OPTICAL NAVIGATION SIMULATION AND PERFORMANCE ANALYSIS FOR OSIRIS-REX PROXIMITY OPERATIONS


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Figure 3. NTE1 Test Simulation Timeline

A primary goal of NTE1 was to exercise the team’s ability to process star based OpNav data as Bennu grows from an unresolved to a resolved object and incorporate this data with radiometric Range, Doppler, and DDOR. Figure 3 shows NTE1 spanning AAM-2 - 1 day through AAM-2a + 2 days, allowing for an AAM-2 and AAM-2a reconstruction as well as AAM-2a and AAM-3 maneuver design and verification activities.

Figure 4. NTE2 Test Simulation Timeline

NTE2 was designed to test the FDS team’s ability to insert into the first orbit around Bennu. The test spanned maneuver M79 through M5A, which covers the 7-km south pole flyby, the drift away from and re-approach to the asteroid, and the Orbit-A insertion. Similar to NTE1, the navigation team used radiometric Range, Doppler, and DDOR as well as star-based optical navigation of a resolved object as the measurement types.

Figure 5. Post-processed long/short exposure pair, showing observed star and body centroids

OpNav Image Processing Results
Plots of the NTE2 Bennu centroid residuals computed with respect to orbit determination solution OD0012 are shown in Figure 6. A perturbation to the pole position and spin rate cause small errors in the solution. Figure 7 shows both NTE1 and NTE2 centroid residuals plotted with respect to truth. In addition to pole perturbation errors, there is a ~0.7 px bias in the Bennu limb direction in NTE1 images that has not yet been explained. Still, the results are well within expected and required performance.

Figure 6. NTE2 centroid residuals w.r.t. OD0012 trajectory, plotted in pixel and kilometer space

Figure 7. NTE1 and NTE2 centroid residuals w.r.t. truth centers, plotted in pixel and kilometer space