MARS ROVER MISSION

Space exploration is one of the most prominent research areas mankind has ever engaged in. As you may know, over the years, there have been several unmanned missions to explore various bodies in our Solar System, the latest of which is the exploration of Mars.

The Jet Propulsion Laboratory (JPL) teamed up with NASA once again to send a new and much more sophisticated autonomous robot to explore the red planet. They have decided to give the task for writing the software that guides this new Rover robot to you.

The Rover is a six-wheeled autonomous robot equipped with:

- An imaging sensor that provides it with information about the terrain in its close proximity
- A digital camera for taking high resolution pictures
- Two redundant sets of meteorological sensors for measuring: pressure, temperature, wind speed and wind direction
- A UHF radio transceiver to communicate with Earth

The Rover will be in radio contact through the UHF Transceiver with Mission Control (MC) at NASA, and will receive commands from human operators, but due to the great distance between Earth and Mars, radio transmissions will reach it with an approximate delay of 11 minutes. As a result, real-time operation is out of the question (the actual distance may be as long as 400 million km). A human operator can issue one of the several commands:

- Move to a relative coordinate set – when the Rover receives this command, it attempts to reach that set of coordinates on its own, climbing and going around obstacles. The terrain where the Rover will operate is made up of adjacent hexagons of flat terrain, much like a honeycomb. Each hexagon has a certain relative height to the one occupied by the Rover. See picture 1. The robot can move from one hexagon to an adjacent one if the relative height is less than 5 cm. If the height difference is larger, the Rover may tip over. The Imaging Sensor is capable of seeing only the six adjacent hexagons to the one occupied by the Rover. Each movement from one hexagon to another will be logged and sent back to MC, upon arrival at the specified coordinates.

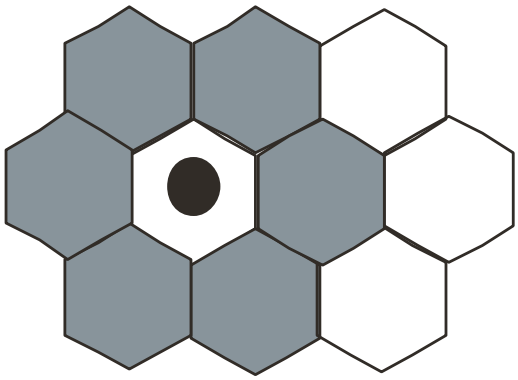

Figure 1: The Mars terrain

- Probe sensors – when the Rover receives this command, it measures the values for temperature, pressure, wind speed and direction and sends them back to Mission Control
- Take picture – when the Rover receives this command, it takes a picture and sends it back to mission control.
- Undo last movement – when the rover receives this command, it returns to the position it occupied prior to the last move command.

While moving, the Rover will automatically take pictures after every 30 cm or after every turn and store them until it reaches its destination. Then it sends them back to Mission Control. If for some reason, the Rover is stuck and cannot find a way to its final destination, it stops and send a warning to Mission Control together with all the pictures it took.

The Rover will continuously monitor the meteorological sensors and if a significant change in one of the values is detected, an update with this new value is sent to Mission Control. Due to extreme atmospheric conditions some of the sensors may break in which case the Rover has to stop and inform Mission Control about the event. The human operator may instruct the Rover to switch to the redundant set of backup sensors.