16th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Space Debris Detection, Tracking and Characterization (1)

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A REAL-TIME SPACE DEBRIS DETECTION SYSTEM FOR BIRALES

Abstract

The ever increasing satellite population in near-Earth orbit has made the monitoring and tracking of cooperative and non-cooperative objects ever more important. Non-cooperative objects, or space debris,

pose a threat to existing and future satellites as they cannot avoid potential collisions. Furthermore, the orbit of the smaller debris is often not actively monitored. As the population grows, the risk of a collision increases. Thus, various institutions around the world have been upgrading their space detection capabilities in order to better monitor the objects orbiting Earth down to a few centimetres in diameter. One of the latest such systems is the BIstatic RAdar for LEo Survey (BIRALES) space debris detection system based in Italy. The BIRALES system is a bistatic radar composed of a radio transmitter in Sardinia and the Medicina Northern Cross radio telescope near Bologna as the receiver. The backend of this system includes a digital beamformer able to synthetize 32 beams covering the instrument's Field of View (FoV). As a high-velocity object transits, its Doppler shift signature (or track) can be measured. Whilst a number of streak detection algorithms have been proposed for optical telescopes, the number of detection algorithms for high-speed objects for bistatic radars is limited. This work describes the detection algorithm used in the BIRALES space debris detection pipeline. The detection algorithm takes the beamformed, channelized data as input. Firstly, the data undergoes a number of pre-processing stages before the potential space debris candidates are identified. Secondly, the candidates are validated against a number of criteria in order to improve the detection quality. The algorithm was designed to process the incoming data across 32 beams in real-time. Initial validation results on known objects are positive and the system has been shown to reliably determine orbiting objects with minimal false positives.