Paper ID: 71670
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20th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Operations in Space Debris Environment, Situational Awareness - SSA (7)

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GEOTRACKER - AUTOMATION OF CATALOGUE MAINTENANCE AND TRACKING CAPABILITIES WITH ARTIFICIAL INTELLIGENCE FOR SPACE SITUATIONAL AWARENESS

Abstract

In recent years more than ever, space situational awareness has become a strategic issue. ArianeGroup has therefore developed unique expertise in the detection and tracking of space objects. Using a network of optical sensors scattered around the Earth and a centralised control centre, GEOTracker provides precise data, including orbits and apparent magnitude, of space objects in geostationary (GEO) and medium-earth (MEO) orbits in order to protect assets from collisions, interferences and undesired visits from debris or other active satellites.

Automation is the key to building and maintaining this overview of space objects. In order not to miss any evolution in the behaviour of these objects, they all need to be tracked on a regular basis, with a special attention to objects whose behaviour has changed, whether through manoeuvre or dislocation.

As soon as an observation from the ground has been made, acquired images are processed using an artificial neural network to isolate the space objects from stars and other detections, and to extract the relevant data. This data is then transmitted to the control centre, which uses another neural-based method to identify the objects. This method uses "attention" mechanisms and proximity-based relationships within the hidden layers of the neural network to free itself from the constraints faced by more classical deep-learning technologies, such as the fixed size requirement for the input data, and the fixed number of possible outputs for the identification of known objects. The identification is also based on several knowledge sources aggregations, from public sources to internal history, and allows relabelling observations from the past thanks to an assessment of reliability of new information compared to observations, such as new objects in the catalogue or declared manoeuver.

This paper will introduce the challenges and difficulties of classical approaches, and present the methods and techniques used in the GEOTracker workflow to build and maintain this catalogue of spatial objects. Through this presentation, we will focus on concrete examples of catalogue improvements obtained.