Date: 25 Oct 1991

The ground system has been requested to support the correction calculation for the FOS geomagnetic field deflection response. The FOS photocathode image/spectrum appears to move around in a cyclical fashion. This apparent motion is really caused by the interaction between the FOS internal detector magnetic field and the geomagnetic field. The absolute detector deflection (x,y) coordinates of any given physical point on the photocathode vary with time. That is, the deflection coordinate system is not fixed. The actual image location in detector coordinates at any given time depends on 1) where the telescope is within the geomagnetic field, 2) how the telescope is oriented in this field, and 3) the data acquisition mode.

There will be a patch to the FOS onboard software to inject x and y deflection offsets before any deflection motion is commanded. These deflection offsets must be updated periodically during each FOS exposure so that the deflection pattern remains stationary with respect to the photocathode image space. We must compensate for the magnetic field changes which occur throughout the exposure duration.

There will also be an upgrade made to the FOS Housekeeping Applications Processor to periodically supply the FOS software with the appropriate x and y deflection offsets. This AP will calculate the offsets from a table of third-order polynomial coefficients which are uplinked from the ground. See Glenn Foley's "Requirements and Proposed Design for the FOS GIMP Correction NSSC-1 Flight Software, 3rd Order Polynomial Coefficient Approach".

So, PASS must use its knowledge of the geomagnetic field, the spacecraft ephemeris and the data acquisition mode to compute the delta-x and delta-y motions of the deflection coordinate system as a function of time.

Adopted ground system method: Upload polynomial fit coefficients

The SMS will provide information about the data acquisition mode, the telescope position, the computation start time, and (optionally) the computation duration time. PASS will calculate delta-x and delta-y deflection offsets to cover the whole computation duration time. One offset (x,y) pair will be calculated every 15 seconds starting with the SMS-supplied computation start time. Using a 30?

polynomial fit to the data. One equation for the x-offset motion and another for the y-offset motion.

For T(t) = T0 + 15sec*t where t=0,1,2.... (@ min Ticks)
and T0 = computation start time

1. Compute the geomagnetic field B(v1,v2,v3) in gauss in s/c coordinates from the SMS supplied s/c orientation and the orbital location at time T(t).

2. Compute the geomagnetic field components along the digicon axes, B(x,y,z), by successive cartesian coordinate rotations. See attached diagram.

   a. Rotate about v1 axis by -135 degrees

      B0_x = cos(theta)* B_v2 + sin(theta)* B_v3
      B0_y = -sin(theta)* B_v2 + cos(theta)* B_v3
      B0_z = B_v1

      where theta = -135 degrees

   b. Rotate about v2-v3 bisector by -23 degrees

      B1_x = B0_x
      B1_y = cos(delta)* B0_y + sin(delta)* B0_z
      B1_z = -sin(delta)* B0_y + cos(delta)* B0_z

      where delta = -23 degrees

   c. Rotate about the detector Y axis

      B_x = cos(alpha)* B1_x + sin(alpha)* B1_z
      B_y = B1_y
      B_z = not needed for further calculations

      where alpha = 8 deg for red detector
      alpha = -8 deg for blue detector

   d. Reverse sense of x component

      B_x = - B_x

4. Compute effective geomagnetic field B_eff(x,y), correcting for ExB electron-optical drift, by rotating about the detector z axis by 17.6 degrees

B_eff_x = cos(beta)* B_x + sin(beta)* B_y
B_eff_y = -sin(beta)* B_x + cos(beta)* B_y

where beta = 17.6 degrees

5. Compute GIMP(x,y) offsets by scaling B_eff(x,y) with a scale factor located in the SICF PDB file. The scale factor is dependent on detector and data acquisition mode. The units will be detector deflection steps per gauss. The SMS will supply a mnemonic to use in retrieving the correct scale factor.

SICF lookup table:

SMS mnemonic	x_scale_factor	y_scale_factor	
ACCUM1	***	***	red detector
IMAGE1	***	***	red detector
ACCUM2	***	***	blue detector
IMAGE2	***	***	blue detector

The actual values are TBD but should be in the range of -200 to +200.

GIMP_x = x_scale_factor * B_eff_x
GIMP_y = y_scale_factor * B_eff_y

Determine the equation coefficients to be uploaded to the NSSC-1.

1. Using a standard least-squares fitting technique, compute a third-order polynomial fit to the above data.

X-gimp = A t**3 + B t**2 + Ct + D
Y-gimp = Z t**3 + Y t**2 + Xt + W

where t is in units of 15 sec (aka a GIMP tick)

2. Scale the polynomial coefficients by constants to accomodate the integer math of the NSSC-1.

A = A * 2**24 Z = Z * 2**24
B = B * 2**16 Y = Y * 2**16

```
D = D * 2**8          W = W * 2**5
```

3. Place these coefficients and the SMS supplied initial GIMP tick number into a memory load of the YFGIMPCB table.

```
            ------------------------
YFGIMPCB:  |     coefficient A      |
           |     coefficient B      |
           |     coefficient C      |
           |     coefficient D      |
           |     coefficient Z      |
           |     coefficient Y      |
           |     coefficient X      |
           |     coefficient W      |
           |     initial tick #     |
            ------------------------
```

The SMS input:

```
FOSGIMP, _OPMODE(ACCUM1,IMAGE1,ACCUM2,IMAGE2)
       , _ORIENT(decimal,decimal,decimal)
       [, _TICK(integer)]
       [, _COMPDUR(integer)]
       , TIME = time ;
```

keyword	description	type	units	range	resolution
_OPMODE	data acquisition mode	mnemonic	ACCUM1|IMAGE1|ACCUM2|IMAGE2		
_ORIENT	ST position				
(ra.	right ascension	decimal	degrees	0-360	10**-7
dec.	declination	decimal	degrees	-90,90	10**-7
roll)	position angle	decimal	degrees	0-360	10**-7
_TICK	first gimp tick for FOS use	integer	ticks	0-120 (default=0)	1 tick
_COMPDUR	duration range of computation	integer	seconds	0-1800 (default=1800)	1 sec

for table load
and computation
start

Determination of YFGIMPCB table load time:

Let time on FOSGIMP data block = T
nearest MFP + 25 sec = L1
nearest MFP − 5 sec = L2

Choose either L1 ~~and~~ or L2 for the table load time, the one which is > T and nearest in value.

Determination of PASS computation start time:

Let time on FOSGIMP data block = T
nearest MFP + 33 sec = P1
nearest MFP + 3 sec = P2

Choose either P1 and P2 for the start time, the one which is > T ~~and~~ or nearest in value.

● Does Pass require information on Activation flags?