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P-Band Satellite Remote Sensing Antenna

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ABSTRACT

Today, there are a huge number of satellites out there in the space orbiting the earth, and there are specific frequency bands allocated for data transmission from these satellites. Signals from these satellites can be accessed at different places on earth, and used for remote sensing. Lower frequency bands are being used in this project, which have not been used earlier for remote sensing. The main idea of this study is to use the properties of two P-band communication satellites to assess their utility for 'reflectometry'. This remote sensing method is based upon the comparison of the direct and reflected signals, observed along a line of sight to the satellite. P-band is useful since radiation at this frequency will penetrate deep enough to determine the water content in the top 1m of the soil. This root zone soil moisture (RZSM) content is a very important parameter, which has further far reaching applications in monitoring agricultural production and studying changes in climate. The research involves the building and design of antennas for certain specific frequency ranges. Firstly, a communications link budget has to be prepared for the antenna, taking into account factors such as transmitted power, antenna gain, signal modulation, polarization effects, noise, and atmospheric losses. All the antenna parameters are then put into a modelling tool (such as 4NEC2) so as to assess the geometry structures and generate the radiation pattern for our model. After the design is done, the antenna is built according to the specifications. Finally, it is taken out to test if it can get signals from the specific satellite in orbit. Depending on our location and the satellite elevation, the antenna is directed, and the spectrum analyser is used to get a display of the data from the direct and the reflected signals. These plots and spectrums allow us to compare the power of the direct and reflected signals. The generated cross-ambiguity function is a signal property related to range resolution of the measurement and the ability to separate reflections from different satellites. Analysis of these signals collected using the antenna will determine if satellite transmissions in the P-band are feasible for use in reflectometry remote sensing. This will also immensely contribute to the field of space borne remote sensing.

KEYWORDS

Remote sensing, communications link analysis, Yagi antenna, polarization, modulation, spectrum analyzer, azimuthal angle and elevation angle, RF spectrum, reflectometry, gain, space losses, bit energy