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Orbit Determination and Propagation (9)

Author: Dr. Alessandro Vananti
Astronomical Institute University of Bern (AIUB), Switzerland, alessandro.vananti@aiub.unibe.ch

Prof. Thomas Schildknecht
Astronomical Institute University of Bern (AIUB) / SwissSpace Association, Switzerland,
thomas.schildknecht@aiub.unibe.ch

METRIC FOR OBJECT ASSOCIATION IN THE KEPLERIAN ORBITS SPACE.

Abstract

Orbit determination of space debris objects in the context of space surveillance is often performed by associating several sequences of observations related to the same object. If preliminary orbits can be computed from the single sequences, there is a need for an association criterion to evaluate whether they belong to a unique object. The definition of a distance between orbits allows for a threshold criterion for which two orbits are considered associated. Several definitions of distance exist that satisfy the metric space axioms. These depend on the choice of the parameters to describe the orbit. For Keplerian orbits one possible definition formulates the distance as a function of the traditional Keplerian orbital elements. The appropriate metric changes according to the degrees of freedom considered in the problem. In this paper we propose a new metric that includes the orbit anomaly in addition to the other orbital parameters which characterize the orbital plane and shape. Contrary to models adopted in the asteroid research, in the case of space debris and satellite orbits, where the revolution periods are much smaller, considering the position of the object along the orbit can significantly improve the orbit characterization and therefore the orbit association. Additionally, in our approach the proposed metric is scaled according to the obtained orbit covariances. Applications of the distance definition to several association examples are shown.