Testing of the Orion Optical Navigation Image Processing Algorithm

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The Orion optical navigation algorithms have been matured and tested in preparation for incorporation on the i5 computer on the Orion Crew Module Adaptor. The camera used for optical navigation will be mounted on an optical bench on the CMA. This affords a measure of optical stability since the two Jena Optronix star trackers are mounted on either side of the optical navigation camera. The camera will be used to image either the Earth or the Moon and the associated image processing software will be used to generate a optical navigation measurement to the flight computer. The optical navigation measurement comprises a planetary centroid and a range to the planet. Both the Earth and the Moon provide unique challenges for generating an accurate measurement. The atmosphere of the Earth results in a range measurement bias which is a function of the viewing angle as well as a myriad of other factors. In contrast, the terrain of the Moon introduces an error which is a function of the range. The algorithms have been exercised using lunar imagery gathered from ground observations as well as from the images gathered by astronauts on the International Space Station. Whereas these images provide an opportunity to use real imagery, the errors introduced by both the ground based and ISS-based imagery only can be used to characterize the range measurement. The ground-based imagery is affected by atmospheric distortion; the ISS-based imagery is obtained by the crew pointing a camera through the windows in the Cupola. For this paper, synthetic imagery (using EDGE (Enhanced DOUG Graphics Emulator) will be used to characterize the algorithms. This paper will discuss the error models of both the Earth and the Moon and will detail the images that are used to characterize these errors. As well, the performance of these algorithms and the resulting navigation accuracy will be presented.