November 2, 2021

**ILRS QCB Meeting**
**October 5, 2021**
**Virtual Meeting**
**Next Meeting December 6, 2021**
**9:00 am EDT (14:00 UT)**

**Participants**

Peter Dunn, Van Husson, Mike Pearlman, Randy Ricklefs, Toshi Otsubo, Claudia Carabajal, Frank Lemoine, Tom Oldham, Tom Varghese, Jason Laing, Stefan Riepl, John Ries, Erricos C. Pavlis, Mathis Bloßfeld, José Rodríguez, Matthew Wilkinson, David Sarrocco.

The charts from the meeting are available at
https://ilrs.cddis.eosdis.nasa.gov/science/qcb/qcbActivities/index.html

See the charts for more detail.

Agenda

Brief on the ILRS contribution to the ITRF 2020 – Erricos Pavlis
Presentation and discussion on hardware biases.
- Peter Dunn
- Van Husson
- Stefan Riepl
- Others

Discussion.

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Peter

In response to a question from Stefan Riepl on the existence of a standardized data base on time walk measurements, data and modeling, Peter Dunn introduced a panel with acronym AWC (Analysis Walking Committee) to study systematic errors in SLR data, with emphasis on discriminator time walk. So far, they have focused on a concentrated period of MOB7 data in early 2019, which included frequent discriminator tests. Range-dependent biases between 0 and 9 mm were observed from TW during that data period; some were above the 5 mm ceiling for unmolested inclusion in ITRF2020. Models to describe and correct the data were discussed. It was noted that MLRO includes automatic time walk calibration, and that this might contribute to improved MLRO data quality.

Van

Van showed some charts on the behavior of Monument Peak (MOBLAS-4) and apparent TW behavior. Tom O mentioned that unlike NASA, MLRO uses an 'amplitude correction' on its discriminator. The Site Logs allow for YES or NO entries for Amplitude Measurement/Return-Rate Controlled on the discriminator. All the NASA Systems (MOBLAS and TLRS) have YES/YES; MLRO always has YES/NO (except for one NO/blank). The MLRO site log lists CFD, Tennelec, TC454, just like the NASA systems; there is no mention of anything different. It appears that the NASA site logs are incorrect; the satellite return rate is not controlled by the NASA systems. If the receive signal is too strong, the operators may add attenuation (ND filters) to lower the receive energy. This may just be a reporting issue; is there any real difference between NASA systems and MLRO?

Van showed some results where discriminator timewalk curves where subtracted from satellite observations, with encouraging outcomes for some targets (Starlette and Sentinel-3). For LAGEOS, LAGEOS-2, and Ajisai the amplitude dependencies did not appear cleanly removed at this first stage of testing.

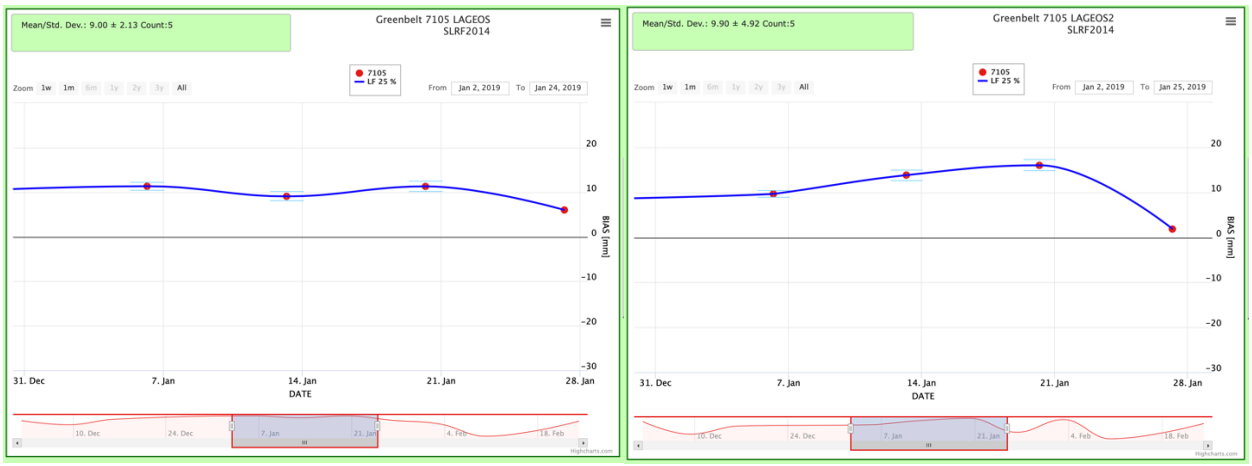
It is noted that the post timewalk curve removal plots show a linear dependence with receive energy, with the stronger returns being biased more negative. This is in agreement with the expectation for multi-photon ranging and leading-edge detection systems. At higher return rates more photons, in an absolute sense compared to intensities, are reflected from deeper in the surface of the satellite. But the same holds true for the rest of visible retroreflectors. The end result is that the distribution of returns still follows the optical response function of the satellite, with more photons from near the front face that will be able to trigger a detection.

According to José Rodríguez, the plots shown by Van Husson illustrate very well some of the arguments that had been made throughout the years regarding the difficulties to reliably model and calibrate multi-photon SLR systems at mm-levels. Namely, because of the fundamental working mechanism of discriminators, their simultaneous calibration for a range of objects, from terrestrial targets to extended satellites, is problematic due to the different pulse shapes the device has to deal with. However, the purely time-walk issues (not satellite signature) appear tractable, as the work presented by V.Husson shows.

John R

John mentioned that he observed a positive range bias in MOBLAS-7 in January 2019. Found an average bias of 16 mm for 7105 for L1 and L2 between 1/6/2019 and 1/29/2019.

Erricos distributed JCET graphs of the observed biases on the two LAGEOS:




Stefan

Comments on AWC charts presented on Oct. 5 2021 regarding the objective to process MCP multi photon data with a Wiener filter

1. In contrast to single photon data, recording the entire satellite response function, multi photon data is restricted to leading edge detection imposing stringent requirements on the definition of the leading edge with respect to the center of mass of the satellite.

2. The periodically performed time walk measurements are a splendid tool to correct full rate data in order to retain the remaining satellite signature effect involved in the detection process and pave the way for a spectral analysis of the residuals.

3. For improving intersystem consistency (single - multi photon detection) it may be helpful to derive center of mass corrections from a unified reflectivity function. With detailed information on calibration measurements, spectral characteristics of the residual distribution can be retrieved for multi photon systems.

Toshi

Toshimichi Otsubo provided a link to Residuals vs. Intensity for 7110 (July 2016 to June 2017): http://geo.science.hit-u.ac.jp/slr/bias/2017sp/SortIntensity7.pdf.