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Author: Dr. Gaetano Zarcone
University of Rome "La Sapienza", Italy

Mr. Matteo Rossetti
University of Rome "La Sapienza", Italy
Mr. Simone Varanese
University of Rome "La Sapienza", Italy
Ms. Mascia Bucciarelli
University of Rome "La Sapienza", Italy
Mr. Lorenzo Cimino
Sapienza University of Rome, Italy
Mr. Shariar Hadji Hossein
Sapienza University of Rome, Italy
Dr. Lorenzo Mariani
Sapienza University of Rome, Italy
Dr. Fabrizio Piergentili
Sapienza University of Rome, Italy

LARGE DATA COLLECTION THROUGH INNOVATIVE OPTICAL SYSTEMS FOR ANGLES-ONLY ORBIT DETERMINATION

Abstract

The Orbit Determination (OD) is the process that allows, starting from an available set of measurements, the estimation of the dynamic state of an object that orbits around a central body. Given the raising number of active satellites and space debris both in Geostationary (GEO) ring and Low Earth Orbit (LEO) orbits, a continuous and accurate monitoring of these objects is strictly necessary and increasingly important. Furthermore, in the framework of the Space Traffic Management (STM) an accurate optical observation system and a precise OD procedure are fundamental in the orbiting object's catalogue maintenance and mitigation services. Nowadays, the OD procedure can be carried out using optical measurements, in terms of Right Ascension (RA) and Declination (Dec), obtained pursuing the sidereal tracking observation method and using a Charge-Coupled Device (CCD) sensor with a narrow field of view. This method is the most classical but during a single passage it is possible to acquire only a few number of measurements. The Sapienza Space Systems and Space Surveillance Laboratory (S5Lab) research team has years of experience in Space Surveillance and Tracking (SST) trough optical observation, with a network of telescopes and observations systems that implement not only the classical methods, but also new technologies and methodologies. The purpose of this paper is to investigate the OD for all the orbital regime, performed with the newest data acquisitions methods and systems. As regards a LEO object observation, the last generation sensors scientific Complementary Metal-Oxide Semiconductor (sCMOS) are used. These sensors are characterized by a high frame-rate acquisition, that allows to collect a large amount of data for an object during a single passage above the observatory, that is using the angles only short-arc optical OD procedure. For the GEO objects, a fixed large field of view is used. In this way the GEO satellites are immediately recognizable in the frame by their near circular shape since they remain in the same position during the exposure. This optical system allows to obtain a

huge number of measurements spread in a time span of several hours, that is the whole observation night duration. The OD results are then compared with the ones obtained with classical optical observation in order to validate the OD procedure performed with these new systems data. Moreover, all the obtained measurements are previously calibrated to verify the accuracy of the acquisition systems.