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SPACE DEBRIS SYMPOSIUM (A6)
Modelling and Orbit Determination (9)

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ON THE COMPUTATION OF PRELIMINARY ORBITS FOR SPACE DEBRIS WITH RADAR OBSERVATIONS

Abstract

Different methods for obtaining preliminary orbits using optical and/or radar observations already exist in the literature: e.g. Gibbs' method [1], Kepler integrals (KI) method [2,3].

We introduce a new algorithm that we call Infang [4], that computes preliminary orbits for space debris on Low Earth Orbits from radar data collected in short time intervals. This method works with two tracks of radar observations. Each track consists of $n \geq 4$ topocentric position vectors per pass of the satellite:

$$(t_j\ ,\ \rho_j\ ,\ \alpha_j\ ,\ \delta_j\ ),\ j = 1...n.$$

Here (ρ, α, δ) are the spherical coordinates of the target at time t: ρ is the range, α is the right ascension, and δ is the declination. We assume ρ is very accurately known but α and δ are not precise.
The new method forms a linkage of the two tracks using the two-body dynamics, Lambert's theorem, and the equations of motion projected onto the line of sight direction.

We consider some test cases to compare the orbits computed by the Gibbs', KI and Infang methods for one simulated object, assuming errors in the observations and without including the perturbation from the J2 effect. The numerical results illustrate the good performance of Infang in correcting errors in the angular positions assuming exact knowledge of the range.

We are still investigating the case including the J_2 effect and we intend to test the new algorithm on a larger scale.

References :

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[3] L. Dimare, D. Farnocchia, G. F. Gronchi, A. Milani, F. Bernardi, and A. Rossi: "Innovative system of very wide field optical sensors for space surveillance in the LEO region" - project SARA (LEO), AMOS Conference Hawaii, 2011.

[4] G.F. Gronchi, L. Dimare, D. Bracali Cioci, H. Ma : "On the computation of preliminary orbits for space debris with radar observations", 2015, submitted.