Introduction

- During the collation of NASA’s Next Generation Satellite Laser Ranging (NGSLR) system with current NASA Standard, MOBLAS-7, it was found that a centroid estimation of the return distribution using a 3 sigma RMS filter provided a more accurate estimate of the target range than using peak estimates of the return distribution (~1.8 sigma RMS filter). One observed consequence of utilizing the 3 sigma RMS filter was the loss of valid passes with weaker signal due to the inclusion of background noise within and outside the signal distribution. A background noise suppression technique was developed and used prior to the centroid estimation such that these weaker signal passes were again viable and produced valid normal points. This paper will discuss the algorithm that was developed and present the effect of the algorithm on the quantity of valid normal points and the range determination of the normal points.

Noise Suppression Technique

- A noise suppression technique was developed so that weaker passes would not have to be eliminated from the data set.
- The technique consisted of determining the background noise rate by sampling the noise outside the signal window and then randomly editing observations at the noise rate ± 1σ.
- This “noise rate ± 1σ” editing was chosen because it appeared to do the best job of eliminating noise while not significantly eliminating signal.

Noise Suppression Algorithm

- The algorithm processes data in time bins of ± 1σ starting a beginning of the pass.
- For each time bin the following steps are performed:
  - Reject all data outside of a range residual window from R̂R̂ to R̂R̂ (signal is centered in window).
  - Estimate background noise rate using counts in a smaller range window outside the signal (counts in the Δt by Δt box).
  - Perform noise suppression to residual steps of Δt, starting at R̂R̂ and ending at R̂R̂. For each step the noise suppression is performed using the following decisions:
    - If the number returns in the step (counts in the Δt by Δt box) is less than the expected noise returns, E, then all the returns are rejected.
    - If the number returns are greater than E, then the total returns in the step are rejected.

Noise Suppression Parameters

- The plots below display the results of noise suppression on two weaker signal passes.
- The top three plots in each set display the raw residuals before noise suppression, the raw residuals after noise suppression, and the returns that were edited during noise suppression. The noise suppression eliminates most of the background noise and very little of the signal.
- The bottom two plots in each set display the processed data (smoothed and sigma multiplier filtered) with and without noise suppression. The data with noise suppression accepts almost entirely signal, while the data without noise suppression includes large amounts of noise.

Results of Noise Suppression

- Most of the newly included passes were tracked during the daytime or under poor seeing conditions. Only six of the new normal points had overlapping MOBLAS-7 normal points with enough full rate observations to be used in collation.
- The mean range difference between NGSLR and MOBLAS-7 decreased ~2.5 mm when the data was processed with noise suppression due to the distribution of the edited background noise in the signal.
- The mean range difference is in good agreement with Lageos theoretical predictions given the different types of receive systems used by NGSLR and MOBLAS-7 (Degnan, 1994; Fan et al., 2001).

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Effects of Applying a 3.0 versus a 1.8 Sigma Filter to the Collocation Data Set

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