Radiometric Calibration, Spatial Characterization, and Spectral Evaluation of the Advanced Land Imager and Hyperion Sensors

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This summary describes the effort to characterize the spatial response of the EO-1 Advanced Land Imager (ALI) multispectral and panchromatic bands using datasets derived from two different geographic areas. The cross-track and in-track performance of the ALI 30-meter multispectral bands was evaluated using agricultural berms between fields at the Maricopa Agricultural Center (MAC), Arizona (Figure 1). This dataset was acquired on July 27, 2001. IKONOS data acquired on July 26, 2001, were used for target validation purposes. The cross-track performance of the ALI 10-meter panchromatic band was analyzed using the Lake Pontchartrain Causeway, Louisiana (Figure 2). The ALI data used for this analysis were acquired on September 20, 2001. The results of this analysis were compared to published results for the Landsat 7 Enhanced Thematic Mapper Plus (ETM+), which also used the Causeway. The in-track performance of the ALI 10-meter panchromatic band was analyzed using the same Maricopa data used for the multispectral bands.

Figure 1. Maricopa Agriculture Center was used to characterize performance of ALI multispectral and pan (in-track) bands. IKONOS was used for target validation

Figure 2. Lake Pontchartrain Causeway was used to analyze the ALI 10-meter panchromatic band in the cross-track direction. These results were compared to the spatial response of ETM+.

The agricultural fields at Maricopa are oriented in a north-south and east-west pattern and formed angles of 13.08° with the ALI in-track and cross-track directions. This inclination of the fields to the EO-1 orbit provided sub-pixel sampling across the target. Results indicated that there was a 20% broader spatial response in-track compared to cross-track for ALI's multispectral bands. This is probably due to integration time smear in-track.

The Louisiana causeway target used to evaluate ALI's panchromatic band consists of a double-span bridge, each span 10 meters wide and with a center-to-center separation of 24.4 meters. This separation was large enough to allow two separate spatial response measurements. The angle between the causeway and the ALI data was 4.1949°, resulting in a sub-pixel cross-track sample increment of 0.0733 ALI pixels. The in-track analysis of the panchromatic band was done using the east-west berms at Maricopa.

Results indicated that the measured cross-track on-orbit MTF was about 0.1 higher at the Nyquist frequency (0.5 cycles/pixel) than pre-launch data for sensor chip assembly (SCA) 4. The cross-track spatial response Full Width Half Maximum (FWHM) value was found to be 1.3 pixels (13-m) and the cross-track MTF at 0.5 cycles/pixel, corrected for the target, was found to be 0.31. These values compare to 1.28 pixels (19.2-m) and 0.28, respectively, for ETM+ as reported by J. Storey in an earlier analysis.

A comparison of in-track and cross-track ALI spatial response calibration showed an expected lower on-orbit performance in-track. The panchromatic band in-track, on-orbit MTF was measured to be about 50% lower than the cross-track MTF at the Nyquist frequency. As in the case of the multispectral bands, this is consistent with in-track integration time smear. Results from this on-orbit characterization of the ALI multispectral and pan bands are somewhat different from pre-launch measurements and models developed by Lincoln Lab, but are consistent in terms of lower response in-track compared to cross-track. A detailed comparison of pre-launch and on-orbit results is in progress.