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FOS GIMP NSSC-I Flight Software Requirements Review

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October 22, 1991

Agenda

o GIMP FSW History & Overview

o NSSC-I Flight Software Requirements

- scheduling
- processing
- data flow

o User Perspective

o Concerns

o Plans

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History & Overview

o GIMP correction kickoff meeting at STScI 5/9/91

o analyzed various approaches to GIMP correction:
- straight ATC commands: 810 wds ATC/orbit
- packed correction table/NSSC-I AP: 169 wds ATC/orbit
- polynomial coefficient/NSSC-I AP: 39 wds ATC/orbit
  (3rd order curve fit polynomial)

o polynomial coefficient approach: basic ideas; ground
supplies high level enable, low level "issue corrections" flag,
and table of X and Y correction coefficients

o NSSC-I GIMP FSW reqs memos: 6/28/91 & 10/11/91

o plan to have GIMP implemented in Baseline 4.0, early 1991

o FSW requirements review goals

o return RIDs to Glenn Foley by COB Fri 10/25 (FAX 286-4632)

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NSSC-I FSW Reqs: Scheduling

● GIMP correction shall be a function of the FOS Housekeeping Processor (AP30), executing every 30 seconds, after parts 1 and 3 (minor frames 6 and 66)

● basic timing concepts:

- GIMP "tick" : the unit of time used for inputs to the GIMP correction polynomials; nominally 15 seconds

- correction cycle: an execution of the FOS Housekeeping Processor during which GIMP deflection corrections MAY be generated and sent to the FOS

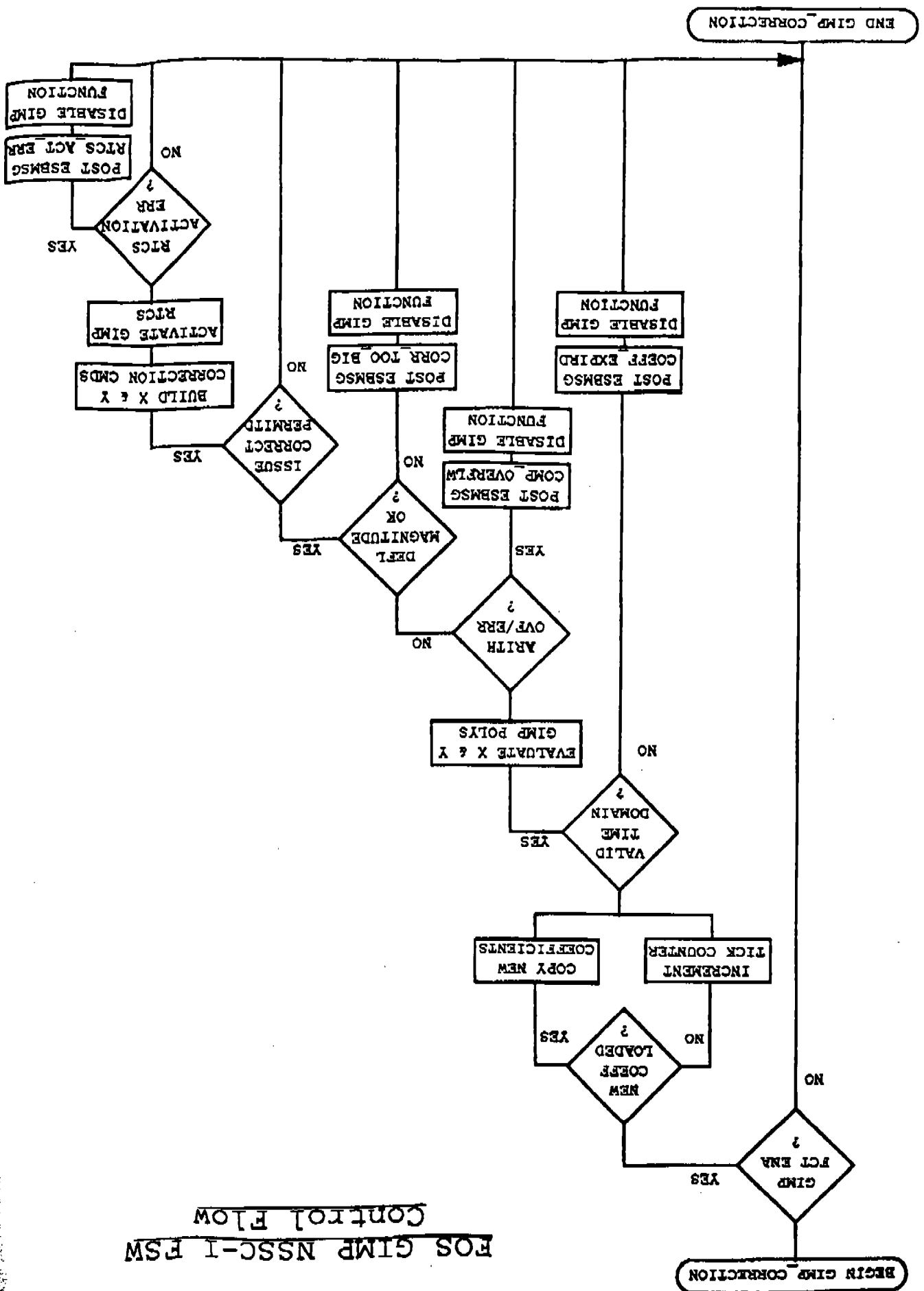- a GIMP correction cycle occurs every 2 GIMP ticks

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NSSC-I FSW Reqs: Processing Control Flow

● all activities are controlled by 3 STScI-managed data items:

- GIMP function enable flag
- issue GIMP correction flag
- X & Y correction polynomial coefficient table

● details are described in GIMP FSW memo and following flow chart

FOS GIMP NSSC-I FSW
Control Flow

BEGIN GIMP_CORRECTION

GIMP FCT ENA ?
— YES
— NO

NEW COEFF LOADED ?
— YES
— NO

COPY NEW COEFFICIENTS

INCREMENT TICK COUNTER

VALID TIME DOMAIN ?
— YES
— NO

POST ESBMSG COEFF_EXPIRD
DISABLE GIMP FUNCTION

EVALUATE X & Y GIMP POLYS

ARITH OVF/ERR ?
— YES
— NO

POST ESBMSG COMP_OVERFLW
DISABLE GIMP FUNCTION

DEFL MAGNITUDE OK ?
— YES
— NO

POST ESBMSG CORR_TOO_BIG
DISABLE GIMP FUNCTION

ISSUE CORRECT PERMITD ?
— YES
— NO

BUILD X & Y CORRECTION CMDS

ACTIVATE GIMP RTCS

RTCS ACTIVATION ERR ?
— YES
— NO

POST ESBMSG RTCS ACT ERR
DISABLE GIMP FUNCTION

END GIMP_CORRECTION

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NSSC-I FSW Reqs: Processing Computations

● two 3rd degree curve fit polynomials of the form:

$$X\_GIMP\_CORR = a_3 t^3 + a_2 t^2 + a_1 t + a_0 = a_0 + t(a_1 + t(a_2 + t(a_3)))$$

$$Y\_GIMP\_CORR = b_3 t^3 + b_2 t^2 + b_1 t + b_0 = b_0 + t(b_1 + t(b_2 + t(b_3)))$$

where:

X_GIMP_CORR, Y_GIMP_CORR = X and Y corrections in units of deflection
steps, with a range of [-128..+127] (8 bit, 2's comp integers)

t=time in units of GIMP TICKs with a domain of [0..120] (0-30 minutes), $t >= 0$

a_i, b_i =coefficients of curve fit polynomials with following scales:

a_3, b_3 = cubic coeff in units of [(deflection steps) / (GIMP tick)^3] * 2^{24}

a_2, b_2 = cubic coeff in units of [(deflection steps) / (GIMP tick)^2] * 2^{16}

a_1, b_1 = cubic coeff in units of [(deflection steps) / (GIMP tick)] * 2^{12}

a_0, b_0 = cubic coeff in units of [(deflection steps)] * 2^8

o evaluated by Horner's method, rounding to nearest integer

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NSSC-I FSW Reqs: Processing Error Handling

o GIMP FSW shall recognize the following error conditions and respond by posting a descriptive NSSC-I executive status buffer message and by disabling the GIMP function of the Housekeeping Processor:

- time domain outside of legal bounds
- intermediate result overflow
- generated X or Y correction out-of-bounds
- GIMP RTCS activation error

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NSSC-I FSW Reqs: Processing Initializations

o upon FOS Housekeeping Processor initialization, the GIMP function enable flag shall be set to disabled

- since GIMP correction may have terminated unexpectedly (e.g. safing) and the previously loaded coefficients may no longer be valid when the Housekeeping Processor again becomes active

o upon FOS Housekeeping Processor initialization, the issue GIMP correction flag shall be set to enabled

- with unexpected GIMP correction termination, it is desirable to return this STScI-managed flag to a known state

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Data Flow

o inputs (from stored commanding) - all 18 bit, 2's complement integers

- GIMP function enable flag (1 word): 1=enabled, 0 = disabled
- issue GIMP corrections flag (1 word): 1=issue corrections, 0=do not
  issue corrections

- X & Y correction polynomial coefficient table/zero time indicator
  (9 words): 4X coeffs, 4Y coeffs, and "zero time" indicator as
  described and scaled in GIMP FSW memo

o outputs

- YXDGIMP and YYDGIMP serial mag cmds from FOS-unique RTCS
  + each has 50 millisecond timetag
  + RTCS ends with 50 millisecond NOOP
  + commands will not be issued at 1 second ATC processing boundaries

- NSSC-I executive status buffer entries as described earlier

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User Perspective

o setup
- load GIMP coefficient buffer/zero time indicator
- load GIMP function enable flag with 1

o maintenance
- periodically refresh GIMP coefficient buffer: 4X and 4Y coefficients
  plus zero time indicator every 30 minutes (120 GIMP ticks)

- load "issue GIMP corrections" flag with 0 when it is desired to
  maintain the GIMP tick counter and calculate corrections but to not
  issue corrections to the FOS; load "issue GIMP corrections" flag
  with 1 when OK to issue corrections

o cleanup
- load GIMP function enable flag with 0

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User Perspective (cont.)

o notes

- GIMP correction cannot be performed when Housekeeping Processor
  is not enabled

- new GIMP coefficients must be loaded after a period when
  Housekeeping Processor has been inactive since generated
  corrections will be out of sync

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Concerns

o new FOS-unique RTCS

- will be used in conjunction with new overlite scheme in Housekeeping
  Part 2; this RTCS must be enabled whenever Housekeeping AP is active

- need to modify Exec to allow handling of non-contiguous SI-unique
  RTCS'

- need to look into 50 millisecond command separation to avoid S/M
  command collisions

o coefficient scaling

- scales are based on expected but non-quantified ranges

- recommend a ground check be implemented to test all scaled
  coefficients to be in range of [-131072..+131071]

- scale adjustments during onboard calculations are static but patchable
  on-orbit

- looking for test data on ground-generated coefficients and commanding
  as soon as available

o no regular telemetry for GIMP processing planned

- can report status in spare CVT words if desired...

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Plans

- RIDs to Glenn Foley/512 by Friday, 10/25/91

- STScI to generate overall GIMP CCR including changes to NSSC-I Flight Software Requirements Document DM03B, Appendix B

- Code 512 to begin design iterations and finalize with DM03B CCR

Version 2: October 11, 1991

<u>Requirements and Proposed Design for the
FOS GIMP Correction NSSC-I Flight Software
3rd Order Polynomial Coefficient Approach</u>

I. Background

This memo describes the requirements and proposed design for the HST NSSC-I Baseline 4.0 flight software to support correction of the FOS Geomagnetically-induced Image Motion Problem (GIMP). Refer questions about this memo to Glenn Foley, GSFC Code 512, at (301)286-5809.

Conceptually, the GIMP fix will provide the FOS with X and Y deflection corrections to compensate for detector susceptibility to the force of the earth's magnetic field at a particular attitude and orbital position of HST. Ground system elements shall compute a series of predicted X and Y corrections over a given time domain based on models of the earth's magnetic field, models of the FOS detector susceptibility, and predicted HST orbit and attitude. The ground shall then calculate from these corrections the coefficients of two curve fit polynomials: one which generates X deflection corrections and one which generates Y deflection corrections. These coefficients shall be periodically uplinked to the NSSC-I.

FOS GIMP correction software resident in the NSSC-I will periodically evaluate the polynomials to generate the X and Y deflection corrections, build them into FOS YXDGIMP and YYDGIMP (formerly YSPARE48 and YSPARE49) serial magnitude commands, and issue them through an FOS-unique relative time command sequence (RTCS) to the FOS. Modifications installed in the FOS instrument microprocessor software will recognize these corrections and apply them to the FOS X and Y deflection DAC settings.

II. Detailed NSSC-I Flight Software Requirements

Analysis by George Hartig at the STScI has demonstrated that in the worst case rate of change, deflection corrections must be sent to the FOS every 40 seconds. Furthermore, a third order polynomial with coefficients of 16 bits of precision (over a static interval) can generate corrections over a time domain of 30 minutes with an error of less than 1/16th diode (2 XBASE units or 4 YBASE units). It is from these specifications that the detailed NSSC-I flight software requirements are derived.

A. GIMP Correction Software Scheduling

The GIMP correction software shall be incorporated as a subroutine to the FOS Housekeeping Processor (AP30). The GIMP correction software shall be executed every 30 seconds, after Housekeeping Processor parts 1 and 3 (minor frames 6 and 66).

A GIMP correction cycle is defined as an execution of the FOS Housekeeping Processor during which GIMP deflection corrections may be generated and sent to the FOS.

A GIMP_TICK is defined as the unit of time of the inputs to the GIMP correction polynomials. One GIMP_TICK shall nominally be 15 seconds. Thus,

1

GIMP correction cycle shall occur every 2 GIMP_TICKs.

B. GIMP Correction Processing Requirements

1. Initialization

Processing of the GIMP correction function shall be disabled as part of the initialization performed by the FOS Housekeeping Processor. This is because GIMP correction may have been terminated unexpectedly (e.g. safing) and the previously loaded correction coefficients would no longer be valid when the Housekeeping Processor again became active.

The issuing of calculated GIMP corrections to the FOS shall be enabled as part of the initialization performed by the Housekeeping Processor. This is also because GIMP correction may have been terminated unexpectedly (e.g. safing) and it is desirable to return this stored command-managed flag to a known state. Note that though the issuing of corrections is enabled, none will be issued while the GIMP correction function of the Housekeeping Processor is disabled.

2. Control Flow

When activated, the GIMP correction software shall first determine whether the GIMP correction function is enabled. If it is not, the GIMP correction software shall exit without further action.

The GIMP correction software shall maintain a counter of GIMP_TICKs which shall be used to evaluate the GIMP correction polynomials with the uplinked coefficients to generate the X and Y GIMP corrections. Initial values for the GIMP_TICK counter shall be loaded as a nonnegative "zero time" by the ground along with each set of correction polynomial coefficients. This zero time shall specify the time in GIMP_TICKs for which the correction polynomials with the new coefficients should first be evaluated during the next correction cycle. The zero time shall nominally be zero.

Before calculating the X and Y GIMP corrections, the GIMP correction software shall determine whether a new table of coefficients and zero time have been loaded. If so, they shall be copied from their input buffer to an array of "current coefficients."

Next, if the counter of GIMP_TICKs is determined to be in the domain for which the current coefficients are valid, the correction polynomials shall be evaluated as described in the next section.

After evaluation of the polynomials, a quality check shall be performed to determine that no arithmetic overflow occurred during the calculation and that the computed corrections are within expected bounds.

A flag shall be interrogated to determine whether the computed corrections are to be issued to the FOS. Nominally, this flag shall be managed by stored commanding to specify when the counter of GIMP_TICKs is to be maintained and the corrections are to be computed, but commanding to the FOS is to be suppressed.

If the commanding of corrections is allowed, the GIMP correction software shall build the two FOS serial magnitude commands YXDGIMP and YYDGIMP with the computed X and Y deflection corrections into an FOS-unique RTCS and request activation of that sequence through the NSSC-I flight executive.

2

3. Computation of GIMP Corrections

The X and Y GIMP correction polynomials are nominally third order least-squares curve fit polynomials. The GIMP correction software shall utilize Horner's method of polynomial evaluation to minimize NSSC-I resources required to calculate the deflection corrections.

The GIMP correction polynomials shall have a domain of time in units of GIMP_TICKs with a lower limit specified by the data item GIMP_DOMAIN_MIN and an upper limit specified by the data item GIMP_DOMAIN_MAX. Nominally, the domain will be from 0 to 30 minutes, or 0 to 120 GIMP_TICKs. The current GIMP correction polynomial coefficients will be considered invalid if time is outside of this domain.

The X and Y GIMP corrections sent to the FOS shall have 8 bits of significance and shall be interpreted as 2's complement integers, with the scale of the least significant bit equal to 1 DAC deflection step. Corrections calculated by evaluating the X and Y GIMP polynomials shall have a final range of -128 to +127 DAC deflection steps after scaling. A generated X or Y correction will be considered invalid if it is less than -128 DAC deflection steps or greater than +127 DAC deflection steps.

The GIMP correction polynomials shall have the form:

$$X\_GIMP\_CORR = a_3 t^3 + a_2 t^2 + a_1 t + a_0 = a_0 + t(a_1 + t(a_2 + t(a_3)))$$

$$Y\_GIMP\_CORR = b_3 t^3 + b_2 t^2 + b_1 t + b_0 = b_0 + t(b_1 + t(b_2 + t(b_3)))$$

where:

t = time, in units of 15 second GIMP_TICKs; $t >= 0$

X_GIMP_CORR, Y_GIMP_CORR = the X and Y corrections in units of deflection steps, with a final range after descaling of an 8 bit 2's complement integer, specifying an effective correction range of -128 to +127 deflection steps

a_i and b_i are the coefficients of the curve fit polynomial uplinked by the ground; namely:

   a_3, b_3 = cubic coeff in units of (deflection steps) / (GIMP_TICK)^3
   a_2, b_2 = square coeff in units of (deflection steps) / (GIMP_TICK)^2
   a_1, b_1 = linear coeff in units of (deflection steps) / (GIMP_TICK)
   a_0, b_0 = constant coeff in units of (deflection steps)

The set of coefficients a_i and b_i shall be multiplied by the following scale factors before uplink by the ground to allow their representation as NSSC-I single precision, 2's complement, 18 bit integers:

coefficient	scale
cubic coefficients a_3, b_3	2^{24}
square coefficients a_2, b_2	2^{16}
linear coefficients a_1, b_1	2^{12}
constant coefficients a_0, b_0	2^8

Flight software design shall provide for adjustments in the scaling of the intermediate evaluations of the correction polynomials. The scaling

adjustment for coefficients a_i and b_i shall be applied before the step of Horner's method where a_i or b_i will be added to the intermediate polynomial evaluation. The scale adjustment shall be equal to the difference in scales between the current coefficient and the previous coefficient.

4. Error Handling

The GIMP correction software shall recognize the following error conditions and respond by posting an Executive Status Buffer message and by disabling the GIMP function from further execution:

o time domain outside of the bounds specified for which the current polynomial coefficients are valid

o overflow of intermediate result in polynomial evaluation (calculation exceeded 36 significant bits)

o generated X or Y correction is out of bounds (result of polynomial evaluation greater than 8 significant bits)

o inability to activate the FOS-unique RTCS containing the generated GIMP corrections

C. GIMP Correction Data Requirements

1. Inputs to the GIMP correction software from stored commanding

o GIMP_FCT_ENA: flag to indicate whether the GIMP correction function of the FOS Housekeeping Processor is enabled (1=enabled, 0=disabled)

o GIMP_CORR_FLG: flag to indicate whether to issue the calculated GIMP corrections (1=issue corrections, 0=do not issue corrections)

o GIMP_COEFF_BUFFER: 9 word buffer which contains the 4 X coefficients, the 4 Y coefficients, and the zero time indicator loaded by the ground. This NSSC-I table shall consist of 9 contiguous 18 bit 2's complement words starting at the NSSC-I symbol of interest YFGIMPCB ("FOS Flight GIMP Coefficient Buffer"). These 9 words shall be as follows:

YFGIMPCB offset (decimal)	description
0	X correction cubic coefficient $* 2^{24}$ (a_3)
1	X correction square coefficient $* 2^{16}$ (a_2)
2	X correction linear coefficient $* 2^{12}$ (a_1)
3	X correction constant coefficient $* 2^{8}$ (a_0)
4	Y correction cubic coefficient $* 2^{24}$ (b_3)
5	Y correction square coefficient $* 2^{16}$ (b_2)
6	Y correction linear coefficient $* 2^{12}$ (b_1)
7	Y correction constant coefficient $* 2^{8}$ (b_0)
8	"zero time" in GIMP_TICKs for which the correction polynomials with these new coefficients should first be evaluated during the next correction cycle; this item must be nonnegative and shall nominally be 0 *

* Note: the zero time indicator is set to an 18 bit 2's complement -1 by the flight software when the buffer has been read, so it also acts as a flag

4

indicating when new coefficients have been loaded

2. Outputs from FOS GIMP AP

o FOS YXDGIMP and YYDGIMP serial magnitude commands containing the generated X and Y deflection corrections via the FOS-unique relative time command sequence GIMP_RTCS; the commands will be separated by 50 milliseconds and shall be followed by a "no operation" command, also with a 50 millisecond timetag

o Executive Status Buffer messages "GIMP_coefficients_expired," "GIMP_computation_overflow," "GIMP_correction_out_of_bounds," and "GIMP_RTCS_activation_error"

III. Proposed Design of NSSC-I Onboard Logic

BEGIN GIMP_CORRECTION

. NOTES:
. 1. the GIMP correction function shall execute every 30 seconds, after
.   parts 1 and 3 of the FOS Housekeeping Processor
. 2. a GIMP_TICK is defined as 15 seconds
. 3. a correction cycle is defined as an execution of the FOS Housekeeping
.   Processor during which deflection corrections may be generated and sent
.   to the FOS
. 4. in data descriptions, X(n) means X is an array of n words;
.   X [n] means X has a default value of n
. 5. the coefficients of the curve fit polynomials are 18 bit, 2's complement
.   integers and are scaled as follows:
.
.   cubic coefficient: least sig. bit = 2^{-24} (deflection steps)/(GIMP_TICK)^3
.   square coefficient: least sig. bit = 2^{-16} (deflection steps)/(GIMP_TICK)^2
.   linear coefficient: least sig. bit = 2^{-12} (deflection steps)/(GIMP_TICK)
.   constant coefficient: least sig. bit = 2^{-8} deflection steps
.
. 6. rounding performed during evaluation of the polynomials is to the
.   nearest whole number; e.g. round(8.2)=8, round(4.7)=5, round(-3.8)=-4,
.   round(-7.1)=-7 .

DATA LOCAL
    CURR_GIMP_COEFFS(8) - 8 word array which contains the coefficients
        currently being used to calculate the X and Y deflection corrections
    GIMP_COEFF_BUFFER(9) - 9 word buffer which contains the 4 X coefficients,
        the 4 Y coefficients, and the zero time indicator loaded by the ground;
        the zero time indicator contains the value in GIMP_TICKs for which the
        correction polynomials with these new coefficients should first be
        evaluated during the next correction cycle (nominally 0); the zero
        time indicator is set to an 18 bit 2's complement -1 by the flight
        software when the buffer has been read, so it also acts as a flag
        indicating when new coefficients have been loaded
    GIMP_CORR_FLG [1] - flag to indicate whether to issue the calculated GIMP
        corrections (1=issue corrections, 0=do not issue corrections)
    GIMP_CORR_INT [2] - interval in GIMP_TICKs between correction cycles
    GIMP_CORR_MAX [127] - maximum X or Y correction which may be sent to the
        FOS in a YXDGIMP or YYDGIMP command (8 bit, 2's complement output)
    GIMP_CORR_MIN [-128] - minimum X or Y correction which may be sent to the
        FOS in a YXDGIMP or YYDGIMP command (8 bit, 2's complement output)
    GIMP_DOMAIN_MAX [120] - maximum number of GIMP_TICKs for which GIMP
        polynomials are valid (default 120 GIMP_TICKs, or 30 minutes)

5

GIMP_DOMAIN_MIN [0] - minimum number of GIMP_TICKs for which GIMP
    polynomials are valid (default 0 GIMP_TICKs, or 0 seconds)
GIMP_FCT_ENA [0] - flag to indicate whether GIMP correction function of FOS
    Housekeeping Processor is enabled (1=enabled, 0=disabled)
GIMP_RTCS(9) - FOS-unique relative time command sequence into which
    YXDGIMP, YYDGIMP, and "no operation" commands are built
GIMP_TICK_CTR - counter to maintain domain of inputs for GIMP polynomials
    in units of 15 second "ticks"; must be in the domain of GIMP_DOMAIN_MIN
    to GIMP_DOMAIN_MAX
NUM_POLY_COEFFS [4] - the number of coefficients in each of the X and Y
    correction polynomials (polynomial order + 1)
SCALE_ADJUST(5) - array containing binary scaling adjustments to be applied
    at each step in the evaluation of the correction polynomials and to the
    result; the scale adjustment represents the power of 2 by which the
    item of interest is to be multiplied; SCALE_ADJUST is composed of the
    following 5 elements:
    ADJ_CUBIC [0]: scale adjustment applied before cubic coefficient added
        to intermediate Horner sum
    ADJ_SQUARE [-8]: scale adjustment applied before square coefficient
        added to intermediate Horner sum; equal to the difference between
        scales of square and cubic coefficients
    ADJ_LINEAR [-4]: scale adjustment applied before linear coefficient
        added to intermediate Horner sum; equal to the differences between
        scales of linear and square coefficients
    ADJ_CONSTANT [-4]: scale adjustment applied before constant coefficient
        added to intermediate Horner sum; equal to the difference between
        scales of constant and linear coefficients
    ADJ_RESULT [-8]: scale adjustment applied to result of X and Y
        correction polynomial evaluation; equal to the difference between
        scales of final result (least sig. bit = 1 deflection step) and
        constant coefficient
X_EVAL(2) - temporary storage used in double precision calculation of X
    correction; X_EVAL(1) contains the low order bits and X_EVAL(2)
    contains the high order bits
X_GIMP_CORR - contains calculated X deflection correction
Y_EVAL(2) - temporary storage used in double precision calculation of Y
    correction; Y_EVAL(1) contains the low order bits and Y_EVAL(2)
    contains the high order bits
Y_GIMP_CORR - contains calculated Y deflection correction
ENDDATA

IF (GIMP_FCT_ENA .EQ. 1) THEN   . is GIMP function enabled?

    IF (GIMP_COEFF_BUFFER(9) .GE. 0) THEN   . a new table of coefficients has
                                             . been loaded since the last
                                             . correction cycle

        GIMP_TICK_CTR = GIMP_COEFF_BUFFER(9)   . save new "zero time" received
        DO LOOP = 1, 8   . copy new coefficients to current coefficients
            CURR_GIMP_COEFFS(LOOP) = GIMP_COEFF_BUFFER(LOOP)
        ENDDO
        GIMP_COEFF_BUFFER(9) = -1   . indicate buffer has been unloaded

    ELSE
        GIMP_TICK_CTR = GIMP_TICK_CTR + GIMP_CORR_INT   . increment domain ctr.
    ENDIF

    IF ((GIMP_TICK_CTR .GE. GIMP_DOMAIN_MIN) .AND.
        (GIMP_TICK_CTR .LE. GIMP_DOMAIN_MAX)) THEN   . still in time domain for

. which current coefficients valid

. evaluate X and Y correction polynomials using Horner's method

```
X_EVAL = 0
Y_EVAL = 0
DO LOOP = 1, NUM_POLY_COEFFS
   X_EVAL = shift(round(X_EVAL * GIMP_TICK_CTR), SCALE_ADJUST(LOOP))
             + CURR_GIMP_COEFFS(LOOP)
   Y_EVAL = shift(round(Y_EVAL * GIMP_TICK_CTR), SCALE_ADJUST(LOOP))
             + CURR_GIMP_COEFFS(LOOP + NUM_POLY_COEFFS)
ENDDO

IF (arithmetic_overflow .OR. significant_bits_in_high_order_words) THEN
   . NOTE:  overflow indicator will latch if set during calculation

   make_ESB_entry(MSG=GIMP_computation_overflow, PARM=GIMP_TICK_CTR)
   GIMP_FCT_ENA = 0    . disable GIMP correction function

ELSE

   X_GIMP_CORR =  shift(round(X_EVAL(1)), ADJ_RESULT)
   Y_GIMP_CORR =  shift(round(Y_EVAL(1)), ADJ_RESULT)

   IF ((X_GIMP_CORR .GE. GIMP_CORR_MIN) .AND.
      (X_GIMP_CORR .LE. GIMP_CORR_MAX) .AND.
      (Y_GIMP_CORR .GE. GIMP_CORR_MIN) .AND.
      (Y_GIMP_CORR .LE. GIMP_CORR_MAX)) THEN

      IF (GIMP_CORR_FLG .EQ. 1) THEN   . commanding corrections permitted

         build_YXDGIMP_and_YYDGIMP_commands
         activate_GIMP_RTCS

         IF RTCS_activation_error THEN
            make_ESB_entry(MSG=GIMP_RTCS_activation_error,
               PARM=GIMP_TICK_CTR)
            GIMP_FCT_ENA = 0    . disable GIMP correction function
         ENDIF

      ENDIF

   ELSE
      make_ESB_entry(MSG=GIMP_correction_out_of_bounds,
         PARM=GIMP_TICK_CTR)
      GIMP_FCT_ENA = 0    . disable GIMP correction function
   ENDIF

ENDIF

ELSE    . new coefficients not loaded in time
   make_ESB_entry(MSG=GIMP_coefficients_expired, PARM=GIMP_TICK_CTR)
   GIMP_FCT_ENA = 0    . disable GIMP correction function
ENDIF

ENDIF

END GIMP_CORRECTION
```

7

IV. Operational Usage of FOS GIMP_PROCESSOR

A. Setup

o load GIMP_COEFF_BUFFER
o load GIMP_FCT_ENA with 1 to enable GIMP correction function of FOS
Housekeeping Processor

B. Maintenance

o periodically refresh GIMP_COEFF_BUFFER: 4 X and 4 Y coefficients and 1 word
"zero time" indicator needed every 30 minutes   (or every (30 min) * (60
sec/min) * (1 GIMP_TICK/15 sec) = 120 GIMP_TICKs)

o memory load GIMP_CORR_FLG with 0 when it is desired to maintain the
GIMP_TICK counter and calculate corrections but to not issue corrections to
the FOS; memory load GIMP_CORR_FLG with 1 when OK to issue corrections to FOS

C. Cleanup

o load GIMP_FCT_ENA with 0 to disable GIMP correction function of FOS
Housekeeping Processor

D. User Notes

Since GIMP correction is a function of the FOS Housekeeping Processor, GIMP
correction cannot be performed when execution of the Housekeeping Processor is
not enabled. Furthermore, new GIMP polynomial coefficients must be loaded
after a period where the Housekeeping Processor has been inactive since the
counter of GIMP_TICKs which acts as input to the correction polynomials has
not been maintained. This could cause the corrections generated to be out of
sync with those intended.

Similarly, the flag indicating whether to issue the calculated GIMP
corrections to the FOS may be in an unknown state due to safing, with the
potential for not sending corrections when desired.

For these reasons, the GIMP function enabled flag GIMP_FCT_ENA is set to
"disabled" and the issue GIMP correction flag GIMP_CORR_FLG is set to "issue
corrections" upon Housekeeping Processor initialization.

V. Issues

o need FOS-unique RTCS: need to have RTCS index 122 reserved for FOS-unique
RTCS 3 & work NSSC-I FSW mechanism to allow non-contiguous SI-unique RTCS'
o need to avoid FOS S/M command collisions
o FOS-unique RTCS 3 must always stay enabled when the Housekeeping Processor
is active due to the new overlite handling

<u>Version 2 Distribution</u>:

HST Project:
    Liz Citrin
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Code 512:
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REVIEW SUBJECT: **FOS GIMP FSW Reqs.** DATE OF REVIEW: **October 22, 1991**	**FLIGHT SOFTWARE SYSTEMS BRANCH** REVIEW ITEM DISCREPANCY	NUMBER (FOR CODE 512 USE ONLY)
ORIGINATOR:	ORGANIZATION/CODE:	PHONE NO:

SUBJECT OF COMMENT:

DESCRIPTION OF PROBLEM/SUGGESTION:

ORIGINATOR'S RECOMMENDATION:

ACTIONEE'S RESPONSE:

NAME OF ACTIONEE:	SIGNATURE:	DATE:

DISPOSITION

ORIGINATOR	FSSB HST NSSC-I TEAM LEADER
☐ APPROVED ☐ DISAPPROVED	☐ APPROVED ☐ DISAPPROVED

FSSB HST NSSC-I TEAM LEADER:	DATE:

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