

ARLISS Project 2003

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Our approach is ...

We have challenged “*Run Back*” approach since ARLISS 2002.



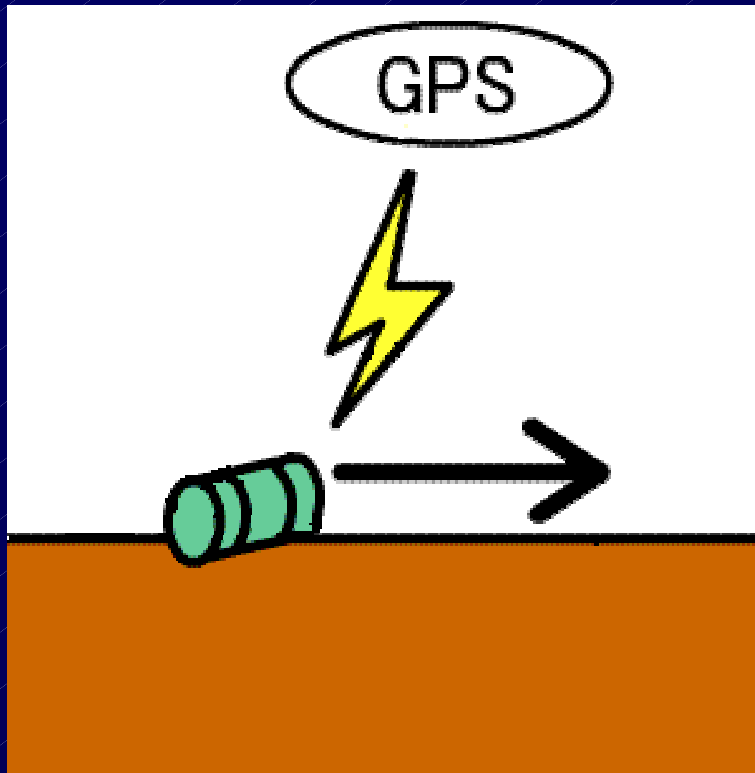
The payload is a *Rover*.

Run - Back Advantages

After landing ...

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

Mission sequence of Run-back



Launch

Separation from the Rocket

(Autonomous sequence starts)

Parachute Open

Landing

Separate the Parachute

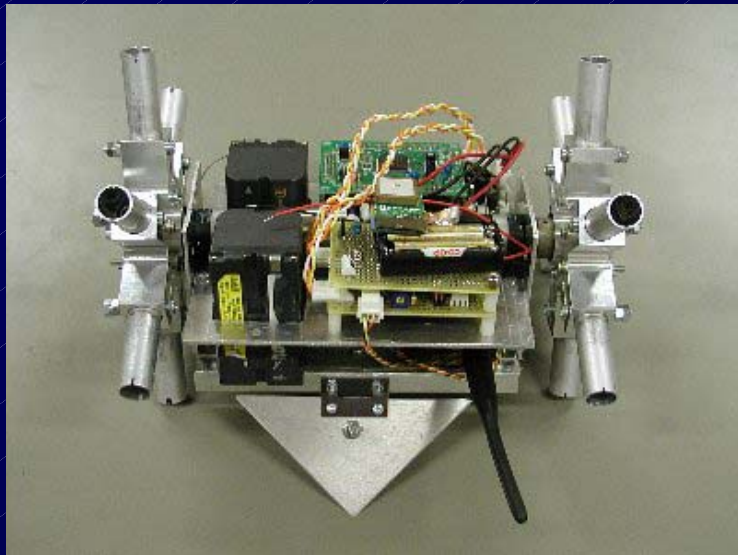
Navigation Using GPS

Rover Overview

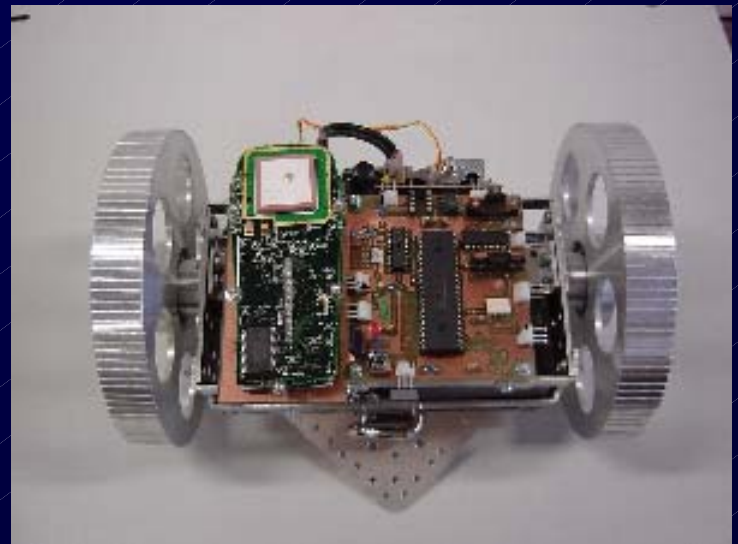
Rover's name = “*Desert Crawler*”

[Design update from 2002 to 2003]

ARLISS2002 : DC-1

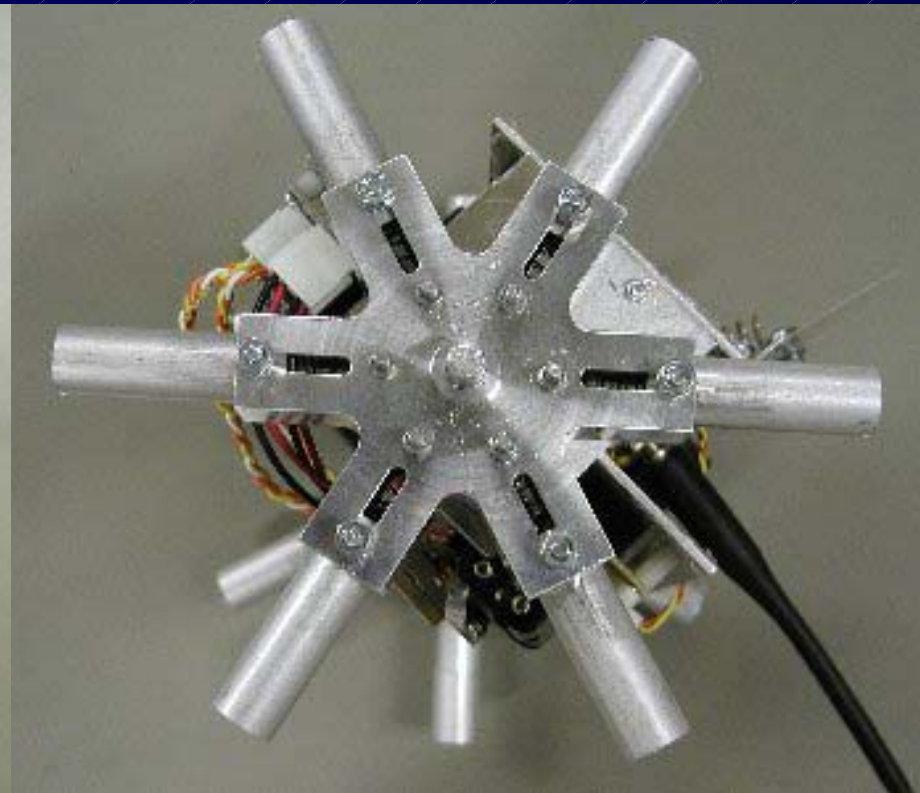
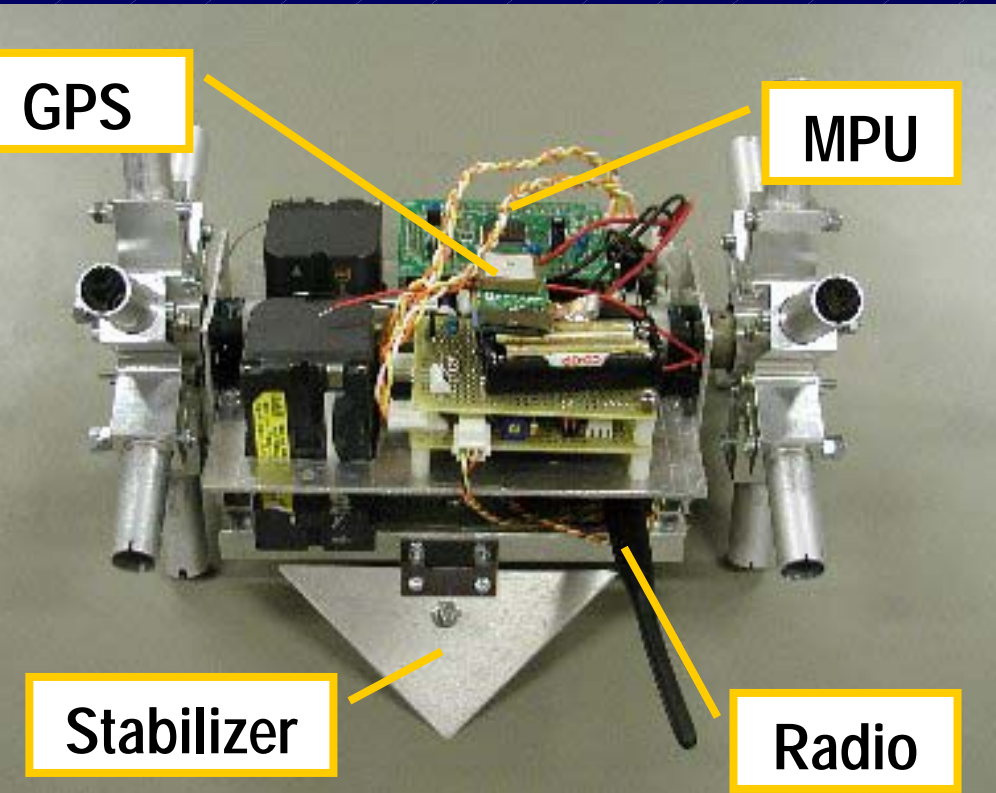


ARLISS2003 : DC-2



DC-1 : Desert Crawler - 1

@ARLISS2002



Width 230 [mm] × Diameter 140 [mm]

DC-1 : Desert Crawler - 1

@ARLISS2002



Design Update

- More effective locomotion

Circular wheels

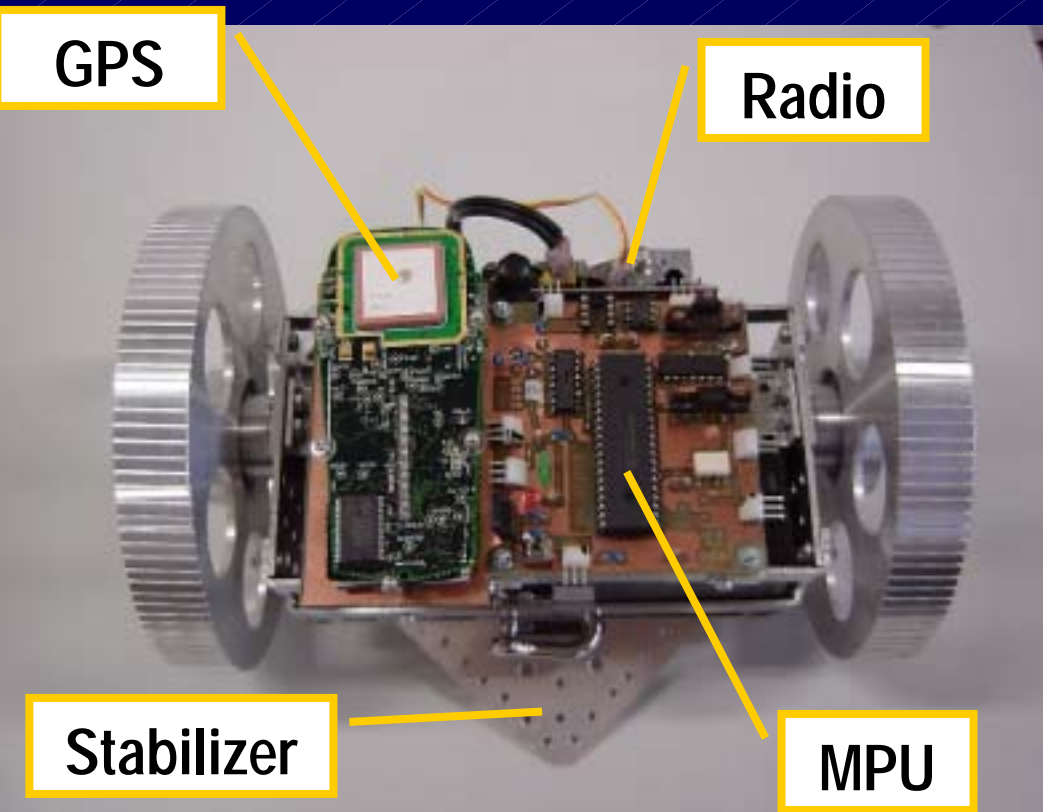
(the expandable wheels are a good idea but the power efficiency is not so good.)

- Refine the electronics

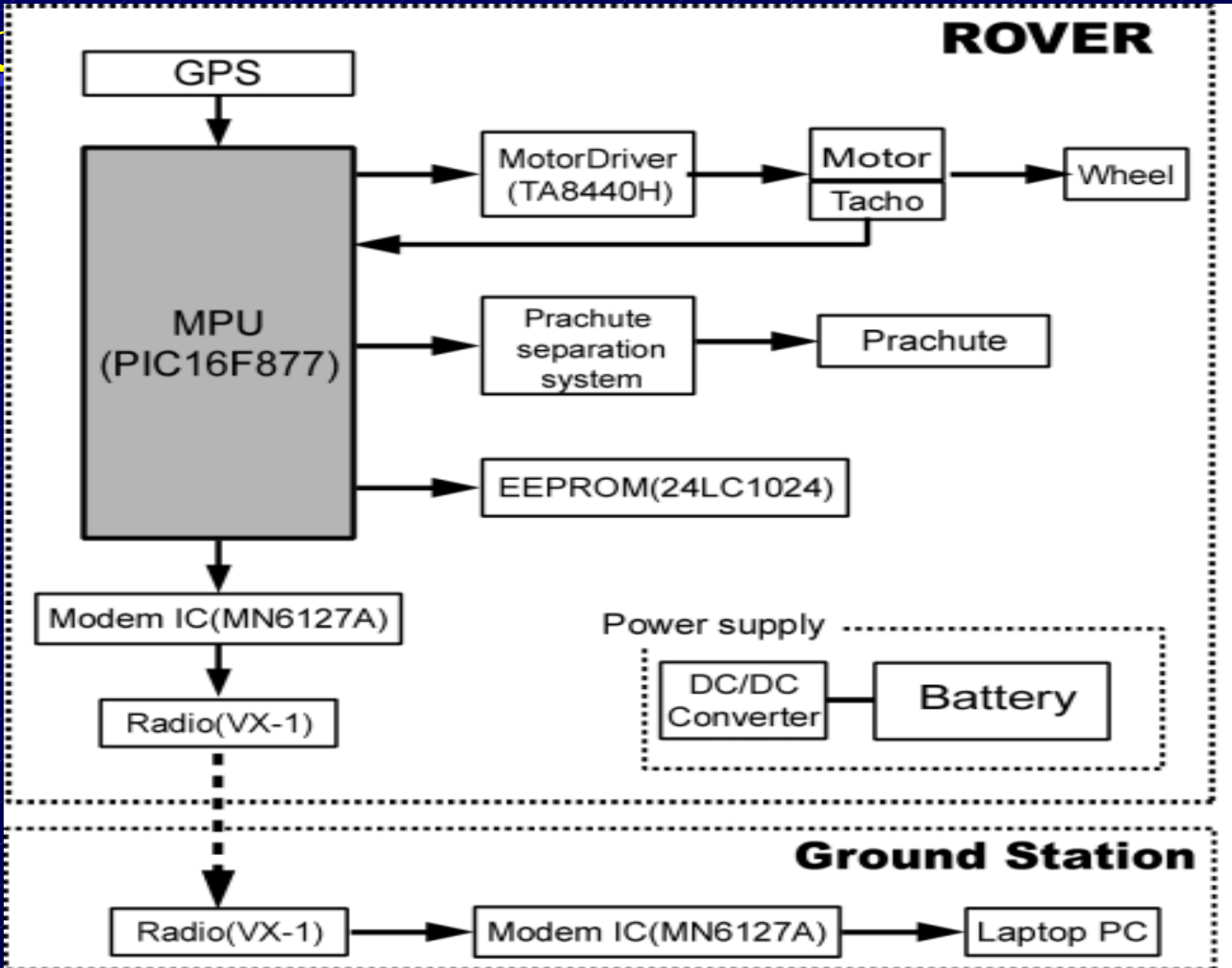
the number of circuit boards was integrated from 5 to 2.

DC-2 : Desert Crawler – 2

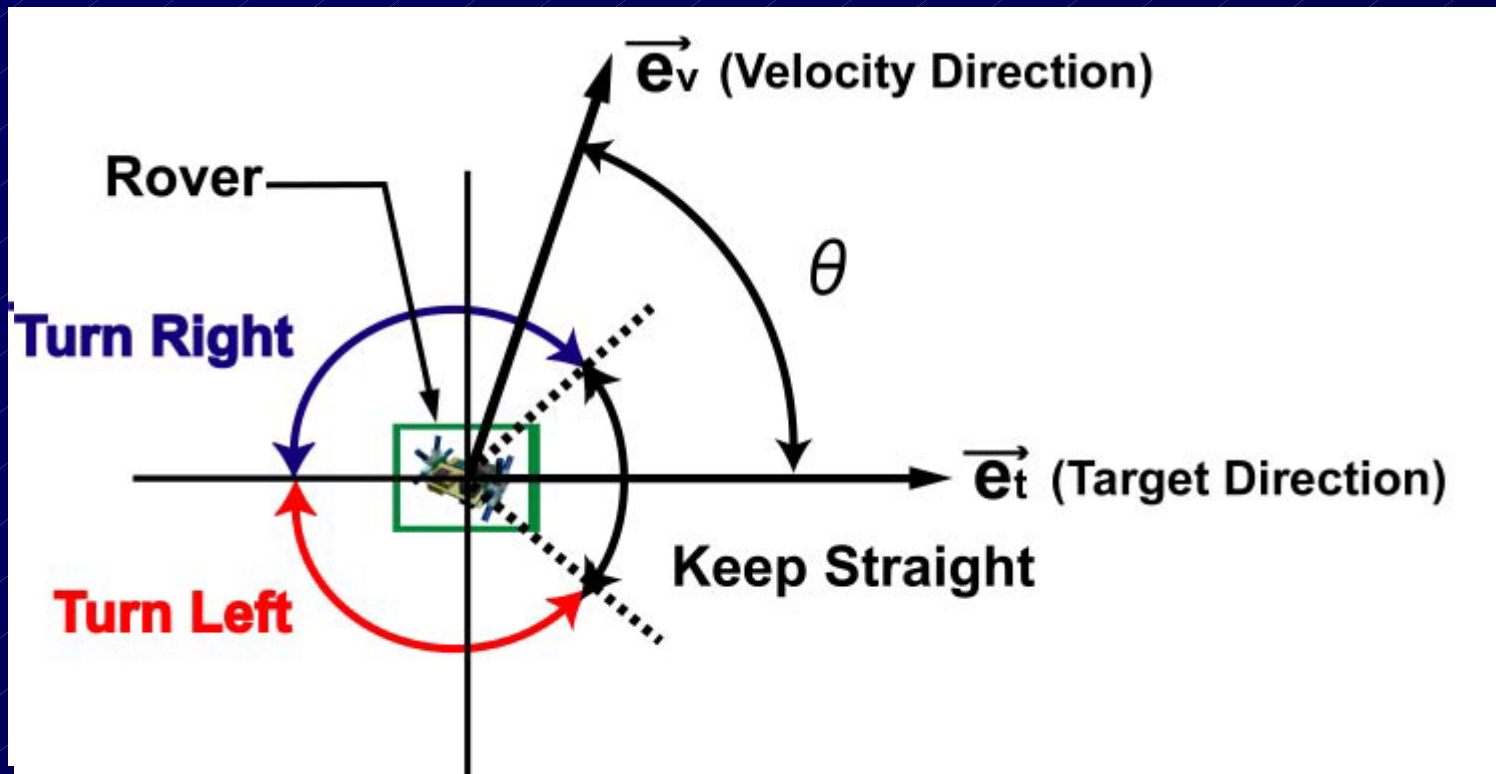
@ARLISS2003



Width 220 [mm] × Diameter 145 [mm]



Navigation Algorithm



$$\vec{e}_v \cdot \vec{e}_t = \cos \theta \quad \longrightarrow \quad \text{An angle of}$$
$$\vec{e}_v \times \vec{e}_t = \sin \theta \quad \longrightarrow \quad \text{A sign of}$$

Result of ARLISS 2003



Mission summary (1/2)

- Launch was beautiful.
- Parachute opened at the apogee.
- Due to the shock and vibration of the launch, the GPS receiver was suspended.

Mission summary (2/2)

- There was only a little damage on the payload at landing.
- After restart the GPS, the rover worked perfectly to the goal.
- The rover traveled more than 3 hours/3 km to reach the goal !!!

Launch !!!



Parachute separation & Start locomotion



Crawl on the desert

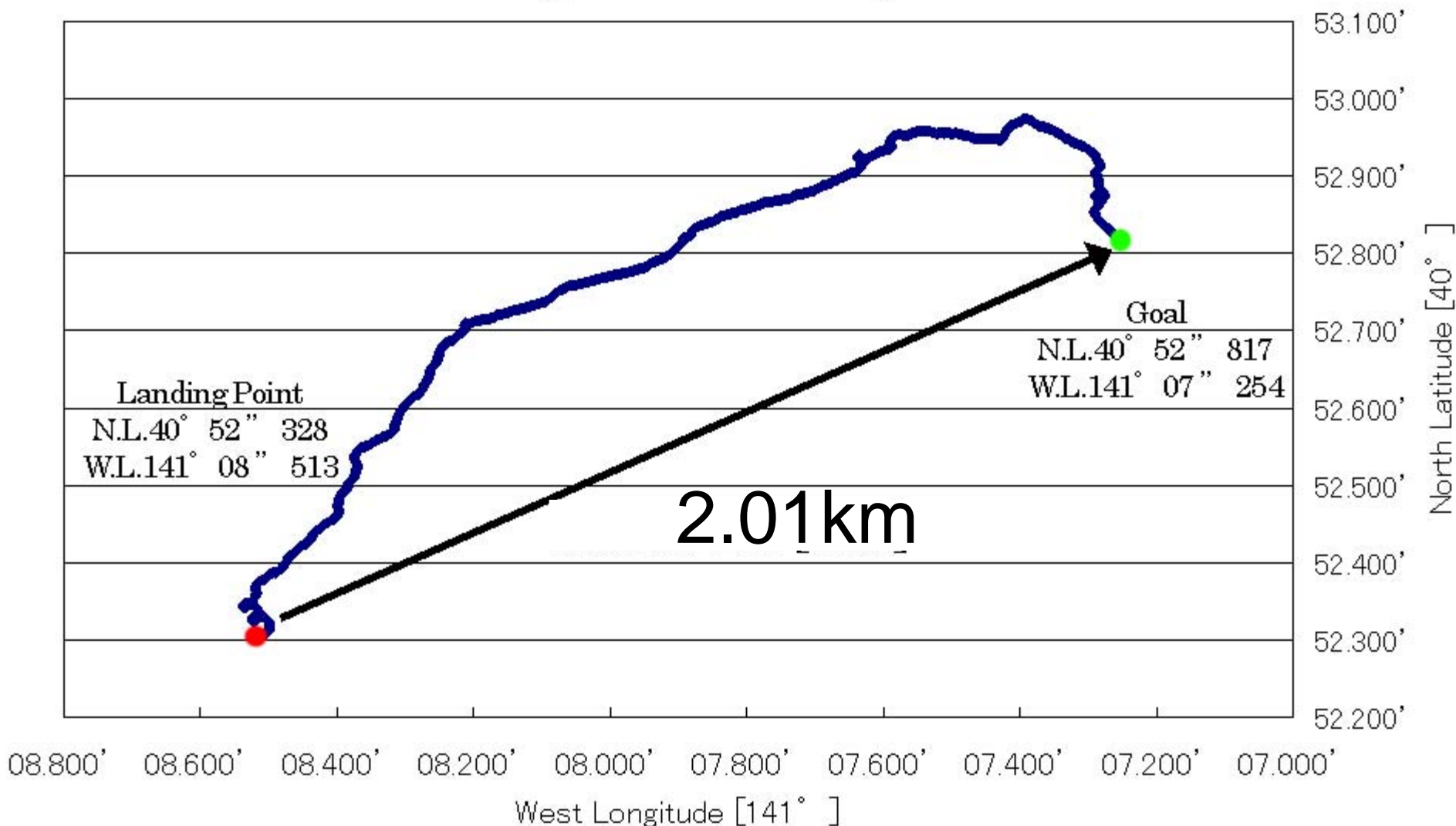


Goal !!!!!

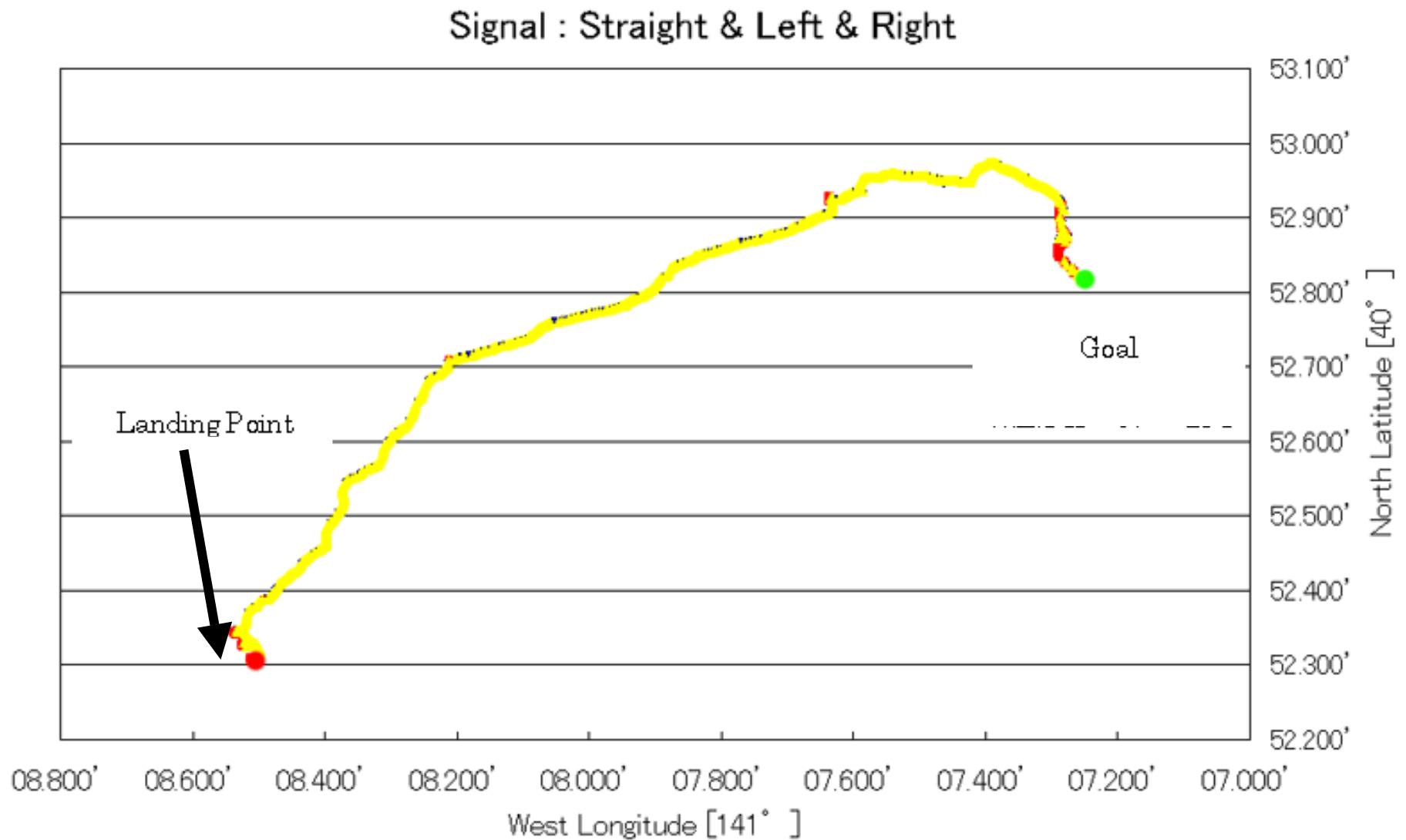


Result (crawl profile)

Navigation from Landing Point



Result (navigation-control signals)



Conclusion

- If the GPS wasn't suspended, the rover was able to keep its sequence to travel towards the goal after the landing.
- Due to wheel slip, the motion direction of the rover was distorted. Versatile tire design for natural rough terrain is necessary to improve the locomotion capability.
- We learned a lot of things, had a good experience, and had a great fun.