

ANTI-JAMMING TECHNIQUES FOR SYNTHETIC APERTURE RADAR

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1. ABSTRACT

SAR is a form of radar in which the large, highly-directional rotating antenna used by conventional radar is replaced with many low-directivity small stationary antennas scattered over some area near or around the target area. It can provide all-weather, high-resolution and wide-swath imaging, and even image targets under the foliage. Since it has many merits, it is now being used for monitoring environment and earth motion, army surveillance, as well as mapping. Now the development of SAR has entered into a new period. The concept of "formation flying" was proposed for future distributed spaceborne SAR systems. In such a system, a large SAR radiating signal is followed by a cluster of assistant satellites orbiting the Earth; these assistant satellites remain in the same relative positions with respect to others. Each satellite of the cluster would be a passive receiver, and gets information from the earth with its own sensors, data from each satellite are combined to produce a single "virtual" satellite with a large synthetic aperture. SAR system based on this "formation flying" concept provides many new merits. As a result, it is important to interfere with such a SAR system to protect important targets or sensitive areas.

Recent researches on jamming techniques have been focused on common SAR system, though few were for the multi-satellite SAR system. Existing jamming techniques on common SAR can be divided into different classifications according to different principle. Those ECM(Electronic Counter Measures) can be divided into active jamming and passive jamming, or coherent jamming and non-coherent jamming, suppressive jamming and deceptive jamming, main-lobe and side-lobe jamming, and so on. Each classification can also be divided further. This paper classifies each kind of jamming technique and analyzes its characteristics including merits, shortcomings and implementation in detail. The jamming techniques are also extended to distributed systems, in which SAR satellites are distributed, and some may be passive, this paper gives methods on jamming such a system effectively.

Corresponding to those jamming techniques, anti-jamming techniques had to be studied at the same time. Most of ECCM(Electronic Counter-Counter Measures) are studied according to existing jamming techniques. Those ECCM can also be classified according to different principles, and have their own application fields. That is to say, each anti-jamming technique has its own characteristics, as well as requirement, analyzing completely each technique is necessary to protect own existing SAR work normally.

On the basis of analyzing existing jamming techniques, this paper suggests corresponding ECCM. After analyzing different classification of all kinds of anti-jamming techniques, this paper gives the merits as well as shortcomings of those anti-jamming techniques, and gives possible solutions. For the trend of distributed SAR system, this paper also analyzes its characteristics, then gives suggestion on ECM and ECCM for such system.

In the end, this paper gives some simulation results of some important anti-jamming techniques, displays the powerful result of ECCM. Through those results, we can see that jamming a SAR system with little power is possible, but at the same time using corresponding anti-jamming technique according to different jamming technique can enable our equipment work normally.

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