Simulating the ExoMars Rover

What is the ExoMars Rover?

Mission

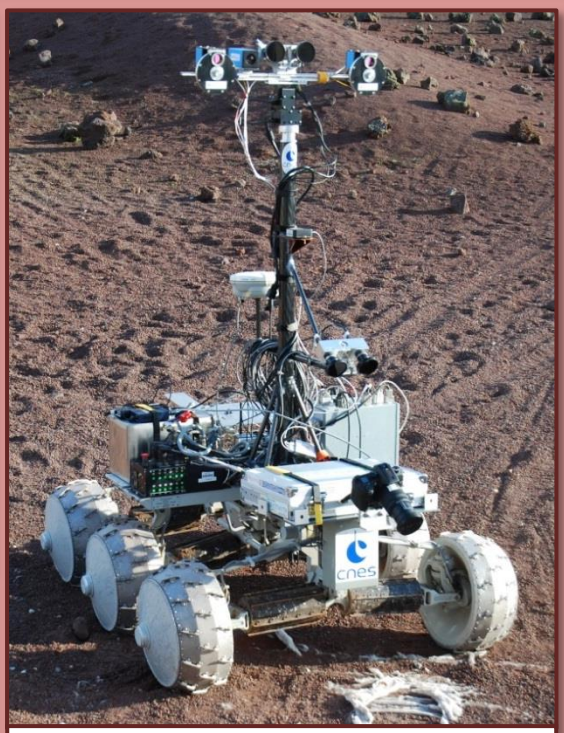
The ExoMars Rover is due to be launched in 2018 by the European Space Agency and it has two main goals: to test technologies that will be required for future missions to Mars, such as gathering and returning geological samples to Earth, and to investigate the chemical composition of the planet and its atmosphere to study its history.

Communication

In 2016 the Trace Gas Orbiter will be launched which, in addition to analysing Mars' atmosphere, will have the important task of allowing communication between the Rover and Earth. Light takes between 3 and 21 minutes to travel between the Earth and Mars, so controlling the Rover directly would be extremely difficult. To make things worse, the Orbiter only passes over the Rover around twice per Sol (Martian day). Because of this, the Rover needs to be largely **autonomous.**

Simulating the ExoMars Rover with the Pi Rover

The ExoMars Rover has many different instruments to detect objects and can use the information from these to make its own decisions. It also receives multiple instructions at once in the small communication window that is available. We have tried to simulate some of these features with our Raspberry Pi Rover.

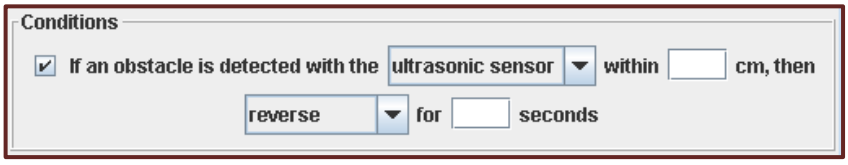


The ExoMars Rover during testing of its instruments

Mapping and Object Avoidance

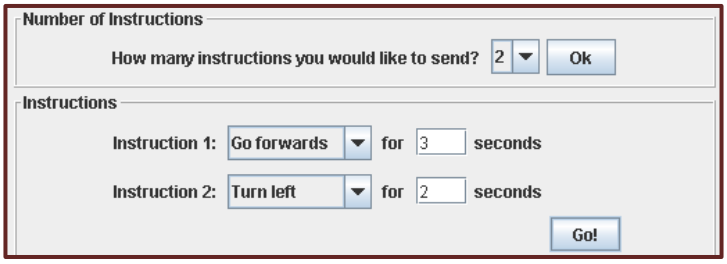
The ExoMars Rover receives target destinations from scientists on Earth during the short communication window, but it is up to the Rover itself to figure out how to get there. It uses a stereoscopic camera to create a 3D map of the terrain and then calculates the most safe and efficient route. A simple example of this would be the ultrasonic sensor on the Pi Rover. Press the Receive ultrasonic sensor values button to get the distance to the nearest object from the ultrasonic sensor every 2 seconds.

The ExoMars Rover also has close up collision cameras to avoid any collisions at the last minute. These are similar to the infrared obstacle sensors on the Pi Rover. You can tick the box and customise a rule to tell the Pi Rover what to do if an object is detected with either the ultrasonic or infrared sensors.



Sending Multiple Instructions at Once

Because communication with the ExoMars Rover is limited, many instructions will be sent at once to avoid time on the planet being wasted. You can do something similar to this using the Pi Rover. Just choose how many instructions you would like to send, press Ok, customise them, and then press Go.



Autonomy with the Pi Rover

The Follow line button gives the Pi Rover a certain degree of autonomy. You are giving it a task, to follow a line, but the robot itself is deciding how to complete that task, based on which line sensors are activated. For example, if the left line sensor is activated but the right one isn't, the line must be on the left so the robot turns left. Similarly, if neither is activated then the line must have ended, so the robot has finished its task and it then stops.

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