Paper ID: 65488
student

IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Advances in Space-based Communication Technologies, Part 2 (5)

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AN ULTRA-LOW PROFILE HIGH-GAIN ANTENNA POINTING MECHANISM FOR MICRO LUNAR ROVER PLATFORMS

Abstract

Communication bottlenecks can severely limit the scientific value and operational bandwidth of space exploration missions. When considering communication architectures for lunar missions, smaller agencies without access to high gain receiving networks such as NASA's Deep Space Network will suffer from low data rates or prohibitively high operating costs.

The Canadian Space Agency and Canadian universities are investigating the feasibility of a micro lunar rover called PEEKbot, with a projected length of under 50 cm and weight under 75 kg. Few existing antenna architectures are suitable for such an application, given the strict volume, mass, and power requirements on this platform. Omnidirectional antennas will suffer from very low gain and data rates, while electronically-steered systems have large footprints and high power requirements.

This paper presents a proof-of-concept prototype of an ultra-low profile mechanical pointing mechanism for a high gain X-band patch array antenna with a projected data rate of 400 kb/s. The mechanism consists of a spring-loaded hinge on a rotating platform, connected by a cable to a winch. This elevation-over-azimuth system achieves full hemispherical viewing angles with a projected mass under 2 kg, total height under 48 mm, and typically null power consumption. A flexible fabric cover covers all moving surfaces, enabling the large range of motion while improving dust ingress resistance.

This paper covers research into existing solutions, predictions of performance, prototyping, and performance testing to validate the prototype's power consumption and pointing accuracy. Finally, the system's path-to-flight, recommendations for improvement, and additional applications are presented.