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Author: Mr. Benedikt Reihs
Astronomical Institute University of Bern (AIUB), Switzerland

Dr. Alessandro Vananti
Astronomical Institute University of Bern (AIUB), Switzerland
Dr. Jan Siminski
ESA - European Space Agency, Germany
Dr. Tim Flohrer
European Space Agency (ESA), Germany
Prof. Thomas Schildknecht
Astronomical Institute University of Bern (AIUB) / SwissSpace Association, Switzerland

ANALYSING THE CORRELATION PERFORMANCE OF ESA'S PLANNED SPACE-BASED GEO SURVEILLANCE MISSION

Abstract

Space surveillance is an important part of the mitigation of risks due to the increasing amount of space debris around Earth. The geostationary orbit (GEO) which is important for various types of missions, e.g. commercial communication, is increasingly congested not only due to the number of newly launched satellites, but also due to fragmentation events of e.g. spent upper stages. Nowadays, GEO is routinely observed by ground-based telescopes which are restricted in their operations due to e.g., weather conditions or coverage of the GEO region. An improvement of GEO surveillance can be achieved by placing a sensor, i.e. telescope, on a satellite which has already been demonstrated (e.g. SBSS, Sapphire). This would be unaffected by weather and could, depending on the exact orbit, repeatably cover the entire GEO within a given time span.

The European Space Agency (ESA) is currently developing technologies and components for such a space-based observation mission. The current concept foresees a satellite in low earth orbit (LEO) close to the terminator plane, possibly in a sun-synchronous orbit (SSO). The main operation mode would be to set up one or even two leak-proof fence(s) at a certain location in GEO which is passed by every GEO object once per revolution.

As the measurements from a single pass through such a fence, called tracklet, usually do not allow a good initial orbit determination, it is rather attempted to combine two of these short-arc tracklets and test whether they originate from the same object, in which case they are referred to as correlated. Various techniques for this correlation task have been developed and tested predominantly for the ground-based case. This paper will apply and analyse the method based on the boundary value problem. Several adjustments and extensions of the method are considered, such as, e.g., the fitting process of the attributables, the modelling of the orbit dynamics considering perturbations and the parameters used for the correlation decision. This is achieved by performing experiments with simulated measurement data, which is aligned to the current technical specifications of the proposed ESA mission. As a result, a conclusion is derived about the performance of the correlation with regard to the different considered optimisations and also on different orbit and observation scenarios.