

Interpreting GHRIS Target Positioning

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ABSTRACT

Frequently asked questions by GHRIS observers and archival researchers include “Was the target acquired? and, “How well centered was the target in the aperture?” This ISR will address these two questions using specific examples of successful and failed GHRIS acquisitions. Pre-COSTAR and Post-COSTAR acquisitions will be discussed. Included are descriptions of other potential guiding and pointing problems and their effect upon GHRIS science observations.

1. Introduction

The Goddard High Resolution Spectrograph (GHRIS) is a First Generation *HST* Science Instrument (SI). It has flown from launch (16-April-1990) until its removal from *HST* during the Second Servicing Mission (February 1997). The GHRIS has two Digicon detectors with independent optical paths, designated Side 1 (D1) and Side 2 (D2). The Digicons operate by accelerating photoelectrons emitted by a photocathode onto a linear array of 512 diodes. The GHRIS has two science apertures, designated Large Science Aperture (LSA or 2.0) and the Small Science Aperture (SSA or 0.25). The 2.0 and 0.25 designations are the pre-COSTAR size of the apertures in arcseconds. The post-COSTAR size of the LSA is 1.74 arcsec square and the SSA is 0.22 arcsec square. The separation of the two apertures are approximately 3.7 arcsec on the sky and 1.05 mm on the slit plate. A Small Angle Maneuver (SAM) is performed to move a target from the LSA to the SSA. The LSA has a shutter to block light from entering the spectrograph, while the SSA is always open. Because of this, scattered light from a target in the SSA can contaminate a wavelength calibration exposure (wavecal). See the *Instrument Handbook for the Goddard High Resolution Spectrograph* for a more detailed description of the operation of the GHR.

2. GHRIS Acquisition

The majority of GHRIS targets are point sources (stars) and are acquired with the normal ACQ target acquisition mode. Other types of targets are acquired either by blind

offsetting from a nearby star, with an FOS acquisition, or offsetting from coordinates determined from a WFPC2 image. FOS acquisitions and WFPC2 offsets are discussed in the *Instrument Handbook for the Goddard High Resolution Spectrograph*. The LSA is larger than the GHRS PSF, and using a blind offset to position a target into the LSA may introduce a wavelength shift in the data.

Acquisition of a target with the GHRS is called an Onboard Acquisition; LSA ACQ, LSA ACQ/PEAKUP, or SSA ACQ/PEAKUP. A target is positioned in an aperture and the flux in the aperture is measured with 8 diodes. All targets are first acquired using the LSA because the SSA is too small to enable the field of view to be mapped effectively. A small angle maneuver (SAM) is executed to slew the telescope to move a target from the LSA into the SSA, followed by a SSA ACQ/PEAKUP. Each OnBoard Acquisition is preceded by a DEFCAL observation. The LSA ACQ has a Target Search and Locate phases. There are 6 steps.

- 1) DEFCAL
Target Search
- 2) 3×3 (or 5×5) spiral search.
- 3) Return pointing to dwell scan position with maximum counts.
Locate
- 4) Y balance
- 5) Coarse X balance.
- 6) Fine X balance.

A DEFCAL observation is an internal calibration observation obtained using the calibration lamps to locate the spectrum on the photocathode. The location of the spectrum on the photocathode will have a thermal and geomagnetic dependence. The spectrum is not saved, but the location of the spectrum on the photocathode is compared to coordinates stored in the onboard data base. An offset is determined and used by the onboard computer during the subsequent Search and Locate phases of the LSA ACQ. A DEFCAL observation only has a header with no science data.

The telescope is slewed in a spiral search pattern. At each dwell point, the flux in the aperture is measured. The target is assumed to be somewhere within the LSA 3×3 (or 5×5) spiral search pattern. The separation between dwell points during the LSA search is 1.52 arcsec on the sky, while for an SSA ACQ/PEAKUP 5×5 spiral search, the separation is 0.052 arcsec. Figure 1 displays normal LSA 3×3 and SSA 5×5 spiral search patterns (from OMS jitter files). The spiral searches are plotted in V2,V3 space.

For most LSA acquisitions, the BRIGHT=RETURN (RTB) was specified. This feature will automatically return the spacecraft pointing to the dwell position with the most counts in the aperture. A 32-bit onboard register is used to store the measured counts. For

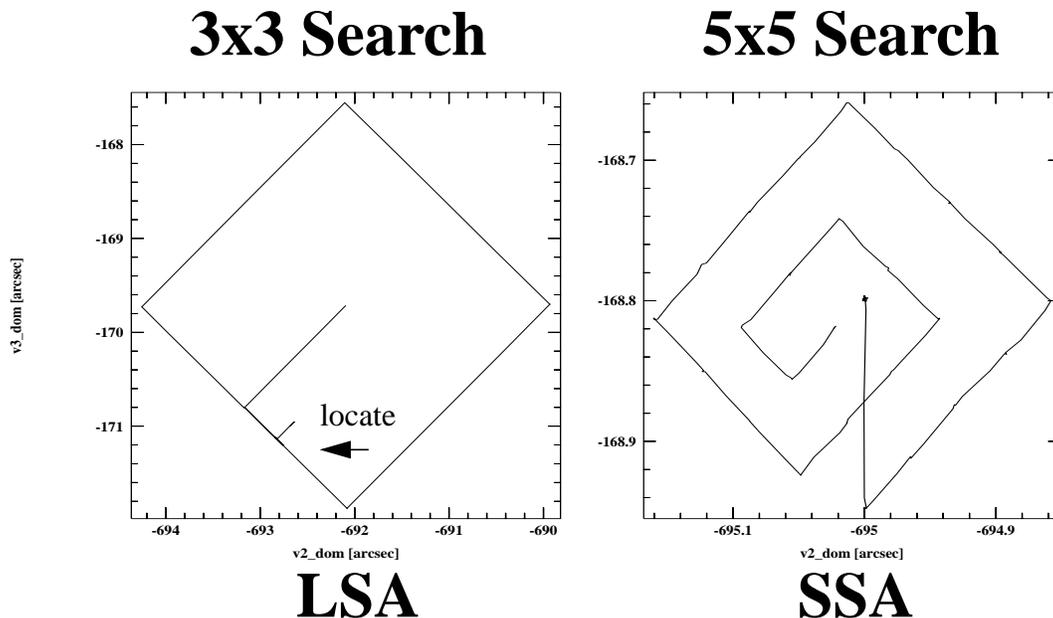
crowded fields, the PI may have specified a BRIGHT and FAINT limit for the spiral search instead of using the RTB. For this case, a 16-bit register is used to store the measured counts and wrapping of the counter may result if a diode exceeds 65,000 counts. The spacecraft pointing returns to the dwell position that has the requested flux. If no dwell position was found to meet the requirements, the spacecraft pointing remains at the last position.

The last stages are Y balance, coarse X balance, and fine X balance. This process determines the location of the target in the aperture, and commands the telescope to slew to position the target in the center of the aperture. The Y balance routine compares the counts in the upper and lower half of the aperture and uses single step offsets to find the optimum centering of the target. The X balance algorithm computes a coarse offset to place the peak of the target on one of the two center acquisition diodes. The peak is then single stepped toward the other center diode until the peak count is sensed on the second diode. Offsets in Y and X are computed and used to slew the telescope. The flux is measured after the completion of the locate phase.

The flux measurement at the end of the LSA target acquisition is written to the Unique Data Log, extensions.uld and.ulh. The UDL contains the command values for the observation as well as some observational data produced by the flight software. Executing the following IRAF command returns the flux value:

```
> hedit z2il0102t.ulh zfluxm .
z2il0102t.ulh,ZFLUXM = 16092
```

Figure 1: Normal LSA 3x3 and SSA 5x5 spiral search patterns (OMS Obs Logs)



A small angle maneuver is performed to move the target to the SSA. The LSA shutter is closed when the SSA is used. An SSA ACQ/PEAKUP is used to perform the centering in the SSA. In practice, the SSA ACQ/PEAKUP is identical to the LSA RTB except the SSA is used and the Locate balance phases are not performed. The pointing is returned to the dwell position with the most counts. For the SSA example in Figure 1, the target was found at the first dwell position. The offset in the return path to the first dwell position is due to a velocity aberration correction.

3. Return-to-Brightest

Since April 27, 1993 (SOGS Build 31.1), the Return-to-Brightest record has been extracted from the embedded engineering and written to the PODPS (now OPUS) processing history trailer file, extension .trl. The trailer file is ASCII and can be displayed to the screen. Position 00 in the Return-to-Brightest record is the center of the spiral search, dwell position 1. For the following example, the target was found at dwell position 6.

```
> page z2il0102t.trl
CTRAIL----Return to Brightest Record found----
CTRAIL-FOV Flux: 00: 35 01: 5 02: 3
CTRAIL-FOV Flux: 03: 11 04: 87 05: 1462
CTRAIL-FOV Flux: 06: 278 07: 31 08: 7
CTRAIL-Max ZFKSLEW = 5; Max FOV Flux = 1462
```

In addition, the OPUS pipeline will format the Return-to-Brightest Record into a pseudo-image, extensions .d1d and .d1h. This pseudo-image can be displayed using SAOIMAGE.

```
> display z2il0102t.d1h 1 z1=0 z2=1600 zr- zs-
```

Figure 2 shows examples of contour plots for two LSA ACQ .d1h/.d1d pseudo-images. The target was found at the first dwell position for the first example, while for the second example, the target was found at dwell position 6. For both examples, the spacecraft pointing was returned to the dwell position with the maximum flux.

During the spiral search, the telescope slews are parallel to the GHRIS X and Y detector coordinates. The first slew in the sequence is in the positive X direction. The next slew is in the negative Y direction, followed by a slew in the negative X direction. All subsequent slews are performed to complete the spiral pattern. Figure 3 displays the spiral search geometry and the corresponding detected counts at each dwell position for the two LSA ACQs presented in Figure 2. Figure 4 displays two examples of the SSA 5×5 spiral search. The upper search pattern found the target (a Cepheid binary star) at dwell position 1. The lower search pattern found the target (a B0-B2III-I star) on the edge of the spiral

pattern at position 19. The spectra for this program were OK, indicating the target was found and subsequently moved to the center of the aperture.

Figure 2: Examples of LSA 3x3 spiral search contour plots.

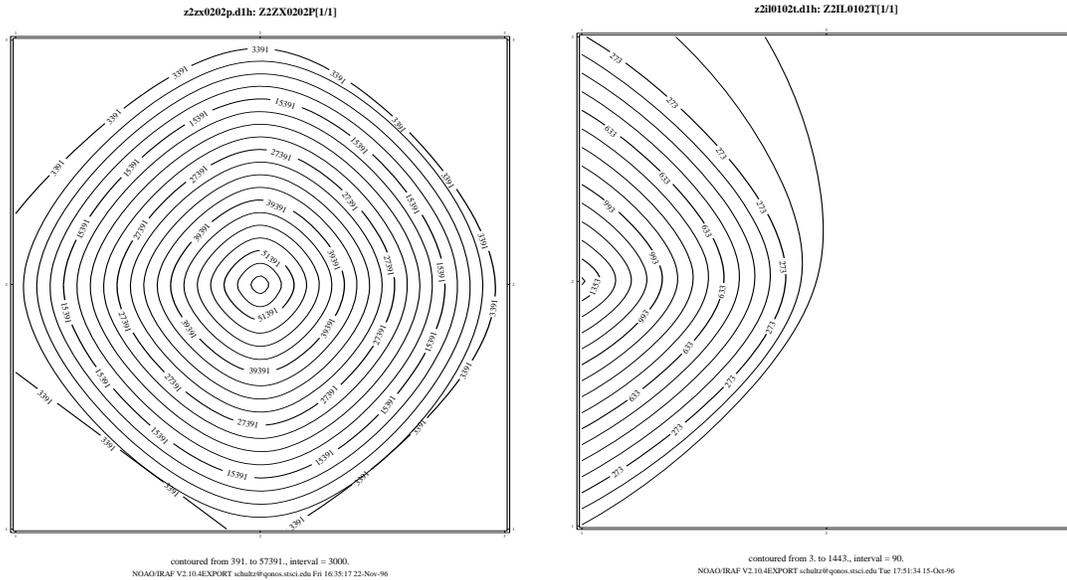


Figure 3: Examples of LSA 3x3 Spiral Search Patterns in Aperture Space (X and Y)

dwell positions			detected counts		
7	8	9	391	1421	725
6	1	2	4618	59488	1158
5	4	3	1197	3739	476
7	8	9	278	31	7
6	1	2	1462	35	5
5	4	3	87	11	3

4. Initial Pointing & The Fine Guidance Sensors

The GHRS has very small apertures and fields of view. The COSTAR optics decreased the projected sizes of the apertures. The target coordinates are required to have an accuracy of 1 arcsecond for acquisition with the LSA, and have to be in the coordinate system of the Guide Star Catalog (GSC). Bright stars represent an exception to the rule and Hip-

Figure 4: Examples of SSA 5x5 Spiral Search Patterns in Aperture Space (X and Y)

dwell positions					detected counts				
21	22	23	24	25	481	956	1211	1095	643
20	7	8	9	10	1384	3312	3242	2746	803
19	6	1	2	11	2701	5246	5366	4974	1036
18	5	4	3	12	2707	4993	5104	4827	950
17	16	15	14	13	2311	4300	4391	4108	673
21	22	23	24	25	49	12	3	4	2
20	7	8	9	10	516	45	20	23	3
19	6	1	2	11	1202	146	22	7	4
18	5	4	3	12	1187	162	64	13	7
17	16	15	14	13	673	158	37	14	7

parcos Input Catalogue coordinates are used. High proper motion stars require specification of proper motion and parallax. All coordinates should have been specified in equinox J2000. The scheduling software will precess the coordinates of a target from J2000 and the stated epoch to the date and time of the observation. It is the responsibility of the observer to provide accurate coordinates.

All GHRIS observations will be scheduled with FINE LOCK guiding, which may be one or two guide stars (dominant and roll). The spacecraft may roll slightly during an observation if only one guide star is acquired. The amount of roll depends upon the gyro drift at the time of the observation, the location during an orbit, and the lever arm from the guide star to the center of the aperture. Usually, two guide stars are used to stabilize the pointing of the telescope. A specific pair of guide stars are selected at the time the observations are scheduled. The guide stars are chosen from the GSC. The uncertainty of the relative positions of the guide stars in the GSC is 0.33 arcsec (1 sigma) in the northern sky and 0.5 arcsec in the southern sky.

If a target is not in the aperture, the acquisition may fail and generate an error message, a Status Buffer Message. Or, the acquisition software may center up on noise or a background object. All of the Flight Software Status Messages have their corresponding numbers placed into the keyword FINCODE. The FINCODE value for each data group are stored in the UDL (.uld/.ulh) file. The STSDAS task **obsum** can be used to display the individual group FINCODE values. The FINCODE value of the last data group is extracted and written to the science header (.d0d/.d0h). FINCODE=102 is a normal end of an observation. Any other value of the keyword indicates a possible problem. The GHRIS FINCODE values found in the *HST* Archive are listed in Table 1.

Table 1. The values for the GHRS keyword FINCODE found in the *HST* Archive.

FINCODE	Explanation	Action
15	X-null balance coarse steps exceeded	Usually benign
16	X-null balance fine steps exceeded	Usually benign
20	Number of correction slews exceeded	Usually benign
101	Beginning of observation	-
102	Normal end of observation	-
104	Observation ends due to over exposure	Shorten exposure?
105	Observation ended due to bad data	Shorten exposure?
106	GHRS observation timed out	Shorten exposure?

5. OMS Products & Guiding

The guide stars used for pointing control during an observation can be found in the Observatory Management System (OMS) observation log header and in the SHP (.shd/.shh) header file. The OMS data header file (.cmh or .jih) contains information about the observation. The header is divided into groups of keywords that deal with a particular topic (i.e., SPACECRAFT DATA, BACKGROUND LIGHT, POINTING CONTROL DATA, LINE OF SIGHT JITTER SUMMARY). A description of OMS products can be found in the *HST Data Handbook* and in the *HST Observatory Monitoring System* document. OMS files are provided on the data distribution tape or may be retrieved from the *HST* Archive.

There are three commanded guiding modes: FINE LOCK, FINE LOCK/GYRO, GYRO. If the acquisition of the second guide star fails, the spacecraft guidance may drop from FINE LOCK to FINE LOCK/GYRO or even to GYRO which may result in a target rolling out of an aperture. It must be noted that single guide star guiding is OK. A GHRS target can remain in the SSA even over multi-orbit exposures. The guiding at the time of the observation can be found in the OMS header keyword GUIDEACT.

```
> hedit z2il0102j.cmh guideact .
z2il0102j.cmh, GUIDEACT = "FINE LOCK"
```

The user should check the OMS header keywords to verify that the guiding mode was the one requested. For the archive user, the guiding mode should be checked to verify no changes occurred during the observation. If it is suspected that a target has rolled out of the aperture during an exposure, a quick check of the counts in each group of the raw science data will verify or discount the suspicion.

A type 51 slew is used to track moving targets (planets, satellites, asteroids, comets). Observations are scheduled with FINE LOCK acquisition; i.e., with two or one guide star. Usually, a guide star pair will stay within the pickle during the entire obset. But if two guide stars are not available, a single guide star may be used. This assumes the drift is small and/or the PI states the roll is not important for his/her program. An option during scheduling is to drop from FGS control to GYRO control when the guide stars move out of the pickle. Guide Star handoffs (which are not a simple dropping of the guide stars to GYRO control) will affect the guiding and may be noticeable when the jitter ball is plotted.

6. Tape Recorder #2 Failure

On January 19, 1996, there was a failure in tape recorder #2. This recorder had been used for recording engineering data for subsequent play back to the ground. The failure was permanent. The two remaining tape recorders have continued to be used for science data. A replacement tape recorder will be installed on the spacecraft during the February 1997 *HST* Servicing Mission. Until the replacement tape recorder is installed, engineering data are only obtained during real-time TDRSS availability (typically 80% or so during each orbit). Consequently, there are gaps in the engineering data resulting in gaps in the OMS products.

7. Displaying Spacecraft Motion

IRAF/STSDAS tools are available to read the OMS tables and graphically display the spacecraft motion during an observation. The package of tools to work with tables is called "ttools". For most observers, the .cmi (or .jit) STSDAS table will contain all the information needed to determine if there was motion or jitter during an observation.

```
% cl
> stsdas
> tables
> ttools
```

For example, plotting "v2_dom" versus "v3_dom" will generate a plot that looks like a ball of string, and called the "jitter" ball. While the same plot for a target acquisition will display the spiral search and locate phase that occurred. See Figure 1.

```
> sgraph "z2o40402j.cmi v2_dom v3_dom"
or
> sgraph "z3d50102j.jit v2_dom v3_dom"
```

After entering the plotting command, the command will plot the data in the graphics window and auto scale using the minimum and maximum data values. The plot may be misleading due to the auto scaling of the axis units.

Plot attributes are set by the 'pltpar' and 'axispar' parameter files. The 'pltpar' parameters specify the attributes of plots, while 'axispar' is used to set scaling attributes drawn by IRAF. The user can reset the plotting attributes to default values by using the IRAF task 'unlearn'.

```
> unlearn pltpar
> unlearn axispar
```

Alternately, the plot parameters for both of these files can be set directly:

```
> sgraph "z3d50102j.jit v2_dom v3_dom" wl=xx wr=xx wb=yy
wt=yy
```

Suggestions:

1) Fixing the plotting window attributes will allow the user to scale the plot to the aperture size and to visualize the magnitude of any spacecraft motion during an observation compared to the aperture size.

2) Overplotting two different target acquisition observations will allow the user to visualize how they were performed.

3) Plotting "z_____j.jit seconds v2_dom" can be used to track down the time of a "recentering" event to help figure out which group may have suspect data.

False Problem Indicators:

1) The plot of the "jitter" ball for all orbits may shift its center due to the graphics plotting routine. This may possibly be due to the starting point for each data set and the default plotting attributes.

2) The RMS values for the "jitter" keywords may seem excessively high.

3) The plot of "z_____j.jit seconds v2_dom" will display multiple orbit pointing's and the discontinuities can be misinterpreted as "Recentering" events instead of as earth occultations.

Note: ESB (Engineering Support Branch) upon request will generate the ".jit" table for an observation. Requests should be sent to the STScI "help@stsci.edu"

8. The GHRIS Carrousel

All optical elements, mirrors, gratings, and echelles are mounted on the GHRIS Carrousel. There is only one carrousel, but each Side of the GHRIS has its own drive motors,

control electronics, and encoder readout stations. During the Spring of 1991, Side 1 carousel control electronics developed an intermittent failure. This manifested itself by causing multiple carousel resets and subsequent safings. To correct this failure a back up mode was devised in which GHRIS Side 1 carousel rotations would be done using Side 2 commanding. Normal operations of the carousel requires the following:

- An auto reset is commanded when power is 1st applied which drives the carousel clockwise through its zero point. As the carousel passes through zero a index pulse is generated, thus initializing a fiducial point.
- When the carousel is commanded to a position, the commanded and sensed positions (16 bit encoder digital signal) are compared, based on the magnitude and direction of the error a voltage is applied to the carousel motor. Once the carousel, has been positioned to a point where there is no error (i.e.command = sensed) the fine track flag is set.
- In fine track the carousel motor controller logic uses a 2^{14} sin/cos analog signal. The logic in the firmware attempts to null out any remaining positional error.
- The NSSC-1 GHRIS FSW verifies that the GHRIS has stabilized at the expected position. This is done by 1st verifying the fine track flag is set. The NSSC-1 FSW then compares subsequent values of the sin/cos analog signal until the difference between to concurrent reads fall below a pre-defined threshold.

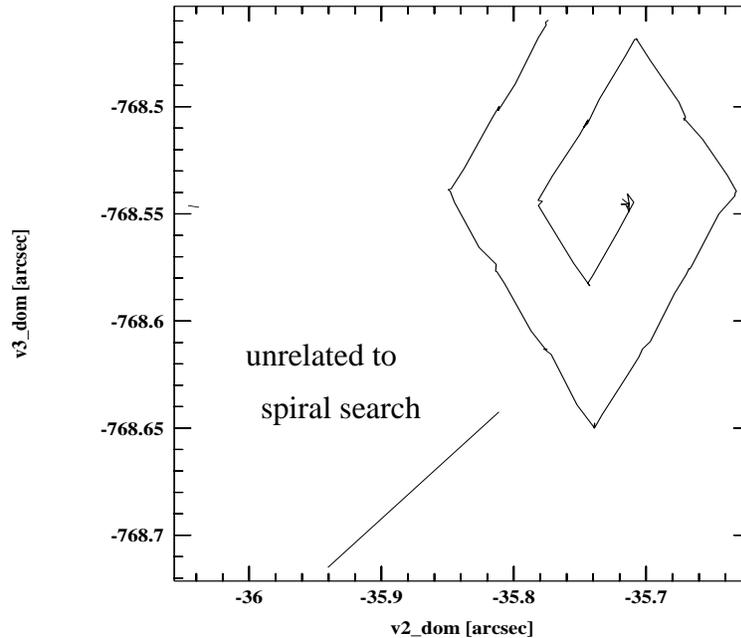
If the null test described above fails to correctly position the carousel, a reset occurs and the carousel returns to the zero point. The process repeats twice to allow the carousel position to be set correctly. A third carousel reset will safe the GHRIS. The GHRIS “time out” is not enforced for target acquisitions. If a target acquisition takes longer than expected to complete due to carousel movement, the following observations may be affected and exposure times shortened (FINCODE=106).

Commanding Side 1 carousel rotation using Side 2 commanding is done exactly as described above except that the Side 2 drive electronics and motor are used to command and verify the rotation. Because the Side 1 carousel encoder is not initialized, the encoder values in the telemetry for Side 1 observations can not be trusted. We have not had any problems with the Side 2 electronics.

Figure 5 shows an example of a SSA ACQ/PEAKUP that started late and completed later than the expected time as specified by the SMS (Science Mission Specification). A guide star reacquisition took longer to complete than normal and there were two loss of locks before the start of the SSA ACQ/PEAKUP 5x5 spiral search. The acquisition did not complete normally. The time window used by OMS to extract the telemetry was for the originally scheduled time. The OMS .jit table contains part of an unrelated slew as well as the start of the spiral search pattern. For this unique case, a request was sent to the STScI help desk (help@stsci.edu) for a new OMS Obs Log. The software engineers determined that the OMS software could not handle this special case, moving the start time of the

observation to extract the spiral search pattern information. OMS software will be modified to handle these special cases. Currently, the anomalous OMS Obs Log is in the archive.

Figure 5: SSA ACQ/PEAKUP started late due to long guide star reacquisition.



9. False Fine Lock

This anomaly is not specific to GHRIS. A False Lock is simply a failure of an FGS (Fine Guidance Sensor) to lock onto the null point of the S-curve for the acquired guide star. Instead, it locks onto noise, onto a fake fine error signal at the edge of the FGS interference field of view, or onto a very weak S-curve. These sources of noise may be influenced by:

- large noise in the FGS of faint stars.
- star fainter than FGS magnitude limit due to magnitude error.
- large star magnitude error of relatively bright star.
- double star.
- mask misalignment.

Figure 1 shows an example of a GHRIS spiral search target acquisition while in a normal Fine Lock condition. The path indicates a very smooth travel during the slewing maneuver. Figure 6, on the other hand, exhibits a very ragged and irregular travel, a False Fine Lock.

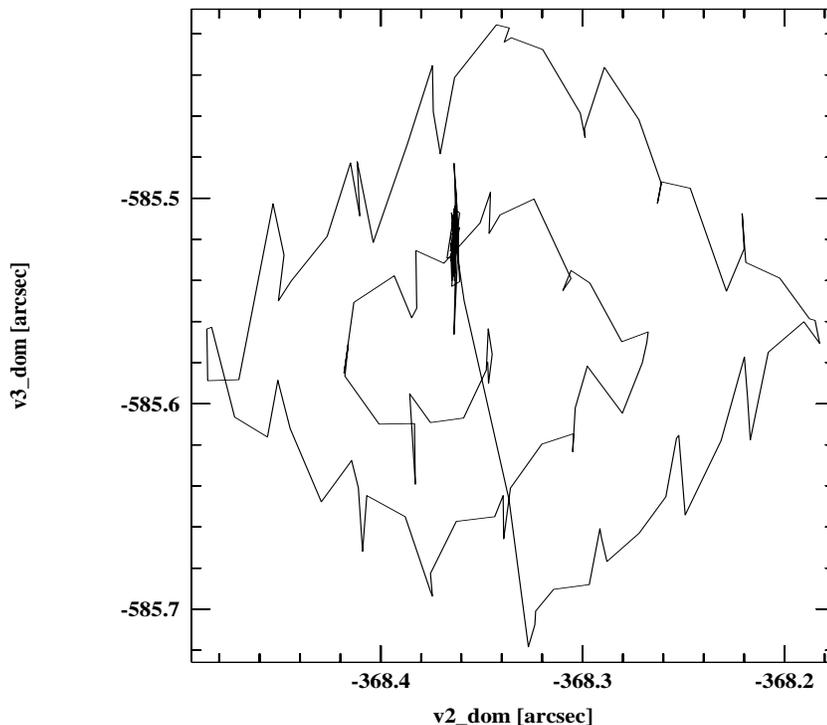
The potential impacts of a False Lock may include...

- prolonged acquisitions.
- loss of lock.
- positioning errors.
- loss of science in subsequent orbits.

It is also possible that a roll in the spacecraft could be introduced causing the target to drift toward the edge of an aperture. Positioning errors, occurring as a result of an undetectable false lock, could result in a misinterpretation of the spacecraft attitude error. When corrected, the end result would be a real *HST* pointing error, virtually impossible to identify without examining the data. However, such errors will not exceed 2.5 arcsec due to the maximum allowed drift. Loss of science in subsequent orbits could occur in cases where a reacquisition results in a good, ‘true’, lock following a false lock orbit. In a case such as this, it is entirely possible that the target would not be found in the aperture upon successful reacquisition.

Prolonged acquisitions could delay subsequent science activities or result in the loss of science altogether. False locks, while possible, are not frequent. During 1995, false locks represented only 0.7% of the total number of acquisitions with *HST*. Unfortunately, however, most of the factors contributing to false locks are not preventable or fixable.

Figure 6: Example of False Fine Lock



10. Loss of Lock

During a Loss of Lock, spacecraft motion can be large (>0.2 arcsec). FGS control of the spacecraft is given up, and the FGSs execute a sequence of maneuvers to re-acquire the guide stars (sort of an on-the-spot guide star re-acquisition). During a loss of lock recovery, the spacecraft Take Data Flag (TDF) is set to No. The function of the TDF is to provide a simple reference for the science instruments to query about the stability of the spacecraft pointing. During a Loss of Lock, the GHRS stops acquiring data, but the LSA shutter does not close. If an observation is taken in the SSA, the LSA shutter is already closed. Once Fine Lock pointing control has been re-established, the TDF is set to Yes.

A loss of lock may not necessarily result in the loss of science if the guide stars can be reacquired and the observation completed before the next scheduled activity. However, this is unlikely for most GHRS observations and a delay will force a time-out to occur for this observation.

11. Suspect Spoiler Guide Stars

The Guides Star Catalogue (GSC) was created with entries down to 15th magnitude from digitized photographic Schmidt plates. Suitable guide stars are selected for each observation by the Guide Star Selection System (GSSS) to be used for fine pointing and guiding of *HST*. Most guide star acquisitions and guiding are successful, $> 98\%$. The dominant source of problems are due to very close binary stars that are unresolved on the Schmidt plate which cause FGS fine lock failures. There are infrequent failures (1-3 a year) due to misclassification of an object in the GSC (blend of two stars or faint circular galaxy).

A spoiler star may result in acquiring the wrong star with the FGS and the target would not be in the aperture due to this mispointing of *HST*. This may also result in a shift in the pointing following a guide star reacquisition when the scheduled star is acquired. The target could roll in and out of the aperture resulting in changes in the counts between observations obtained during different orbits.

The differences between the predicted (PREDGSEP) and the actual (ACTGSSEP) measured separation between Guide Stars can be used to test for a spoiler star. For the following example, the science observation z2zx0207 started with the target in the aperture, was halted for earth occultation, and the observation completed on the following orbit. However, the guide star reacquisition (REACQ) locked up on a spoiler star. The target was not centered in the aperture during the remaining exposure time. Observation z2zx0208 was noise. Observation z2zx0209 was halted for earth occultation and upon the REACQ, the target was moved into the aperture. For this observation, the first part of the exposure resulted in noise, while for the second orbit, the target was in the aperture.

```
> hedit z2zx020*.jih PREDGSEP,ACTGSSEP .
```

```

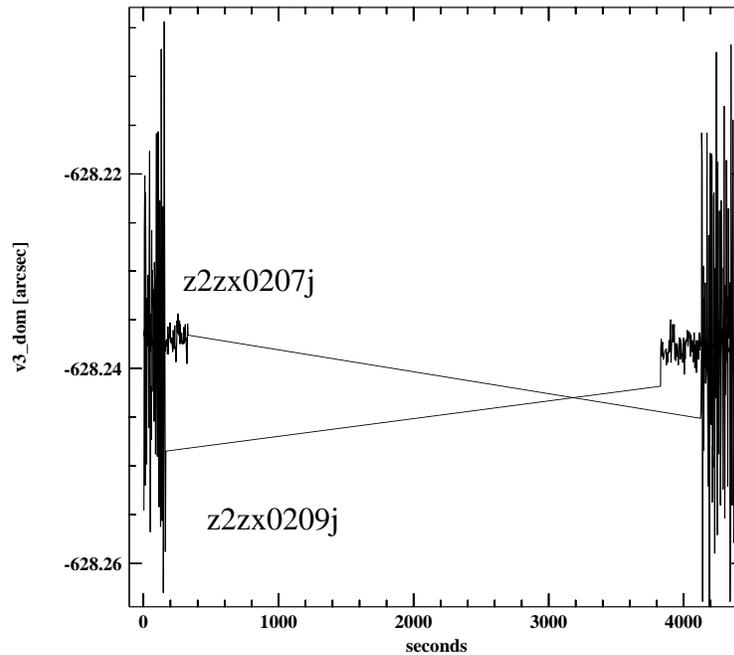
z2zx0204j.jih,PREDGSEP = 1328.046 <-- SSA ACQ/PEAKUP
z2zx0204j.jih,ACTGSSEP = 1326.466
z2zx0205j.jih,PREDGSEP = /          <-- SPYBAL
z2zx0205j.jih,ACTGSSEP = /
z2zx0206j.jih,PREDGSEP = /          <-- WAVECAL
z2zx0206j.jih,ACTGSSEP = /

z2zx0207j.jih,PREDGSEP = 1328.046 <-- first science obs.
z2zx0207j.jih,ACTGSSEP = 1328.019      guide star REACQ
z2zx0208j.jih,PREDGSEP = 1328.046      wrong pointing
z2zx0208j.jih,ACTGSSEP = 1328.019
                                     <-- guide star REACQ
z2zx0209j.jih,PREDGSEP = 1328.046 <-- correct pointing
z2zx0209j.jih,ACTGSSEP = 1326.475

z2zx020aj.jih,PREDGSEP = 1328.046 <-- no further problems

```

Figure 7 presents the overplotting of the pointing for each observation (v2_dom versus seconds). This shows the change in *HST* pointing for this program. An *HST* Observation Problem Report (HOPR) was filed by the PI and the observations repeated using different guide stars.

Figure 7: Jump in HST Pointing due to a Spoiler Guide Star.

12. Recentering Events

During a recentering event, pointing control of the telescope by the Fine Guidance Sensors is paused until the spacecraft motion excursions have become small enough that FGS guiding can be resumed. Recenterings typically last a few seconds, the total spacecraft motion should be less than 0.1-0.2 arcsec, and after the recentering is finished, the pointing position should be the same as before the recentering (to within ~ 7 marcsec).

During a recentering event, the GHRS continues to acquire data. The PI (or archival researcher) is the only one who can determine whether or not a recentering event affected the target acquisition or data. Careful comparison of the time of recentering and the time during which the individual exposures were made can be obtained from the OMS Obs Log. Plotting the OMS “recenter” column vrs “seconds” will indicate whether or not a recentering event occurred. The recentering event may have occurred during a time when data was being read out, in which case there is no problem. If the recentering was short compared to the exposure time of a given group of data, it probably has no effect on the data.

13. Conclusions and Recommendations

OPUS (formerly OSS & PODPS) staff perform a quick Procedural Data Quality Assessment (DQA) evaluation of the target acquisitions and the science observations. This

assessment is performed to identify any target acquisition failures, guide star acquisition failures, other spacecraft anomalies, or instrumental problems. This assessment is recorded in the Data Quality keywords contained in the PDQ (Procedural Data Quality) file. The PDQ files are archived to data class PDQ and can be retrieved from the HST Archive using StarView. OCX files (Observation Support System (OSS) Observer Comment files) contain information about the success or failure of target acquisitions and science observations. Before April 17, 1992, OCX files were not always archived separately and in some cases, were prepended to the RSDP pipeline history file, the .trl trailer file. After February 1995, OCX files were produced only to document Real-Time activity (Interactive Target Acquisition) in support of an observation. After October 1996, OCX files may contain information about observation execution problems.

The PI (and archival researcher) should retrieve the PDQs (and possibly OCX files) from the archive to verify the success or failure of the target acquisitions. Information about PDQ, OCX, and .trl trailer files can be found in the *HST Data Handbook*.

Additional information about the GHRS can be found at the STScI World Wide Web pages accessible from <http://www.stsci.edu/>. At this location, GHRS Advisories, Calibration Resources, and Documents (Instrument Science Reports (ISRs), GHRS Instrument Handbook, HST Data Handbook, and copies of the Space Telescope Analysis Newsletter) can be found. Questions should be sent to the STScI help desk, help@stsci.edu.