5th GOES Users' Conference: GOES Advanced Baseline Imager – Ground Processing Development System

P1.7

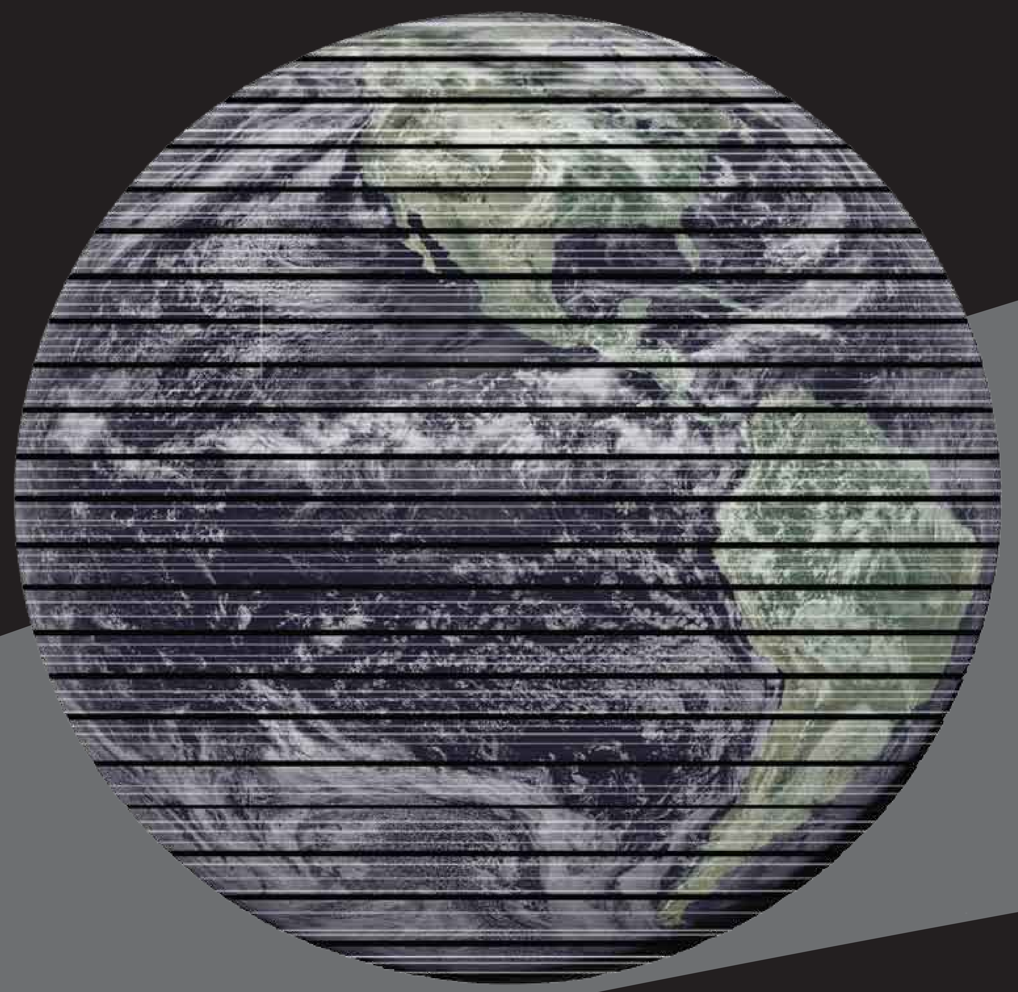
Jonathan P. Ormiston, Jon Blume, Joseph Ring, Jeff Yoder – ITT Corporation

ABI LEVEL 0 TO LEVEL 1B IN REAL TIME

The GOES ABI Ground Processing Development System (GPDS) illustrates that the ABI instrument's ground processing algorithms can be implemented and performed in real time. Raw ABI instrument CCSDS packet data (Level 0) is input into GPDS where it is decompressed, calibrated, navigated, and resampled to create images (Level 1b).

GPDS is a distributed processing application implemented in C++ using open source libraries and is platform independent. ITT's GPDS implementation is currently in development. Initial results demonstrate specification compliant latency with at least 28% margin. These latency results were achieved using 11 computer nodes (Dual Opteron Model 246, 2.0 GHz, 4 GB Memory, 1 Gbps Ethernet [copper]) running the Fedora Linux operating system. The ABI Instrument Performance Simulation (AIPS) generates Level 0 data streams for use in GPDS development.

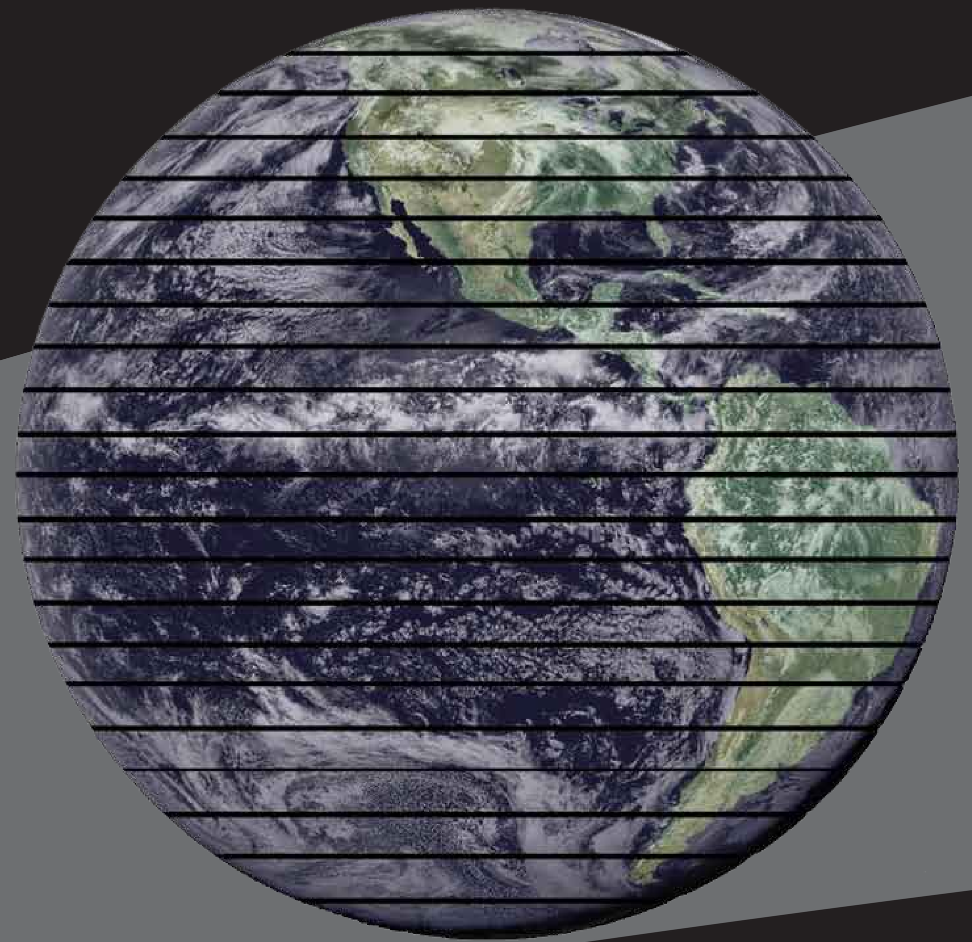
Reference P1.29 AIPS: ABI Instrument Performance Simulation for additional information.



DECOMPRESSION

ABI instrument data is generated in a standard packet format. This instrument compresses all image data using an adaptive lossless compression algorithm that conforms to the Consultative Committee on Space Data Systems (CCSDS) standard for international space data systems (reference CCSDS 121.0-B-1). Various implementations of this algorithm include szip and Universal Source Encoding for Science Data (USES).

GPDS ingests, parses, and distributes relevant ABI instrument data packets to the ground processing algorithms (GPAs). All ABI image data is decompressed using the szip implementation of the CCSDS standard.



CALIBRATION

Calibration transforms instrument counts to Level 1b radiance products. Calibration removes instrument effects such as detector gain, offset, and spectral variations. The algorithm uses delta counts, the difference between scene and space counts. Space counts provide a measure of detector offsets, since there is no input flux to be measured. The inverse responsivity or slope is updated every 15 minutes for the IR channels using a blackbody target and is updated at various intervals throughout the life for the VNIR channels using a solar calibration target. Nonlinear terms are determined during prelaunch calibration using a variable temperature blackbody and do not change through the instrument's lifetime. The calibration algorithm ties the radiance product to a standard scale then updates the responsivity throughout the lifetime of the instrument.

Reference P.1.15 GOES-R ABI Calibration Approach for additional information

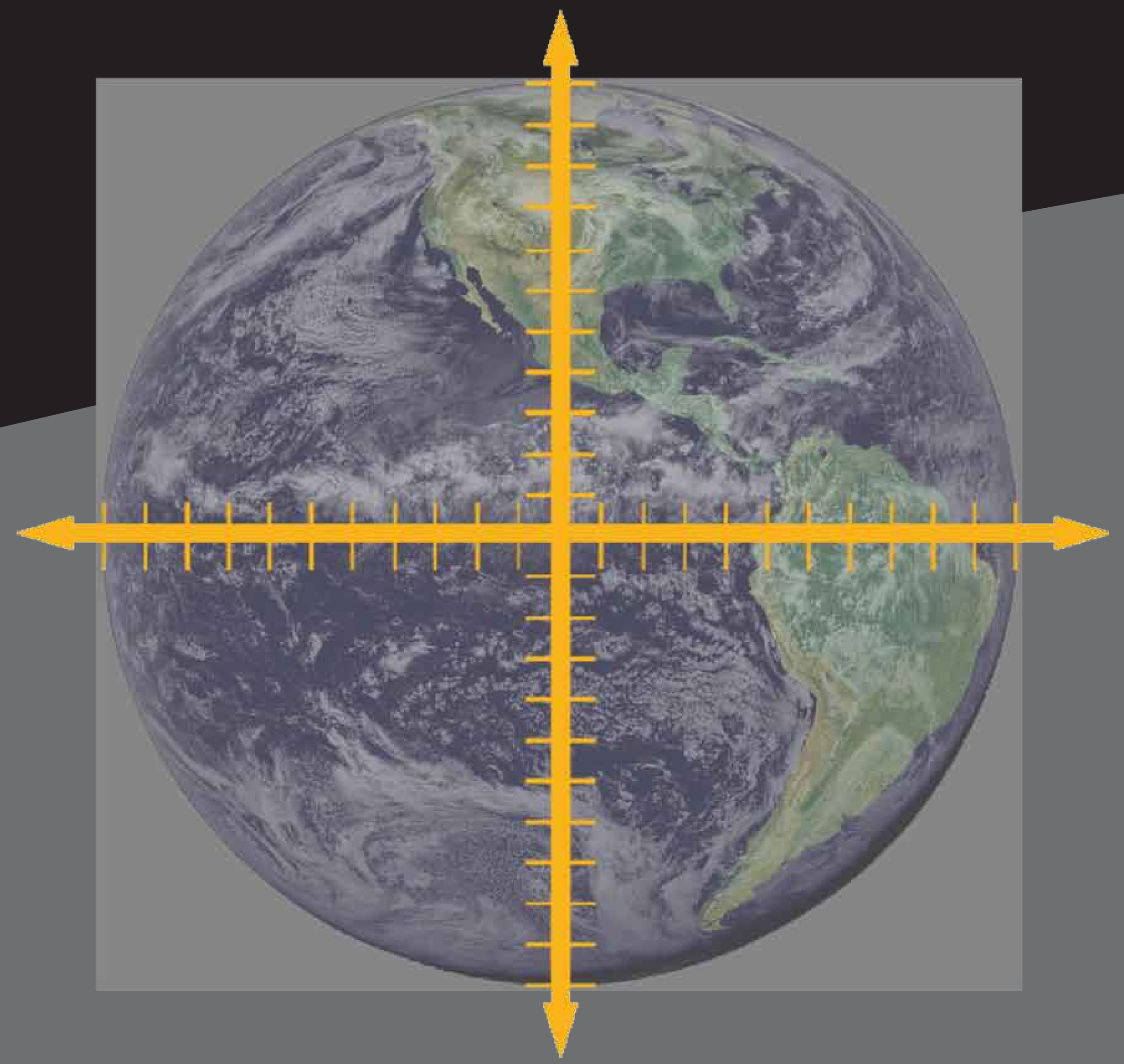
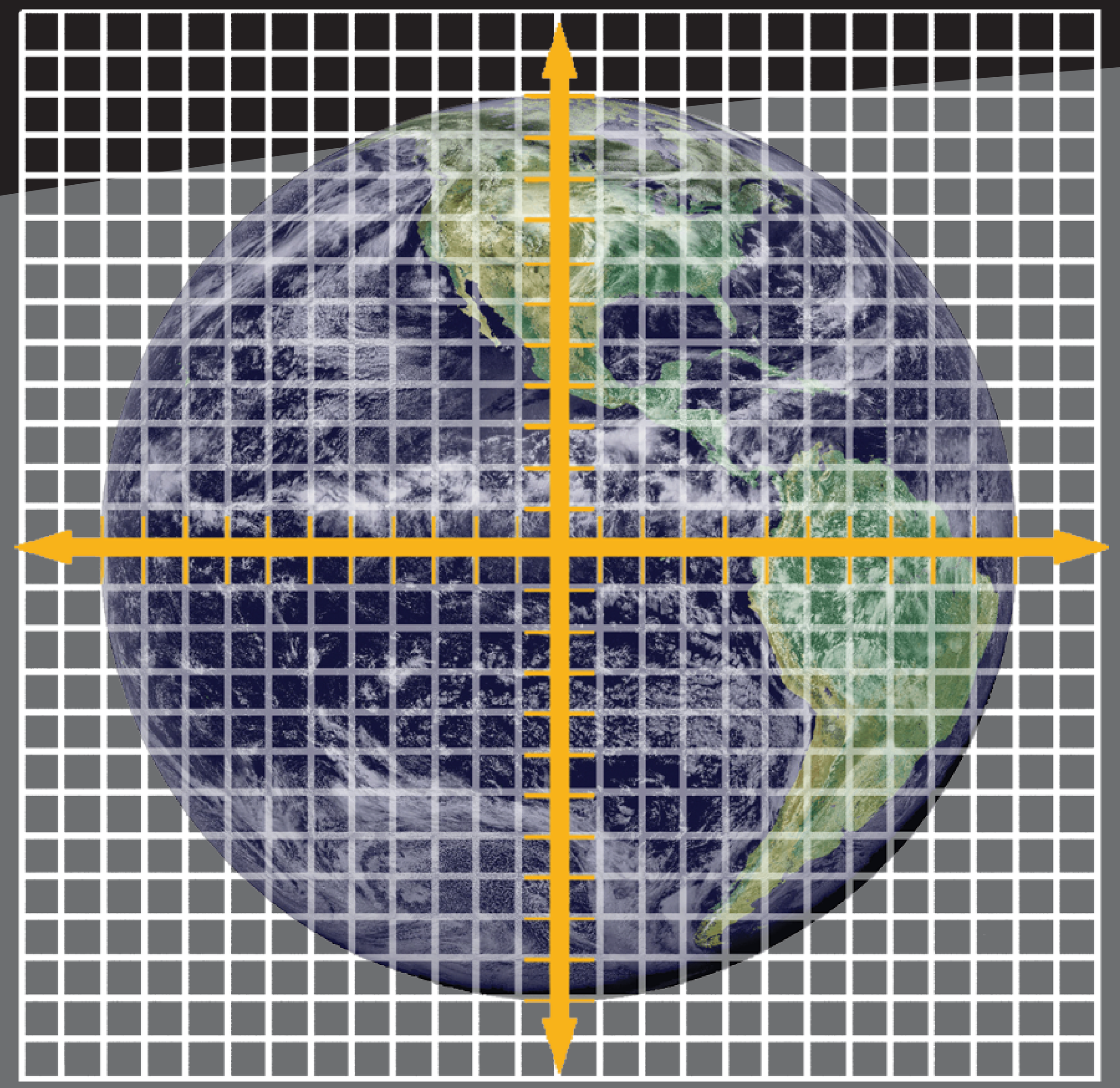


IMAGE NAVIGATION AND REGISTRATION

INR geolocates Earth scene samples using ABI star observations and spacecraft telemetry. The GPDS INR implementation consists of the following elements: a star catalog, star selection, star detection, a recursive Kalman filter, a coregistration algorithm, and a navigator. The INR process selects stars with magnitudes that provide high probability of detection and accuracy. It recursively filters these star observations with a Kalman filter to determine instrument and spacecraft attitude. The Kalman predictor uses kinematic rate measurements of spacecraft motion in place of a dynamic model, and uses a reduced-order ABI misalignment model. The navigator combines the attitude estimates with the orbit and the rate telemetries from the spacecraft. It produces an earth location for each Earth scene sample in the continuous Fixed Grid plane.

The ABI contains three focal plane modules, VNIR, MWIR, and LWIR. INR error allocations cover the small relative motion between the MWIR and LWIR modules. However, the VNIR and MWIR modules have enough relative motion to require additional star measurements to meet INR coregistration requirements. Therefore, INR star selection, star observation, and navigation have both VNIR and MWIR components. INR coregisters VNIR and MWIR focal plane modules using residuals between VNIR and MWIR star observations. The navigator uses information from the diurnal profile of these residuals to correct the LOS of channels in the MWIR and LWIR modules.

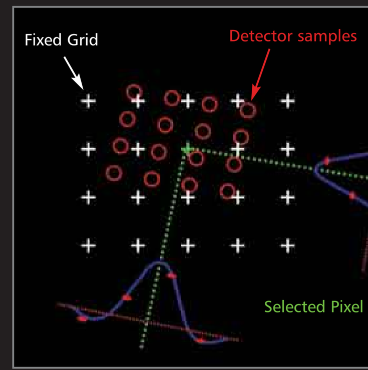
Reference P1.27 The ABI Image and Navigation Registration and P1.28 The ABI Star Sensing and Star Selection for additional information.



RESAMPLING

Resampling is an interpolation process that estimates the value of a pixel as the weighted sum of surrounding detector samples. The weight assigned to each detector sample is based upon its proximity to the selected pixel, which is gleaned from the coordinates assigned during the INR portion of the ground processing algorithm. The general resampling algorithm process is illustrated below.

Locations of a 4x4 subset of detector of samples are represented by the 'o' symbols and the pixels defined by the Fixed Grid are represented by the '+' symbols. Because the locations of the detector samples do not coincide with the pixels of the Fixed Grid, resampling is required to produce the desired Level 1b pixels.



Shown to the bottom and the right of the illustration are graphical depictions of the mathematical functions, known as kernels, which are used to assign a weight to each detector sample, included in the interpolating sum. Two resampler kernels are provided for each spectral channel. One kernel operates along the rows of detector samples (along-track dimension) and the other

operates independently along the columns of detector samples (cross-track dimension). Both resampler kernels are centered upon the selected target pixel. The resampler kernel is aligned with the detector sample scan pattern. If the scan pattern rotates relative to the Fixed Grid, then the resampler kernel rotates with it. This eliminates the need to transform the resampler kernel to Fixed Grid coordinates.

The Advanced Baseline Imager (ABI) is a NOAA funded, NASA administered meteorological instrument program.
This poster does not reflect the views or policy of the GOES-R Program Office. The authors thank the NASA ABI program office for permission to publish it.
The information in this poster has been derived from work performed by ITT Corporation for NASA under the ABI program, contract NNG04HZ07C