Paper ID: 99079
student

53rd IAF STUDENT CONFERENCE (E2)
Student Team Competition (3-GTS.4)

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REAL-TIME RSSI-BASED ANTENNA TRACKING: LEVERAGING MACHINE LEARNING FOR LUNAR AND MARTIAN ROVER COMMUNICATION

Abstract

The use of mobile robotics systems, such as rovers, has become a key paradigm in scientific research for Martian and Lunar environments. Using a fixed on-surface relay-station allows for smaller, lighter and faster rovers as satellite and Earth communications systems are often large and have significant power demands. The absence of a planetary magnetic field or GPS-based localisation systems in these environments introduce significant challenges in establishing reliable communication between a mobile rover and a stationary relay-station.

We present a novel approach to real-time antenna tracking using a ring of directional antennas, guided by Received Signal Strength Indicator (RSSI) and rover odometry measurements. A machine learning model trained on experimental data will be employed to determine the direction of an incoming control signal. This direction is used to position a separate pair of highly directional narrow-beam antennas carrying communication data, operating on the 900MHz or 2.4GHz radio bands. This method allows for greater range and throughput than traditional omni-directional antenna systems, ensuring reliable local communications.

A relay-station and rover system we have developed at Monash Nova Rover, a student-led engineering team at Monash University, demonstrates this system on Earth and highlights its potential in planetary exploration. Whilst some initial experimental results have been obtained so far, the developed system as well as performance data will be prepared to be presented ahead of the 2025 International Astronautical Congress.