SPACE DEBRIS SYMPOSIUM (A6)
Measurements (1)

Author: Dr. Hai Jiang
National Astronomical Observatories, Chinese Academy of Sciences, China, jhai@nao.cas.cn

Dr. Jing Liu
National Astronomical Observatories, Chinese Academy of Sciences, China, liujing@nao.cas.cn
Mr. Yao Zhang
National Astronomical Observatories, Chinese Academy of Sciences, China, yaozh@nao.cas.cn
Ms. Teng Teng
National Astronomical Observatories, Chinese Academy of Sciences, China, tengteng0527@gmail.com

PERFORMANCE ANALYSIS OF PHASED ARRAY RADAR DETECTION WITH SMALL PROPAGATION WINDOW

Abstract

With the increasing number of the human aerospace activities, space debris environment is seriously threatening in-orbit spacecraft safe operation. Electromagnetic fence (EF) is ordinary measuring equipment, and which is the essential device for space debris detection in low earth orbits (LEO). Due to the limitation of its working mode, EF can detect most of the large LEO objects but with low detection accuracy.

Phased array radar (PAR) is another candidate tool for space debris detection. It is well known that PAR is widely used in space surveillance as its large power-aperture product, flexible beam-scanning and effective resource management. PAR not only can work in searching mode for large area detection, but also can work in tracking mode for tracking object of interest with high accuracy. PAR can overcome the EF's drawbacks with proper working mode, but how to improve the performance of PAR becomes new challenge.

In the paper, the performance of PAR detection with small propagation window is studied under the background of space debris detection. Firstly, the performance of PAR detection without prior surveillance space indication information is discussed. After analyzing the space object's orbit propagation and their precisions, the recurrence algorithms for positions and radiuses, and coordinates transformation are presented, and the small surveillance spaces window model for PAR detection based on the space object's orbit propagation is established, detailed theoretical detection performance is analyzed with this model. Comparing its detection performance with the PAR working in the whole-space searching mode, results show that the PAR working in small propagation window mode not only can greatly improve the detection probability, but also can detect smaller objects that cannot be detected by PAR working in whole-space searching mode. Finally, some simulations are demonstrated to validate the conclusions.