Paper ID: 62359
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Lunar Exploration (1) (1)

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AN ASSESSMENT OF THE EFFECTIVE AND EFFICIENT USE OF ONBOARD SOFTWARE DEFINED RADIOS (SDR) ON CUBESATS FOR LUNAR EXPLORATIONS

Abstract

This paper is an assessment of the effective and efficient use of onboard software defined radio (SDR) on CubeSats for lunar explorations. SDR technologies have been used for various terrestrial communication applications with minimum environmental effects and these include receiving broadcasting radio, radio astronomy, tracking aircraft via Mode S transmissions and mobile wireless networks. The rational of the SDR are that they have scalable, extensible, reprogrammable and modular designs that support evolution over time. Moreover, SDR can be implemented in a miniaturized and lightweight way that fits in constrained and limited power, size, and weight of small satellites (CubeSats). However, little work has been done on SDR performance evaluation for CubeSats under lunar space conditions such as cosmic radiation, micrometeorite impacts, solar wind, daily swings in surface temperature, and gravity waves. These result in poor data transmission, packet loss, performance degradation of satellite communication systems and mission failures. Therefore, special considerations are needed to assess the SDR for lunar missions. To determine a suitable SDR, an evaluation was carried out based on SDR receiver and transmitter dynamic range, sensitivity, spectral purity, noise figures, modulation error ratio, error vector magnitude, power stability, temperature operating ranges and isolation between channels under realistic space conditions. The results of this study will be vital in selecting effective and efficient SDR for future reliable lunar explorations.