Expanded SLR Target Constellation for Improved Future ITRFs

E. C. Pavlis, M. Kuzmicz-Cieslak and K. Evans
JCET, Univ. of Maryland, Baltimore County (UMBC), Maryland, USA, epavlis@umbc.edu

Abstract

The GGOS-imposed requirements to be met by all geodetic techniques per decade are very stringent: 1 mm precision and 0.1 mm/yr temporal stability. We are an order of magnitude worse today due to a poor ground segment and limitations in the space segment. The unavailability of daily sessions on SLR targets results in loss of geometry leading to lower accuracy and resolution of SLR products. The limited (4) satellites used in ITRF development led to several attempts to launch better-designed targets, leading to ASI's LARES (Laser RElativity Satellite), launched by ESA in 2012. With the LAGEOS and Etalon it will now contribute to ITRF2020. Furthermore, ASI approved the development of LARES-2 with a launch in late 2019. We can increase the number of contributing targets by including GNSS spacecraft and LEO cannonballs. GNSS constellations with LRRs provide an opportunity to improve the daily sky- coverage and tracking data geometry over each station. These targets can contribute to ITRF realizations and impose strong ties between the techniques in space, after careful calibration of their LRA reference point, their RF antenna phase center and their center of gravity. We evaluate the utility of extended tracking of the two Etalon satellites, already underused today. Next we evaluate the likely contribution of LARES-2, following with existent in-orbit missions, and finally the addition of selected GNSS targets. We will present here initial results of combination studies with specific targets towards the achievement of the GGOS accuracy goals.

SLR TRACKING MODE FOR GNSS CONSTELLATIONS

The large number of GNSS targets (>100) necessitates that we develop efficient tracking routines taking advantage of the new technology. 4 kHz rates, post-interleaving, etc.

SLR Targets Used Now & in the Future

- At present:
  - LAGEOS 1 & 2
  - Etalon 1 & 2
  - April 2001
  - LARES (ITRF2020)
- Considering to add:
  - Starlette & Stella
  - Ajibat
  - LARES-2 (soon?)

SLR TRACKING RESIDUAL DISTRIBUTION FOR 24 GNSS S/C OVER ONE WEEK

Data coverage from simulated tracking of 16 SLR sites (globally distributed) of 24 GNSS s/c assuming realistic performance with daily tracking success rate of 25% and night tracking success rate of 50%. Only data ≥ 30° elevation were considered.

Extended SLR Tracking Scenario: 24 GNSS S/C

Simulations of the above tracking scenario examined the capability of the future ILRS network (at 5 and 10 years from present) to meet the GGOS goals. The results demonstrated that a 16-station, globally and uniformly distributed network can accomplish the task on a weekly basis and under realistic conditions.

DAILY TRACKING FOR LAGEOS & ETALON:
- Nov. 28 – Dec. 4, 2018
- ENTIRE WEEK

DAILY TRACKING FOR AJISAI & STARLETTE:
- Nov. 28 – Dec. 4, 2018

Summary

The data yield and the "ground segment" – "space segment" geometry of the current and near-future SLR network will be vastly improved for ITRF applications, if we consider the addition of targets such as STARLETTE, STELLA, ALBI and selected parts of Global Navigation System Constellations’ s/c such as GALILEO, GLONASS, BeiDu, GPS, etc. To ensure that the ITRF products’ accuracy is not compromised, we need to enhance the modeling of the tracking data, especially with regards to the LEO targets which are a lot more sensitive to the atmosphere, gravity, etc., and to the large GNSS targets that are plagued primarily by non-conservative forces (solar radiation) and limited accuracy s/c models.

Acknowledgements: This work is performed under Goddard’s Space Geodesy Project, funded under NASA Grant NNX15AT34A. NASA’s support is gratefully acknowledged.