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LONG-TERM STABLE ORBITS FOR PASSIVE TRACKING BEACON MISSIONS TO ASTEROIDS

Abstract

The accuracy of the orbit determination for an asteroid orbit can be improved significantly if a spacecraft is present that can be tracked with radiometric measurements. Long-term precision tracking of an asteroids orbit can measure the effects of small forces on the asteroid orbit (e.g., Yarkovsky and YORP accelerations) and improve predictions of the future asteroid ephemeris. Such tracking could be particularly useful for characterizing an asteroid orbit that has a potential to impact the Earth.

A "beacon" spacecraft with minimal capabilities can provide asteroid tracking for minimal cost. In the case of a potentially impacting asteroid, a beacon could be used to determine if a threat actually exists before implementing a mitigation strategy. Here, a methodology is presented for identifying spacecraft orbits near an asteroid that are stable over many heliocentric asteroid orbits $_{w}ithouttheneedfortranslationalcontrol.Asaresults,s$ $termorbitstabilityproperties[1,2]willbeappliedtotheexampleofabeaconspacecraftdesignattheasteroid(99942)Apophis,wh$ $zerochanceofimpactingtheEarthin2036or2037.Thismethodofstabilitycharacterizationallowsustodealwiththechallenges$

Initial studies have identifies "terminator orbits"as good candidates for beacon missions. These orbits lie in the plane orthogonal to the Sun-asteroid direciton and thus present no solar eclipses. Such orbits provide a consistent thermal environment for the spacecraft and further simplification of the beacon design. Integration over 38 years of such trajectories in realistic models around the asteroid Golevka [2] indicate the strong stability of such orbits, even under perturbations.

References

[1] "Identification of Non-Chaotic Terminator Orbits near 6489 Golevka", S.Broschart and B.Villac, Paper AAS 09-156, Proceeding of the 19th AAS Spaceflight Mechanics Conference, Savannah, GA, Feb. 2009.

[2] "Applications of Chaoticity Indicators to Stability Analysis around Small Bodies", B.Villac and S.Broschart, Paper AAS 09-221, Proceeding of the 19th AAS Spaceflight Mechanics Conference, Savannah, GA, Feb. 2009.

NOTES: These results that will be presented are original and have not been published elsewhere. One author has secured enough funding to attend the conference.