TITLE: Creation of the First Relative DE Calibration File for the PFM2 Detector of the FOC

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ABSTRACT

The creation of the first relative DE calibration file at STScI using the RAL software as installed in the SDAS environment is described. A dark count image was subtracted from the relative DE calibration image, and a correction applied for the source non-uniformity. A self-consistency test was applied to the resulting calibration file, which demonstrated the file was generated correctly. A difficulty encountered in interpreting and applying the source non-uniformity correction is discussed.

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ISB
CSC
SDAS
SOGS
IDT
CDBS Giaretta
The purpose of this report is to describe the processing used to perform the dark count and relative DE corrections to a flat-field image acquired using the PFM2 detector in July, 1984. This exercise will serve as an example for the creation of all the necessary relative DE calibration files for the FOC prior to launch.

An initial problem was encountered which presently remains unresolved. No source non-uniformity maps for the full format (F3) calibration images were available to me. The only source non-uniformity maps at my disposal were those contained in Doc. No. LA.TN.FC.220072 dated 31.01.85. The source non-uniformity maps contained therein for the PFM2 detector were related to the F1 format relative DE images acquired during the calibration of July, 1984. Therefore, it was necessary to create the relative DE calibration file in the F1 format, which was not the original intent of the IDT. In addition, the source non-uniformity maps available do not appear to cover the entire target area, but leave a border of approximately 82 pixels unmeasured for source nonuniformity around the edge of the image. The units of the coordinates for the maps are millimeters. The units were converted to pixels by assuming 1mm=41.5 pixels, as no direct conversion factor was supplied. However, a factor of 2 probably needs to be applied to this conversion to account for the FOC optics, which would eliminate this portion of the problem.

The procedure began with the identification of the ground calibration images to be used in this “first” calibration. Image T3527, a far-UV image at wavelength 121.6nm, was chosen to be used as the relative DE calibration image. Image T3706 is the only available dark count image in this format. T3527 was read onto disk using the MIDAS SDSIN routine in order to use the DeAnza facilities on the FOC MicroVAX. The positions of the reseau marks in T3527 were measured and a table of these positions created on the MicroVAX using MIDAS. Because the reseau locating and removal software requires the reseau marks stipulated to form a complete rectangle, it is necessary to “fill” the table with dummy points in order to have all visible marks removed. The largest possible rectangle is chosen and the cursor placed at any random location to fill the table with a value whenever the appropriate grid point would be outside the image. Further processing was attempted in MIDAS using the RAL software. However, all input images into the MIDAS RAL software must be in mask format by design. This constraint implies that the images must be in integer*2 format. While this constraint causes no problem in the majority of the programs, CONISR, the program which makes the source non-uniformity data into a full-sized image to be divided into the calibration flat-field image, requires the source-non-uniformity data to be entered as an image. Because this data is in the form of a fraction of the central intensity with five significant digits, the integer*2 format is not useable. The MIDAS version of this program, therefore, cannot be used without modification and the remaining processing took place in the SDAS environment.

It was necessary to change the names of the columns in the table of reseau positions created by MIDAS in order to continue processing in the SDAS environment. Column #1 was changed to PIX1 and column #2 was changed to PIX2. T3527 was read again from tape onto disk using SDSIN in the SDAS environment (a conversion program for images from MIDAS to SDAS format would be helpful here). XVGRID was run next to create
the necessary reseau file from the reseau table. Then, XRSFND and XRSREM were run to accurately find the reseau marks in T3527 and remove them.

The source non-uniformity data found in L.A.TN.FC.220072 was used to create a 5 × 15 image with XGENTD. The option to include reseau marks in the generated image was used. One reseau mark was added, centered in the image. The model file which describes the reseau mark contained the actual values from the source non-uniformity measurements, multiplied by 100. In addition to creating this 5 × 15 image with XGENTD, a reseau file of the same dimensions was created using XGRID, giving the pixel coordinates of the measured points of the source non-uniformity map.

Next, the source non-uniformity "image" and reseau file are used by XCONSR to create a full image of the dimensions of the calibration image to be corrected. The non-uniformity data is fit with a cubic spline in this procedure and it is possible to specify 0-8 knots which are automatically or manually placed to execute the fit. In this case, the fit was unsatisfactory because of the extrapolation necessary around the edges of the image. Unacceptable amounts of distortion were introduced, regardless of the number or placement of the knots. Tests were performed which showed that the fit produced by this program was good when no extrapolation was required. Optimal calibration files will only be produced if either source non-uniformity data covering the entire target area for the format selected become available, or the software is adjusted to allow a more accurate fit for the data available. The source non-uniformity in this particular case appears to be a linear ramp and could be represented with a simple algorithm if necessary.

I proceeded with the source-nonuniformity image created by XCONSR, in spite of its obvious shortcomings, in order to test the entire process of the relative DE calibration. The dark count image, T3706, was subtracted from T3527 (having had its reseau marks removed above) using XALGY. In this case it was assumed that the dark count image is raw counts and the appropriate option chosen. Next, the resulting calibration image was divided by the source non-uniformity image with XFLUXIN and then normalized using XQNORM. The region of the image chosen for the basis of the normalization was the central 256 × 256 pixels (option=rectangle). The image produced from this program is the relative DE calibration file for the wavelength 121.6nm.

The first test performed on this new calibration file was the self-consistency test, in which the calibration was applied to the image used to create the calibration file itself, T3527. The raw image, T3527, was processed with XFLUXIN, which divides the raw image by the relative DE calibration file. The resulting image from the self-consistency test should be the simply the source non-uniformity image, and in fact it was, complete with all the distortion. The calibration file was then applied to another F1 image taken at this wavelength, T3709. All software worked properly; however, it is difficult to analyze the results of this test because the distortion introduced by the source non-uniformity image dominates the results.

A schematic representation of the complete processing used to create a relative DE calibration file is shown in Figure 1 for a hypothetical relative calibration image denoted T1234. The final calibration file is denoted by CAL1234. The first step in which the
reseaux are located using the DeAnza was carried out in MIDAS using GET/CURSOR due to present computer configuration; however, the equivalent process in SDAS can be substituted when the FOC VAX is operational.

Before continuing with the creation of the relative DE files, it is imperative to determine if source non-uniformity maps exist for F3 format of the PFM2 detector and if the measurements extend to the edge of the image format. If these data do not exist, then the source non-uniformity maps will have to be simulated, using as much data as is available.