Sensitivity study of radiation pressure models for precise orbit determination

Dominik Stiller

B.Sc. Student, Faculty of Aerospace Engineering, TU Delft, Netherlands

Abstract

Keywords
Radiation pressure, orbit determination

Acronyms: LRO Lunar Reconnaissance Orbiter

1 Introduction

Lunar Reconnaissance Orbiter (LRO)

”SRP is the largest non-gravitational perturbation affecting the LRO orbit and inadequate modeling of SRP is the primary cause of large prediction errors for LRO, particularly during high-beta angle periods” [1]

Operational LRO OD does not use lunar albedo due to computational demand, but used for offline reprocessing. Self-shadowing from Mazarico, Zuber, Lemoine, and Smith is used [3]

High OD error during full-sun periods with cannonball model, but acceptable with multi-panel model and real attitude for SA and HGA [4]

albedo radiation significant since no atmosphere exists, up to 30 % [5]

model setup: solar array tracks Sun, HGA tracks Earth [6] start at start at 26 June 2010 06:00:00 Earth eclipses Sun during this time Moon does not eclipse Sun (Sun beta angle is about -90 deg, see [6])

References

1. S. Slojkowski, J. Lowe, and J. Woodburn, “Orbit determination for the lunar reconnaissance orbiter using an extended kalman filter,” in *International Symposium on Space Flight Dynamics (ISSFD) 2015*, 2015.
2. E. Mazarico, M. T. Zuber, F. G. Lemoine, and D. E. Smith, “Effects of self-shadowing on nonconservative force modeling for mars-orbiting spacecraft,” *Journal of Spacecraft and Rockets*, vol. 46, no. 3, pp. 662–669, May 2009. DOI: 10.2514/1.41679.
3. A. Nicholson, S. Slojkowski, A. Long, M. Beckman, and R. Lamb, “NASA GSFC lunar reconnaissance orbiter (LRO) orbit estimation and prediction,” in *SpaceOps 2010 Conference*, American Institute of Aeronautics and Astronautics, Apr. 2010. DOI: 10.2514/6.2010-2328.
4. S. E. Slojkowski, “Lunar reconnaissance orbiter orbit determination accuracy analysis,” in *International Symposium on Space Flight Dynamics*, 2014.
5. R. Floberghagen, P. Visser, and F. Weischede, “Lunar albedo force modeling and its effect on low lunar orbit and gravity field determination,” *Advances in Space Research*, vol. 23, no. 4, pp. 733–738, Jan. 1999. DOI: 10.1016/s0273-1177(99)00155-6.
6. C. R. Tooley, M. B. Houghton, R. S. Saylor, C. Peddie, D. F. Everett, C. L. Baker, and K. N. Safdie, “Lunar reconnaissance orbiter mission and spacecraft design,” *Space Science Reviews*, vol. 150, no. 1-4, pp. 23–62, Jan. 2010. DOI: 10.1007/s11214-009-9624-4.

Email: d.stiller@student.tudelft.nl