Vidyavardhini's College of Engineering & Technology
An Electronics and Telecommunication Engineering Department Publication

ETA NEWSLETTER

Volume 17; Issue 2; June 2021

Space Rover Technology

"Nobody originally believed that a couple of feet long rover could move around Mars at all, but Science did it!"

A rover is a planetary surface exploration device designed to move across the solid surface on a planet or other planetary mass celestial bodies. Some rovers are designed as land vehicles to transport members of a human spaceflight crew; others have been partially or fully autonomous robots. They are meant to land on other planets. Rovers are tasked to collect information about the terrain, and to take crust samples such as dust, soil, rocks, and even liquids.

Ref: https://airandspace.si.edu/exhibitions/exploring-the-planets/online/tools/rovers.cfm

Rovers help scientists in their quest to understand what different parts of the planet are made of. Mars is made up of lots of different types of rocks, and each rock is made up of a mixture of chemicals. A rover can drive around to different areas, studying the different chemicals in each rock. These chemicals can tell scientists something about the environments that changed that rock over time. They specialize in moving around and land on the surface of Mars to drive to different spots.

They are essential tools in space exploration. Rovers are smart. If being powered by solar, they can orient themselves towards sunlight to weather winter. Carrying enough intelligence and ability to advance the knowledge, they know how to perform very remote robotic activities. They have the capabilities to withstand high levels of accelerations, wide temperature range, pressure, dust, corrosion, cosmic rays without the need of repair.

Ref: https://spaceplace.nasa.gov/mars-rovers/en/

What work does a Rover does?

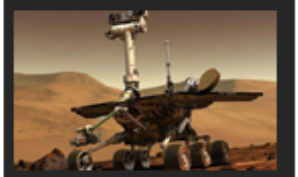
Compiled by Atique & Kushal

The goals of a rover are closely interlinked. It starts off with understanding the current climate and calculations to decide whether humans can safely explore onto this surface. It also includes studying the geology of Mars which helps to better understand the habitability of the specific planet. NASA breaks down the goals of a Rover into eight smaller objectives which ranges from biology to geology and to planetary processes. Depending upon the mission requirement it also includes collection of actual samples like crust, rocks and sand. For a fruitful investigation, the main goal of a rover is to be able to self-adjust itself according to various landscapes. The main highlighting job a rover is to characterize and prepare the first step for human exploration.

A rover completes its goals not just by moving it wheels. They are designed to walk, hop and even roll depending upon the conditions. Some rovers can even spin out a sandy sinkhole by corkscrewing upward to escape. Thus, to say that the intelligence of a rover is unmatched. A rover has some factors which are to be satisfied during designing.

Reliability: The rover must withstand each and every geographical condition.
Autonomy: Rovers which land on celestial bodies far from the Earth cannot be remotely controlled in real-time since the speed at which radio signals travel is far too slow for real-time or near real time communication

Communication in Rover



Communication with Rover is done mainly with the help of DSN (Deep Space Network). It is a worldwide network of large antennas and communication facilities that allows advance communication.
It plays a important role in two way communication and also provides link to control and guide.

Read more on Pg 3

Opportunity's sister rover, Spirit, was launched three weeks later, and landed on the other side of Mars, but it subsequently got stuck in 2009, and no longer was able to function.

How it works?

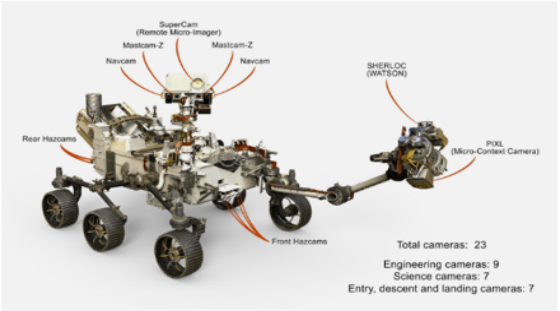
-Compiled by Tarang & Prachi

A rover is a planetary surface exploration contrivance. Although some rovers have been designed as land conveyances to transport members of a human spaceflight crew; most rovers have been partially or purely autonomous robots.

During the NASA Sample Return Robot Centennial Challenge, a rover, named Cataglyphis, successfully demonstrated autonomous navigation, decision-making, and sample detection, retrieval, and return capabilities.

The rovers (utilized in Mars exploration by NASA) were designed to trek up to 100 meters (about 328 feet or 110 yards) across the Martian surface each Martian day, though they were able to go much further than expected. While a complete martian day is about 24 hours and 40 minutes long (or 24 hours 37.5 minutes to be exact).

The communication time delay between Earth and Mars (about 20 minutes approximately) is one of the major barriers as moving the rover safely from a particular location to another location respectively becomes a major challenge. Unlike a remote-controlled car, the drivers of rovers on Mars cannot instantly visually perceive what's transpiring to a rover at any given moment and that they cannot send expeditious commands to obviate the rover from falling off of a cliff, etc.



During surface operations, this device receives a new set of ordinant dictations at the commencement of each sol (or each martian day). The command sequence sent from the world , tells the rover what targets to travel to and what science experiments to perform.

The rover is expected to move over a given distance, precisely position itself with deference to a target and deploy its instruments to take close-up pictures and analyze the minerals or elements of rocks and soil.

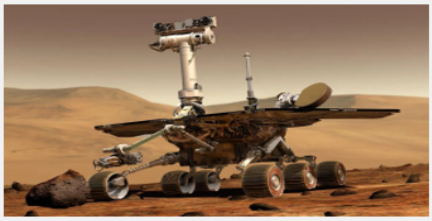
Rover: Example & Fun Facts

-Compiled by Hemant & Nihal

Rovers such as the Mars Exploration Rovers, which land on astronomical bodies far from the Earth, cannot be remotely controlled in authentic-time since the speed at which radio signals travel is far too gradual for authentic-time or near-authentic-time communication.

For example, sending a sign from Mars to Earth takes between 3 to 21 minutes. These rover thus capable of operating autonomously with little assistance from ground control, as far as navigation and data acquisition are concerned, albeit they still require human input for identifying promising targets within the distance to which to drive, and determining the way to position itself to maximise solar power. Giving a rover some rudimentary visual identification capability to make simple distinctions can sanction engineers to expedite the reconnaissance.

Bye-Bye Oppy (A fond farewell to the Mars Opportunity Rover).



After 14 years NASA's Opportunity Rover is saying goodbye and it's breaking our hearts. What was supposed to be a 90-day mission, turned into 14 years.

Ref: Taken during the first drive of NASA's Perseverance rover on Mars on 4 March 2021. Image Credit: NASA/JPL-Caltech

New Insight on Rover: NASA's Perseverance rover nails 21-ft test drive, gets software update for Mars exploration

NASA's newest Mars rover Perseverance has put 21 feet, or 6.5 meters, on its odometer in its first test drive on the Red Planet. The rover ventured out of its landing site in the Jezero Crater, two weeks after setting down on the red planet to seek out signs of past life. However, the drive served as a mobility test – one of many milestones that members of the Perseverance team will test and calibrate on the rover before it takes on any science missions.

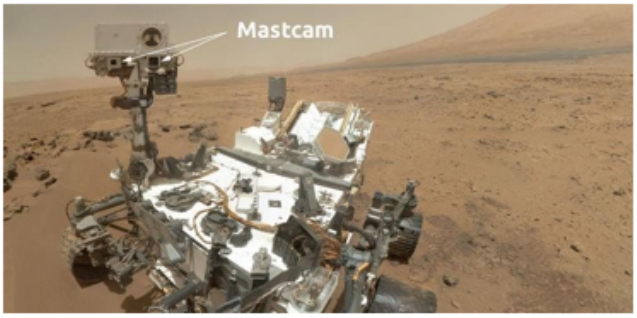


figure 3.1 MastCam

Mast Camera (MastCam)

The Mast Camera, or MastCam for brief, takes color images and color video footage of the Martian terrain. The images are often stitched together to make panoramas of the landscape round the rover.

It serves as the primary science camera on NASA's Perseverance Rover. It was designed in San Diego, California.

Some Features of MastCam:

1. One among the 2 MastCam camera systems features a moderate-resolution lens, almost like the PanCam on the Mars Exploration Rovers. The other camera system features a high-resolution lens so as to review the landscape far away from the rover.

2. The Mastcam can take high-definition video at 10 fps (frames per second).

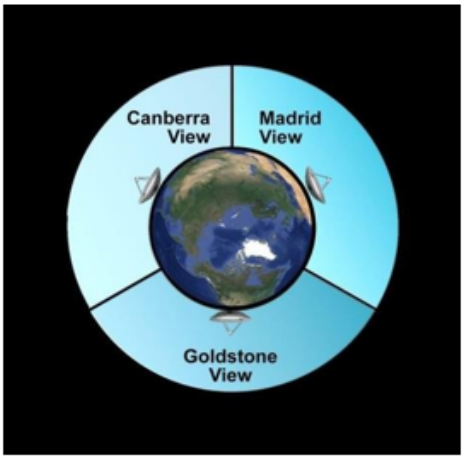
3. The Mastcam is meant to require single-exposure, color snapshots almost like those crazy a consumer camera on Earth.
(In addition, it's multiple filters for taking sets of monochromatic (single-color) images.)

4. Electronics on the MastCam process images independently of the rover's central processing unit.

5. The MastCam has an indoor data buffer for storing thousands of images or several hours of high-definition video footage for transmission to Earth.

How is communication done in a rover?

The main technology used while communicating with space rover is DSN. The Deep Space Network (DSN) is a world-wide network of large antennas and communication facilities that allow people on ground that are present on space center to communicate with satellite rovers and other spacecraft missions.

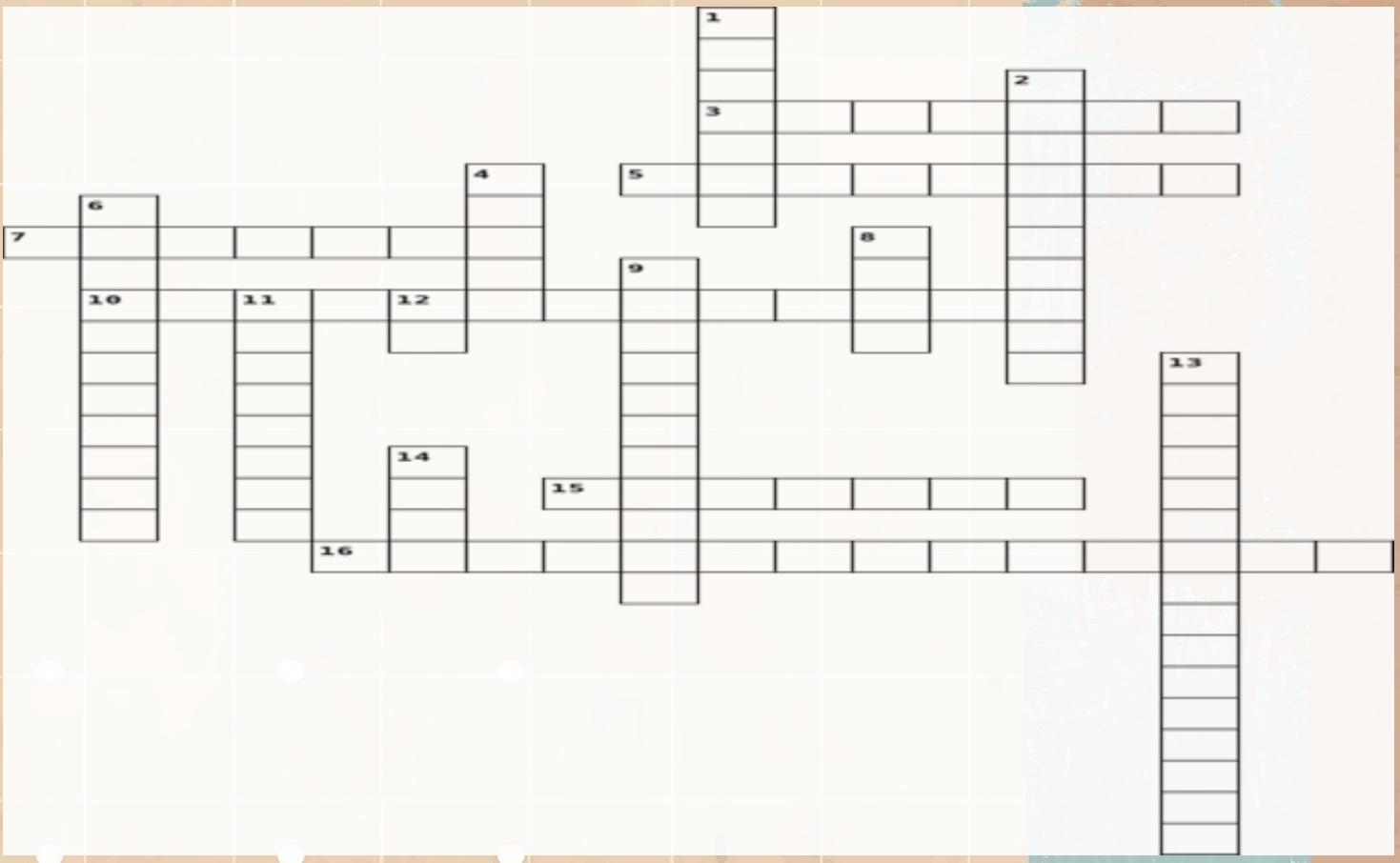


India uses ISDN (Indian Deep Space Network) in similar way NASA uses DSN technology. ISDN consists of ISRO Telemetry, Tracking and Command Network which is augmented by a fully steerable 18m and 32m DSN antenna.

Setting up DSN station 120 degrees apart that will ensure there will always be a station that can communicate with rover or that can send signals and receives signals facing any direction in space at any time. The DSN play an important role in two-way communication between space centre and rover it also provides link that control and guide space rover, and collects the scientific information, images, sounds, quality of soil.

The NASA's DSN currently is placed one third the way around the world. The three spots are at Goldstone, in California's Mojave Desert near Madrid, Spain and near Canberra, Australia. This vital positioning of DSN permits constant observation of space rover and helps to make the DSN most sensitive

Solve it!



Down

1. Cryptographer known as the "father of information theory"
2. This type of pair can be produced using individual transistors or purchased as a single device
4. The BIU prefetches the instruction from memory and stores them in _____
6. How one device communicates with one or more other devices, at a predetermined speed
8. Sharp bend in I-V curve
9. Recovers information from a regulated waveform
11. A voltmeter is used in _____ with the circuit.
12. 30 kHz to 300 kHz
13. Part of a directive antenna that derives energy from mutual coupling with the driven element (2 wds.)
14. Unidirectional antenna

Across

3. Creates neighbourhoods of IP addresses
5. Represents a system's gain and phase as a frequency function [two words]
7. A series of stages in which the output of one stage is the input of the next stage
10. A phenomenon that occurs when a vehicle sounding a siren approaches, passes, and recedes from an observer [two words]
15. Error-correcting code
16. A feedback structure with an odd number of digital inverters [two words]

Did you know?
If you had an light bulb on Moon connected to a switch in your bedroom, it would take only 1.26 seconds for that bulb to light up. (238,857 miles away!)

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Secretary: Nihal Kumar
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