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THE ITALIAN BIRALET RADAR SYSTEM TO PERFORM RANGE AND RANGE RATE MEASUREMENTS IN THE EUSST EUROPEAN SPACE SURVEILLANCE AND TRACKING PROGRAM.

Abstract

Space debris is a term for all human-made objects orbiting the Earth and reentering the atmosphere. The monitoring of space environment is necessary to prevent new collisions and consequently to offer services of collision avoidance. For this reason, radar measurements are relevant, in particular to observe objects in Low Earth Orbit, between 200 and 2000 km of altitude. In this paper, we present the design of the Italian BIRALET system, which acronym stands for BIstatic RAdar for LEo Tracking. It is a bi-static radar used for space debris detection and tracking in Low Earth Orbit. The transmitter is a 7 m parabolic antenna, located in Sardinia and equipped with a set of powerful amplifiers tunable between 1 and 10 kW in the frequency range between 410-415 MHz. The receiver system of the BIRALET is the Sardinia Radio Telescope (SRT), located about 20 km far away from the transmitter. It is a flexible instrument for radio astronomy studies and space science, which recently is also employed for space debris monitoring. The antenna is a multi-reflector system with a 64-meters parabolic primary mirror and a 7.9-meter elliptical secondary mirror. The telescope can host up to 20 receivers operating in the frequency range between 0.3–116 GHz. The front-end used for space debris monitoring is the P-band (305 - 410 MHz) installed in the primary focus of the telescope. The back-end of BIRALET, funded under the EUSST program is based on a National Instrument USRP-2954R board. The board in the TRF is configured to synthesize a mixed signal composed by a chirp plus a continuous wave tone, with an overall bandwidth of 5 MHz. In this way, it is possible to perform range, with a spatial resolution of few tens of meters, and range rate measurements, with a frequency resolution of about 10 Hz. The synchronization in time and frequency between the TRF and the SRT are guaranteed by the GPS receiver integrated in the USRP-2954R. In this paper, we present a preliminary measurement campaign of detection of known objects, for which is possible to estimate range rate and range, in order to establish the performances of the system and in particular of the dedicated back-end. Thanks to range and range rate data collected by the BIRALET system, it is possible to improve the knowledge of the orbit of the space debris observed in the measurement campaign.