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Space Debris Detection, Tracking and Characterization - SST (1)

Author: Mr. Jesus Tirado
GMV Aerospace & Defence SAU, Spain

Mr. David Cano
European Space Agency (ESA), Spain
Dr. Jan Siminski
ESA, Germany
Ms. Cristina Pérez Hernández
CDTI (Centre for the development of Industrial Technology), Spain
Mr. Carlos Paulete
GMV Aerospace & Defence SAU, Spain

MACHINE LEARNING TECHNIQUES TO APPROACH SPACE OBJECT CHARACTERISATION

Abstract

The Surveillance Radar (S3TSR) of the Spanish Space Surveillance and Tracking program (S3T), funded by the Spanish Administration through CDTI management, is in operation since early 2019 and continuously provides data to build-up and maintain a catalogue of objects in low-Earth orbit.

The system derives a radar-cross-section (RCS) from the signal-to-noise ratio. While RCS values are highly variable and difficult to predict due to the complex signal reflection process, the distribution per target can be often well approximated. This allows extracting more information from the signal especially when analyzing larger time series of RCS values from the same object. This information is a valuable asset to support operators in case of contingency situations or to identify operation patterns. Consequently, an extensive training dataset is extracted, which contains tracks of objects with known attitude modes and object shapes.

The presented activity studies the possibility to determine attitude modes from the RCS signal, e.g. stable inertial pointing, Earth pointing, or random tumbling. Secondly and based on the same information, a more fine-grained classification algorithm is developed, being able to associate each RCS sequence with the corresponding object from a corpus of known spacecrafts. In both cases, at the core of each classifier, a Machine Learning (ML) algorithm is responsible for the characterization, with additional advanced pre-processing steps that increase the performance of the ML model. The presentation will discuss the performance of various ML approaches in terms of classification accuracy.