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EXPLORATION OF AN INNOVATIVE RANGING METHOD FOR BI-STATIC RADAR, APPLIED IN  
LEO SPACE DEBRIS SURVEYING AND TRACKING

**Abstract**

Space Situational Awareness (SSA) is referred as one of the capacitive areas of strategic interest to be developed / completed in the future in the short and medium term, for any nation with the target of the access to the space. One of the fundamental components is the Space Surveillance and Tracking (SST) program, considered as the capability to build a spatial mapping of the objects in orbit, their classification and the exact identification of their orbital characteristics. For this reason, radar measurements are relevant, in particular to observe objects in Low Earth Orbit. The Italian National Institute of Astrophysics together with Vitrociset company and Politecnico di Milano, studied and developed a new and innovative method for the range measure applied to bi-static radars to support the European Union Space Surveillance and Tracking (EUSST) program. Several tests have been carried out using the BIRALES and BIRALET sensors for survey and tracking observations respectively. Finally, the results obtained from observations have been compared with the real positions of the targets in order to validate the system. The ranging method relies on the synchronization of the transmitting and receiving antennas and on the correlation of the echo received from the scattering of the orbiting object. To do that, the transmitting antenna emits simultaneously two different signals: a Chirp signal for range measurement and a second “Continuous Wave” (CW) for Doppler shift measurement and object track reconstruction. Overall, we simultaneously obtain time profiles for range, angular position (azimuth and elevation), and Doppler during the passage of the objects inside the sensor Field of View. By virtue of the above plethora of measurements, this method guarantees also the possibility to produce an Initial Orbital Determination (IOD) for unknown objects.