Pipeline Processing of Infrared-Array-Camera Images from the Space Infrared Telescope Facility (SIRTF)

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To be presented at the *Workshop on Computational Optics and Imaging for Space Applications*, NASA/Goddard Space Flight Center, May 10-12, 2000.

Abstract. The Space Infrared Telescope Facility (SIRTF), the fourth and final element of NASA's Great Observatory program, is scheduled for launch into an Earth-trailing solar orbit in December 2001. Its Infrared Array Camera (IRAC) will provide 5.12×5.12 arcminute images of the celestial sky in four infrared bands centered at 3.6, 4.5, 5.8 and 8.0 μm simultaneously. Two InSb and two Si:As focal-plane-array (FPA) systems, each with 256×256 pixels, are used for raw image acquisition in the two shortest and two longest wavelength bands, respectively. The pixels are read out in four multiplexed channels, opening up the possibility of four separate bias drifts in the image data. Prior to distribution of the data to the relevant observers, the raw images will undergo several stages of automated processing at Caltech's SIRTF Science Center (SSC) to remove instrument artifacts and transform them into basic calibrated data (BCD) products. The image-data processing will be done for each band independently, and will include the following steps: 1) transformation of InSb data into the positive "sense"; 2) conversion of the integer image data to real numbers; 3) truncation correction; 4) detection and correction of wrapped-around negative data; 5) barrel-shift and Fowler-sampling number normalization; 6) electronic bandwidth correction; 7) latent-image detection; 8) dark-current subtraction; 9) dark-current channel-offset normalization; 10) linearity correction; 11) non-uniformity correction; 12) cosmic-ray/radiation-hit detection; 13) engineering-to-astronomical units conversion; and 14) quality-assurance characterization. The "science-data processing thread" will require several calibration products generated by at least five calibration threads of the pipeline. There are separate calibration threads for estimating the dark current, detector linearity, and image non-uniformity (field-flatness). There is also an ancillary thread that uses a Kalman filter for noise-mitigated estimates of the image non-uniformity measurements in time. A fifth calibration thread will provide gain and read-noise estimates for the images on a pixel-by-pixel basis. The scale factor that is required for the final step of converting data numbers (DN) into absolute flux densities will be determined by non-automated analysis. A "calibration server" will determine the latest and/or most-suitable calibration products to use in pipeline-reduction of a given data set. The pipeline design calls for modular software elements written in the UNIX-style of command-line inputs and outputs, with namelist capability for parameters that change infrequently. Higher-level scripts written in either Perl or C-shell will chain the relevant software elements into the various processing threads. Other scripts running under an executive (OPUS) will manage the automated pipeline processing with little operator intervention. All raw and processed images will be stored in FITS (Flexible Image Transport System) format, and will be archived at the SSC. Both raw and processed images and intermediate data products, as well as the calibration data used in the processing, will be made available to the appropriate SIRTF observers. Following a data validation period, all SIRTF data will be made publicly available.

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