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A SPACEBORNE DEBRIS SURVEILLANCE RADAR BASED ON MULTISTATIC CROSS ARRAY

Abstract

Space debris has been becoming an increasing threat to spacecraft and satellites. Although most debris can be observed and cataloged by ground-based radars and telescopes, there is still no effective ground-based system to observe tiny debris with diameter smaller than several centimeters due to small RCS and long range. Thus, it's necessary to develop spaceborne debris surveillance radar. The biggest challenge the radar faces is in-time two-dimensional wide-angle searching and detection of space debris with ultra-high speed. Regular phased array radar can steer its beam in several microseconds. However, in order to cover a large space, it still needs a considerably long time during which the debris has already moved out of the radar view field. Thus, a spacebrone debris surveillance radar based on multistatic cross array is proposed in this paper to solve the problem. By using orthogonal coding signal, each radar transmitter transmits orthogonal waveform which enables the radar to illuminate the whole surveillance space with synchronous multi-beam. The echoed signal corresponding to different waveforms will be received simultaneously and processed with digital beam forming (DBF) for target detection and localization. Considering the cost and limitation of weight and volume for satellite payload, the radar operates at Ka-band and uses multistatic cross array which allows for an exceptional reduction in the number of RF modules, while yet delivering high image quality. The simulation result has shown the feasibility and great potential of the proposed radar in tiny space debris detection.