Development of Circularly Polarized Synthetic Aperture Radar onboard Microsatellite (μSAT CP-SAR) for Global Warming Monitoring

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Abstract

Synthetic Aperture Radar (SAR) is a multipurpose sensor that can be operated in all-weather and day-night time. Recently, the SAR sensor is operated in linear polarization (HH, VV and its combination) with limited retrieved information. The characteristic of the conventional SAR sensor is bulky, high power, sensitive to Faraday rotation effect etc. Recently, we are developing the *Circularly Polarized Synthetic Aperture Radar (CP-SAR) onboard Microsatellite* (μSAT CP-SAR) to retrieve the physical information of Earth surface, especially to monitor the global warming phenomenon, i.e. the change on cryosphere, global vegetation and disaster area in the future. In this research, the CP-SAR sensor is developed to radiate and receive circularly polarized wave. The sensor is designed as a low cost, simple, light, strong, low power, low profile configuration to transmit and receive left-handed circular polarization (LHCP) and right-handed circular polarization (RHCP), where the transmission (Tx) and reception (Rx) are working in RHCP and RCHP+LCHP, respectively. Then these circularly polarized waves are employed to generate the *axial ratio image* (ARI). This sensor is not depending to the platform posture, and it is available to avoid the effect of Faraday rotation during the propagation in ionosphere. Therefore, the high precision and low noise image is expected to be obtained by the CP-SAR. This satellite platform is composed by RCHP and LHCP antennas for CP-SAR sensor subsystem, telemetry subsystem that constructed by S band telemetry and X band transponder to transmit CP-SAR signal to ground station, and some altitude controller subsystem. This satellite planned to be launched in 2014 with altitude between 500 km and 700 km. This sensor is operated with center frequency on L band (1.27 GHz) and 10 MHz of chirp pulse bandwidth. The gain in main beam is set higher than 30 dBic to obtain received signal higher than -20 dB (equivalent backscattered noise level). The axial ratio is set lower than 3 dB to obtained ideal circular polarization. The antenna size (inflatable antenna) is 4 m and 8 m for range and azimuth directions, respectively. The center of off-nadir angle and swap width are set 29^{o} and 50 km, respectively. The ARI is expected to retrieve various physical information of Earth surface accurately and high precision. i.e. uplift and subsidence, biomass, vegetation height and age, soil and snow physical characteristics based on the relationship between axial ratio and each characteristic. In the near future, CP-SAR is expected to improve the characteristics of conventional SAR system, especially to extract some new physical information on the Earth surface.