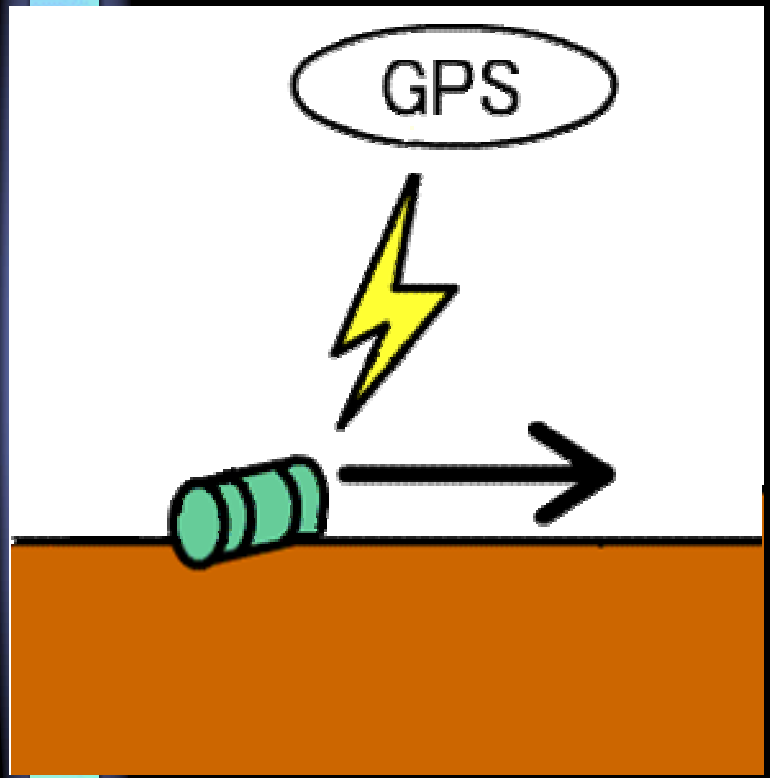
2003 : Due to the shock and vibration of the launch, the GPS receiver was suspended.

vibration test and drop test are necessary!!

This year, our purposes are to develop

1. the technology of the vibration test and drop test.
2. Wheels with high locomotion capability.
3. Light body.
4. High communication ability.

Mission sequence of “Run-back”



① Launch

② Separation from the Rocket

(Autonomous sequence starts by switch)

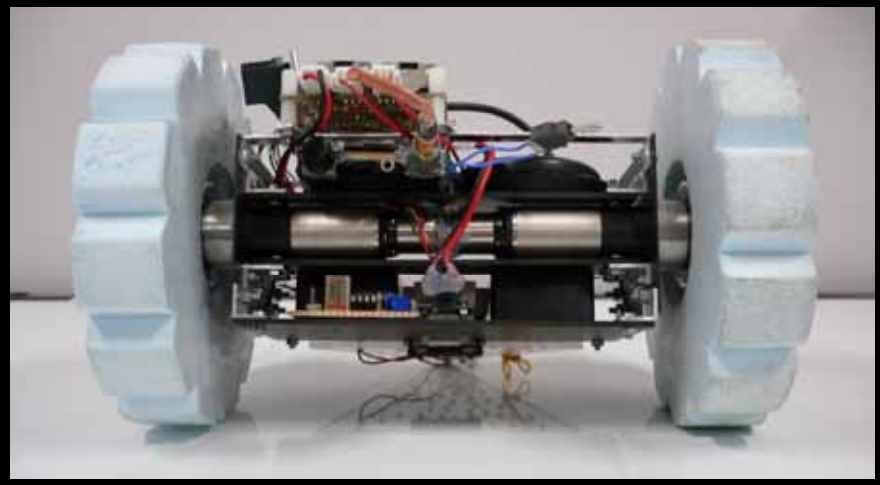
③ Parachute Opens

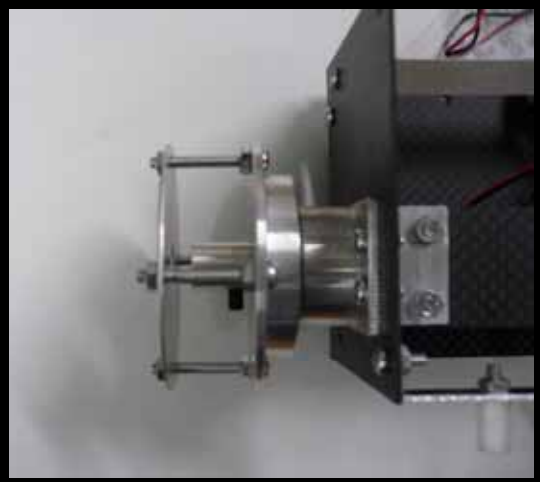
④ Landing (Check by GPS data)

⑤ Separate the Parachute

⑥ Navigation Using GPS

The design of our rover

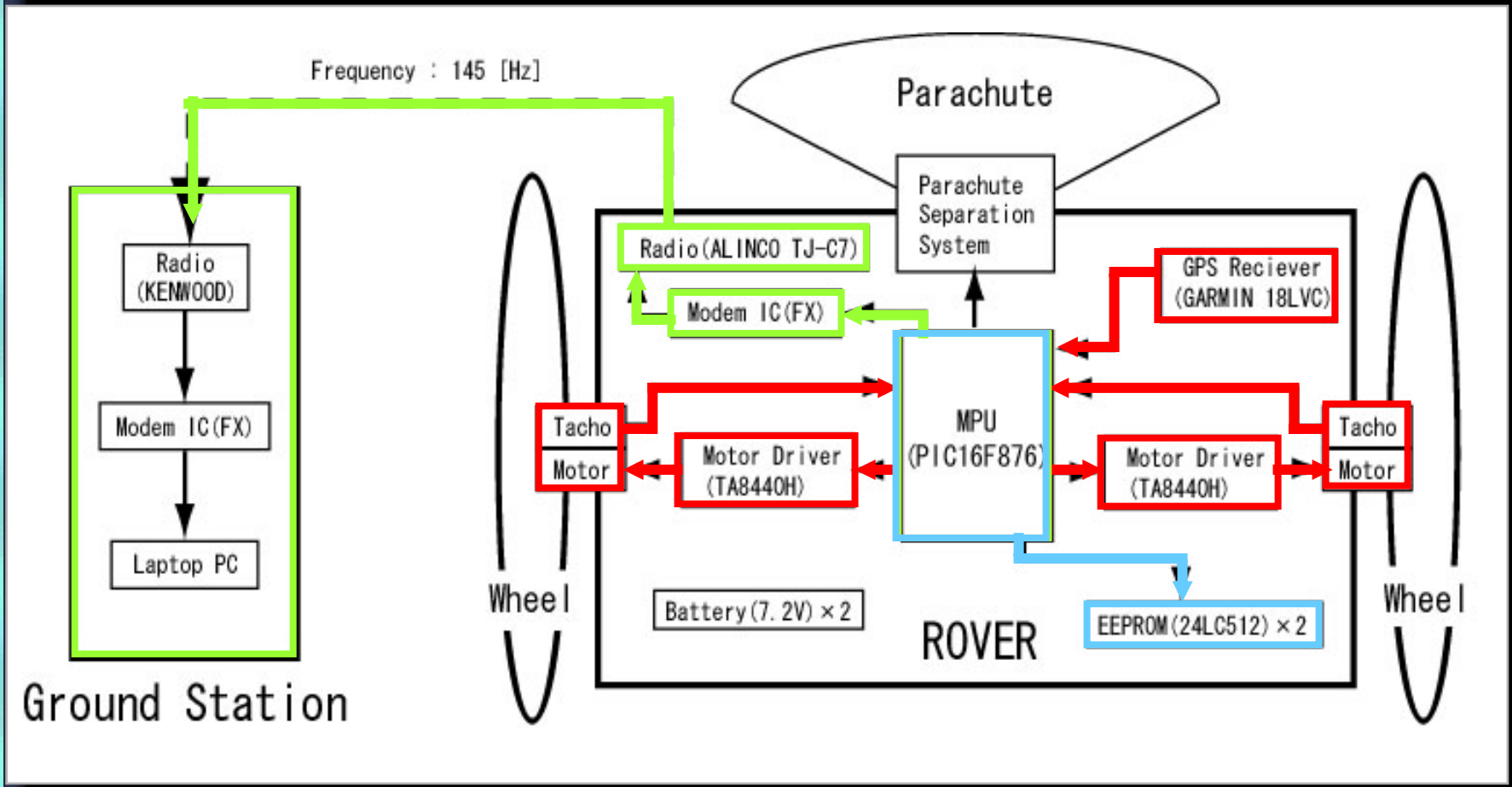




Material : CFRP and Aluminum
Size : Φ145 ×240 [mm]
Weight : 1050 [g]

Wheels are made from polyurethane

Schematic diagram



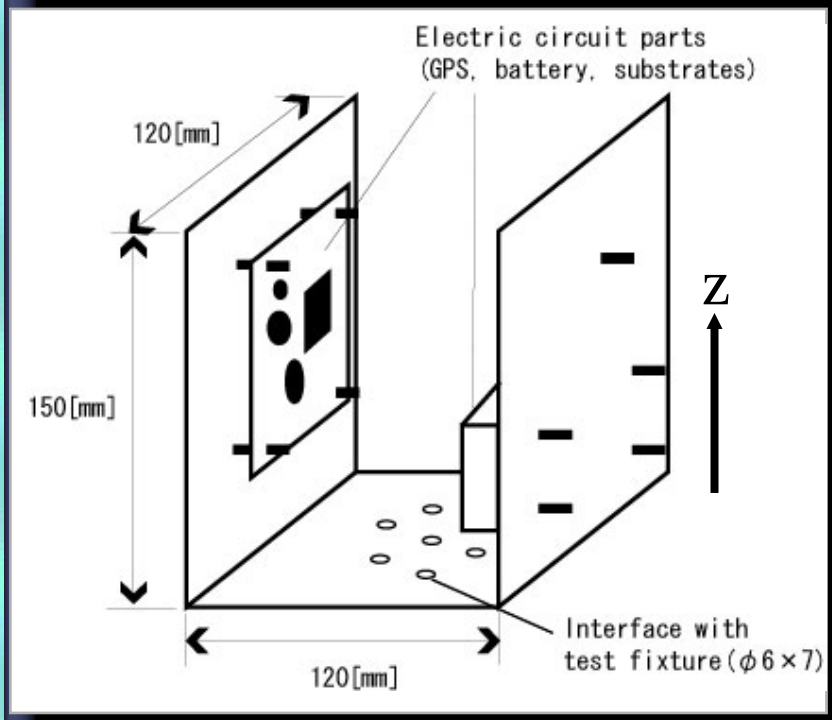
Radio system

Navigation system

Memory system

Summary of tests

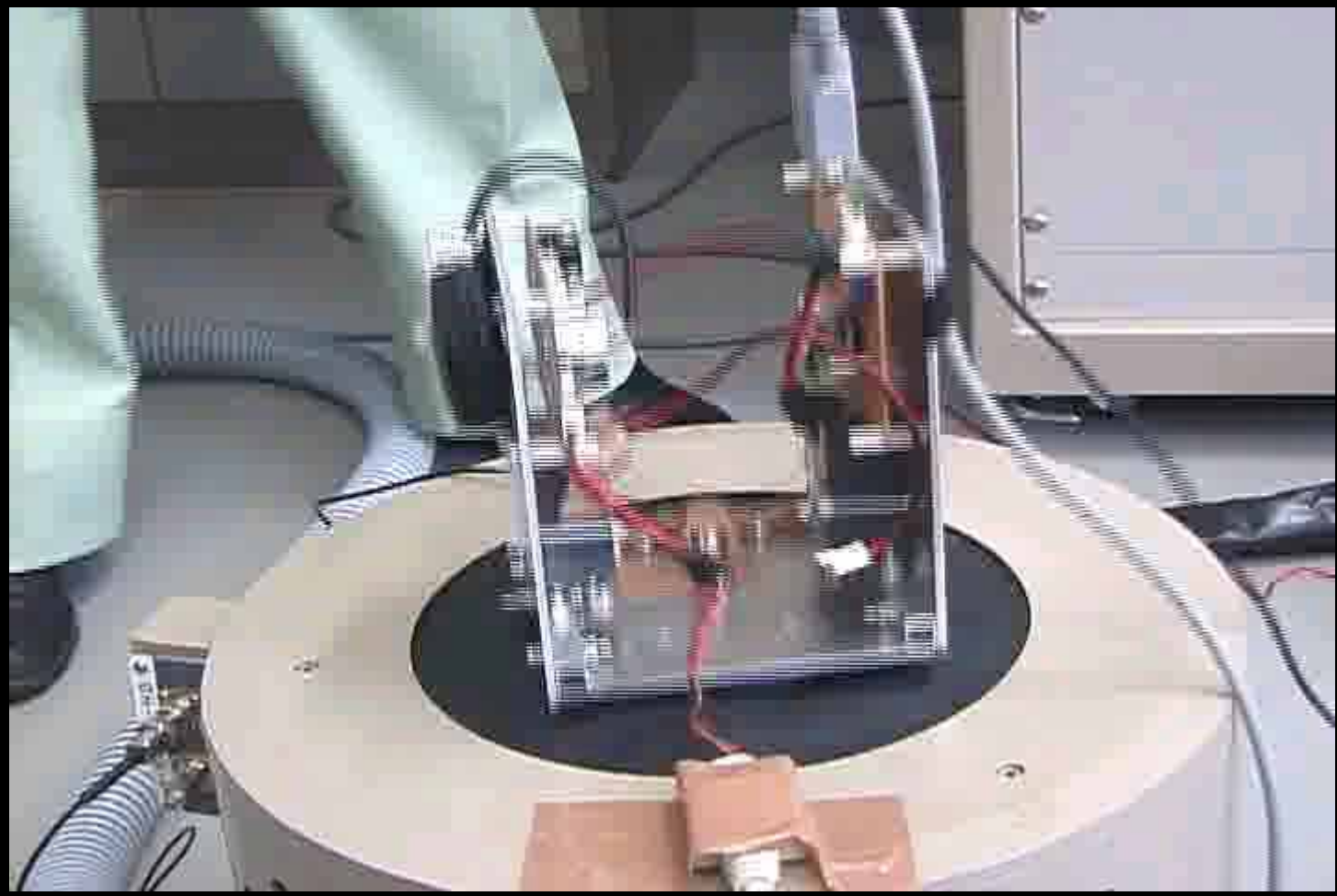
Vibration test



Test condition

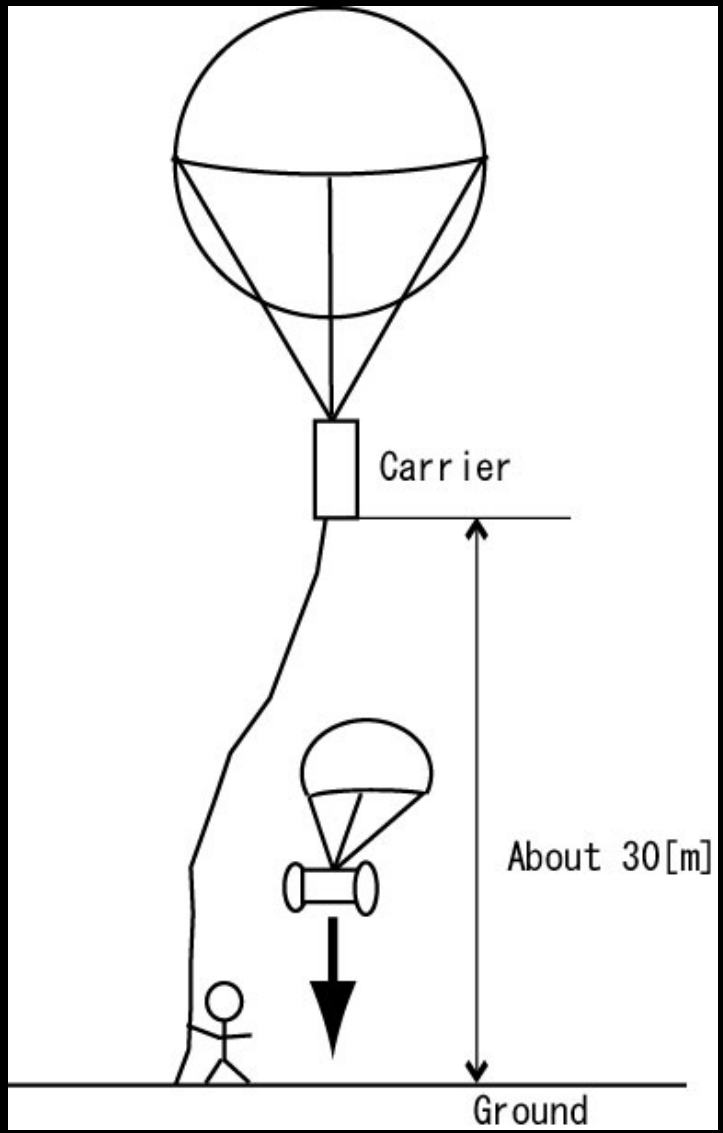
No.	Max acceleration	Frequency	Max displacement
1	3 [G]	16 [Hz]	5.8 [mm]
2	6 [G]	23 [Hz]	5.6 [mm]
3	9 [G]	28 [Hz]	5.7 [mm]

vibration type : sine wave
vibration direction : z direction



- All the electric circuit parts kept operating excellently.
- There were neither fall of parts nor a gap, etc.
- There were a disconnection of the power supply line and loosening of metal fittings.

Drop test



The carrier is given up to the high degree 30m by the balloon, and the payload is discharged.

Diameter of balloon : 2.5 [m]
Gas : Helium
Examination frequency : twice

- The parachute opened both time.
- The rover didn’t have damage.
- When landing, the rover splashed on ground and rolled the string of the parachute.

The result of ARLISS 2004

The launch was perfect, and the rover fell to a place near the goal!!

But The parachute was not open, again…

Circuit parts were not damaged

→ We could get GPS data by radio while it is falling, so the rover could be found easily.

→ After landing, MPU kept giving the control signal.

CFRP body was not distorted and cracked

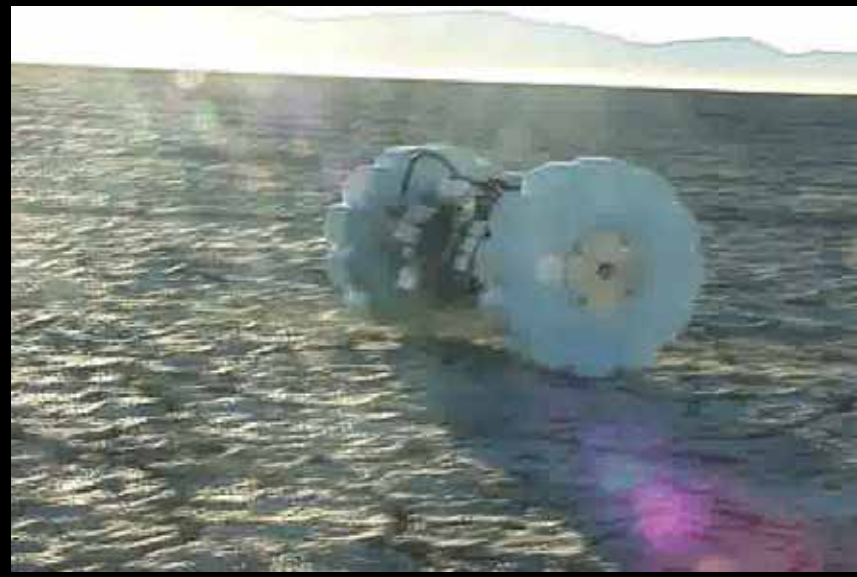
Motors was broken.

→ The rover couldn't move any more.

Original driving performance of the rover

Running in unleveled land

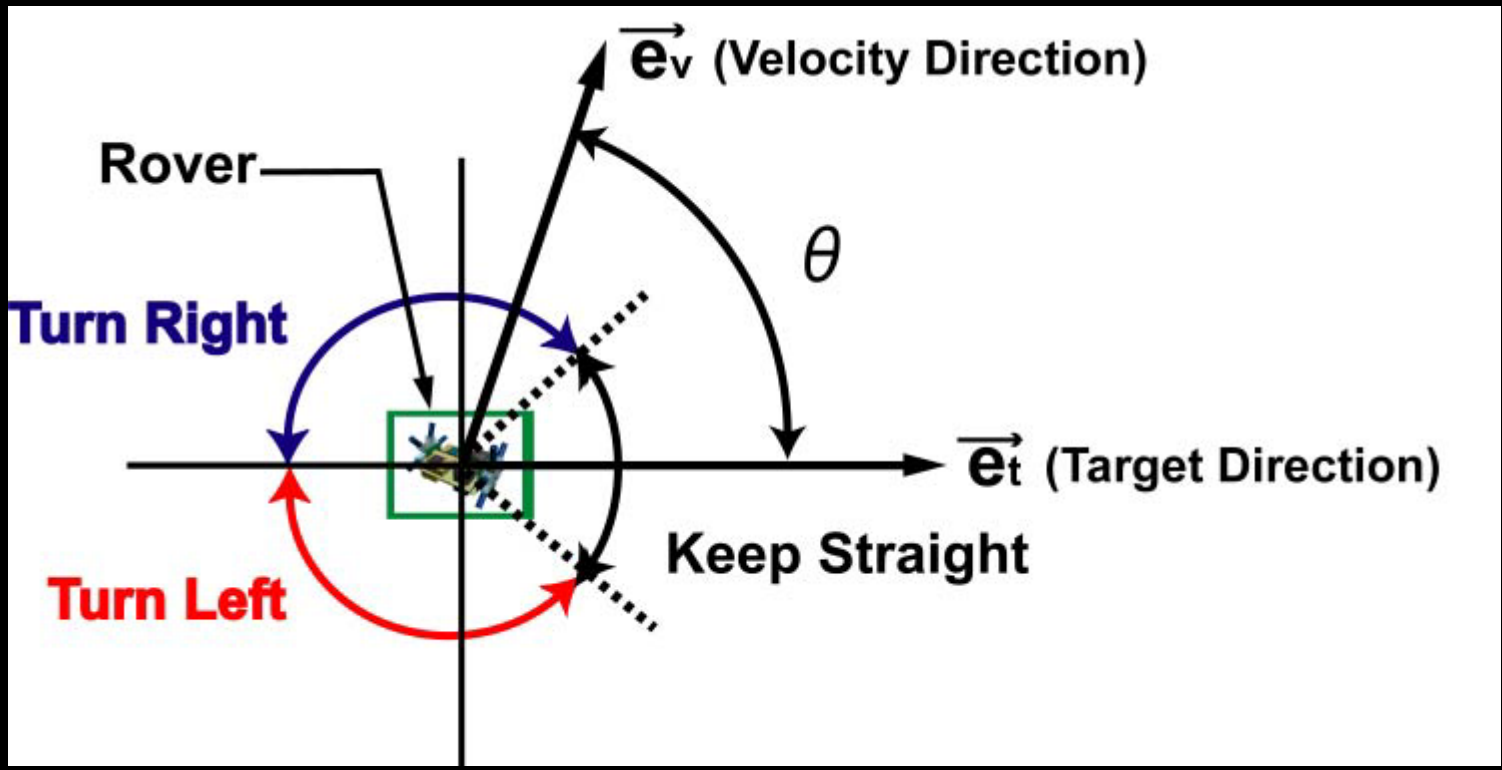
Navigation running



Conclusion

- We did vibration test for electric circuit parts, and circuit parts were not broken at the launch and the landing.
- The parachute did not open though we did the drop test. We should do more tests for the success.
- The utility of the use of materials such as CFRP and polyurethane in place of past aluminum was confirmed.
- The system with a higher communication ability than last year was able to be constructed.

Navigation Algorithm



$\vec{e}_t \times \vec{e}_v = \sin\theta$ → An angle of θ (Right position)

$\vec{e}_t \cdot \vec{e}_v = \cos\theta$ → A sign of θ (Left position)

Parachute Separation system