SIRTF INSTRUMENT POINTING FRAME KALMAN FILTER EXECUTION SUMMARY

IPF RUN NUMBER: 001095
REPORT TYPE: IOC EXECUTION (COARSE)

PRIME FRAME: MIPS_24um_center (95)
INFERRED FRAMES: (96) (99) (100) (103) (104)

IPF TEAM

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1 IPF EXECUTION SUMMARY

This report summarizes the SIRTF Instrument Pointing Frame (IPF) Kalman Filter execution associated with run file: RN001095. In particular, this Focal Point Survey calibrates the instrument: MIPS_24um_center (95), as part of the IOC Coarse Survey. The main calibration results from the IPF filter execution have been documented in IF001095 typically stored in the mission archive DOM collection IPF_IF. This report only summarizes the main aspects of the run, and does not substitute for the full information contained in the IF file.

Section 1 summarizes the filter execution results. The filter configurations are tabulated in Table 1.2 and the mask vector assignments are tabulated in Table 1.3. A total of 27 state parameters are estimated in this run. The overall End-to-End pointing performances are tabulated in Table 1.4. The prediction residuals throughout the estimation processes are tabulated in Table 1.5. Section 3 summarizes resulting plots, a mini summary of the IF IPF output file, and the execution log. Section 4 captures the user comments that are specific to this particular run.

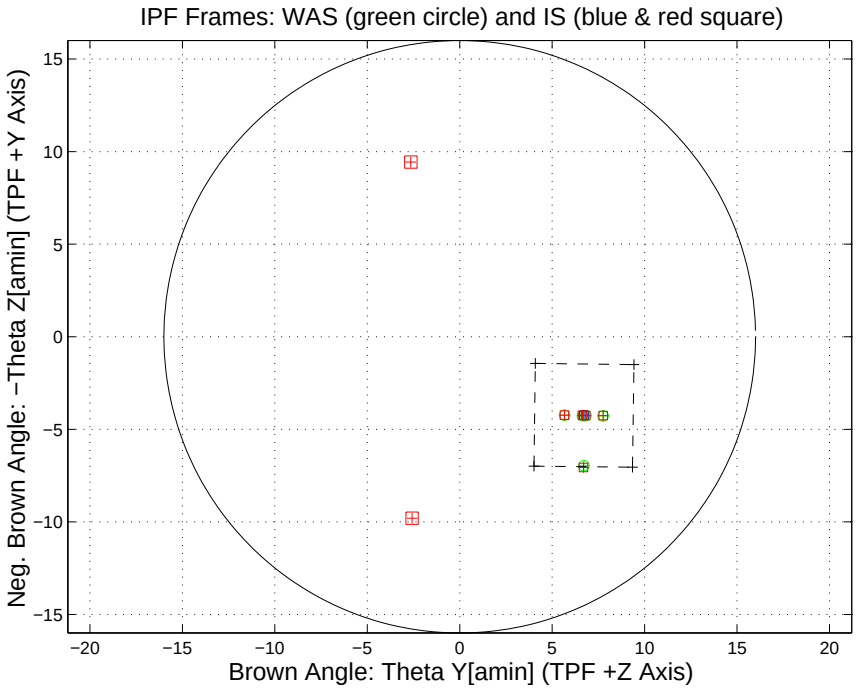

Figure 1.1: A-priori and a-posteriori IPF frames

RAW	FINAL (After Editing)
AA001095	AA001095
AS001095	AS001095
CA003095	CA003095
CB002095	CB002095
CS003095	CS003095

Table 1.1: IPF filter input files

EXECUTION CONFIGURATION ITEM	CURRENT STATUS
IPF Filter Version Used	IPF.V2.0.0D
Frame Table Version Used	BodyFrames_SPC_08a
Scan-Mirror Employed?	YES
IPF Filter Mode	NORMAL-MODE(0)
SLIT-MODE Operation	DISABLED
Kalman Filter Operation	ENABLED
Least-Squares Data Analysis	ENABLED
IBAD Screening	ENABLED
User-Specified Data Editing	DISABLED
Total Number of Iterations	30
LS Residual Sigma Scale	1.05547971E+000
Total Number of Maneuvers	7

Table 1.2: IPF filter execution configuration

Con. Plate Scale			Γ Dependent				Γ^2 Dependent				Linear Plate Scale						Mirror	
a_{00}	b_{00}	c_{00}	a_{10}	b_{10}	c_{10}	d_{10}	a_{20}	b_{20}	c_{20}	d_{20}	a_{01}	b_{01}	c_{01}	d_{01}	e_{01}	f_{01}	α	β
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1
IPF (T)			Alignment R									Gyro Drift Bias						
θ_1	θ_2	θ_3	a_{rx}	a_{ry}	a_{rz}	b_{rx}	b_{ry}	b_{rz}	c_{rx}	c_{ry}	c_{rz}	b_{gx}	b_{gy}	b_{gz}	c_{gx}	c_{gy}	c_{gz}	
20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	
1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1	

Table 1.3: IPF filter execution mask vector assignment

FOCAL PLANE SURVEY ANALYSIS: IOC Coarse Survey.
INSTRUMENT NAME: MIPS_24um_center NF: 95
`PIX2RADW: 1.20874169E-005[rad/pixel] = 2.4932E+000[arcsec/pixel]`
`PIX2RADV: 1.20874169E-005[rad/pixel] = 2.4932E+000[arcsec/pixel]`

FRAME	DESCRIPTION	IPF[1]	SF[2]	TOTAL	REQ
095(P)	MIPS_24um_center	0.0988	0.0855	0.1307	1.00
096(I)	MIPS_24um_plusY_edge	0.1258	0.0855	0.1521	N/A
099(I)	MIPS_24um_small_FOV1	0.1008	0.0855	0.1322	N/A
100(I)	MIPS_24um_small_FOV2	0.0986	0.0855	0.1305	N/A
103(I)	MIPS_24um_large_FOV1	0.0989	0.0855	0.1307	N/A
104(I)	MIPS_24um_large_FOV2	0.0987	0.0855	0.1306	N/A

Table 1.4: IPF calibration error summary ([arcsec], 1-sigma, radial)

RMS METRIC	A PRIORI[3]	A POSTERIORI[3]	ATT. CORRECTED[4]	UNITS
Radial	2.3439	0.3786	0.1557	arcsec
W-Axis	1.3088	0.2156	0.0846	arcsec
V-Axis	1.9445	0.3112	0.1307	arcsec
Radial	0.9401	0.1519	0.0625	pixels
W-Axis	0.5249	0.0865	0.0339	pixels
V-Axis	0.7799	0.1248	0.0524	pixels

Table 1.5: Measurement prediction error summary (1-sigma)

[1]IPF filter removes systematic pointing errors due to: thermomechanical alignment drift (Body to TPF), gyro bias and bias drift, centroiding error, attitude error, and optical distortion. IPF SIGMA presented here is "Scaled" by the Least Squares Scale factor. The Least Squares Scale Factor was: 1.055480. It is assumed that the gyro Angle Random Walk contribution is captured with the Least Squares scaling. The gyro ARW contribution can be approximately calculated as 0.0756 arcseconds, given that ARW = 100 $\mu deg/\sqrt{hr}$, with 5.553000e+002 second Maneuver time (max), and 7 independent Maneuvers.

[2]Gyro Scale Factor(GSF) assumes 95 ppm error over 0.250 degree maneuver.

[3]This can be interpreted as estimate of "pixel to sky" pointing reconstruction error if no science data is used.

[4]This can be interpreted as estimate of achieved S/I centroiding error

IPF BROWN ANGLE SUMMARY					
FRAME TABLE USED: BodyFrames_SPC_08a					
NF	NAME	WAS	IS	CHANGE	UNIT
095	theta_Y	+6.724001	+6.718185	-0.005816	arcmin
095	theta_Z	+4.258239	+4.247276	-0.010963	arcmin
095	angle	+0.577299	+0.638444	+0.061144	deg
096	theta_Y	+6.721218	+6.695268	-0.025950	arcmin
096	theta_Z	+6.970374	+7.063358	+0.092984	arcmin
096	angle	+0.577299	+0.638444	+0.061144	deg
099	theta_Y	+7.758095	+7.758870	+0.000775	arcmin
099	theta_Z	+4.277861	+4.260684	-0.017177	arcmin
099	angle	+0.577299	+0.638444	+0.061144	deg
100	theta_Y	+5.669225	+5.661628	-0.007597	arcmin
100	theta_Z	+4.238226	+4.235185	-0.003040	arcmin
100	angle	+0.577299	+0.638444	+0.061144	deg
103	theta_Y	+6.827410	+6.822038	-0.005373	arcmin
103	theta_Z	+4.260201	+4.248547	-0.011654	arcmin
103	angle	+0.577299	+0.638444	+0.061144	deg
104	theta_Y	+6.641274	+6.635138	-0.006136	arcmin
104	theta_Z	+4.256670	+4.246270	-0.010400	arcmin
104	angle	+0.577299	+0.638444	+0.061144	deg

Table 1.6: IPF Brown angle summary

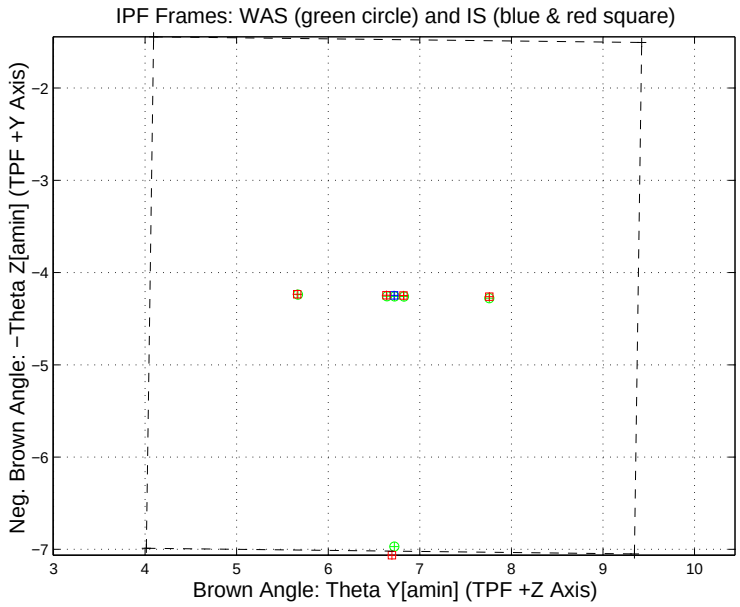

Figure 1.2: A-priori and a-posteriori IPF frames (ZOOMED)

2 IPF INPUT FILE HISTORY

WAS	SIZE	IS	SIZE	REMOVED	PATCHED
AA001095	UNCHANGED	AA001095	UNCHANGED	0	0
CA003095	UNCHANGED	CA003095	UNCHANGED	0	N/A
CB002095	UNCHANGED	CB002095	UNCHANGED	0	N/A

Table 2.1: IPF input file editing status

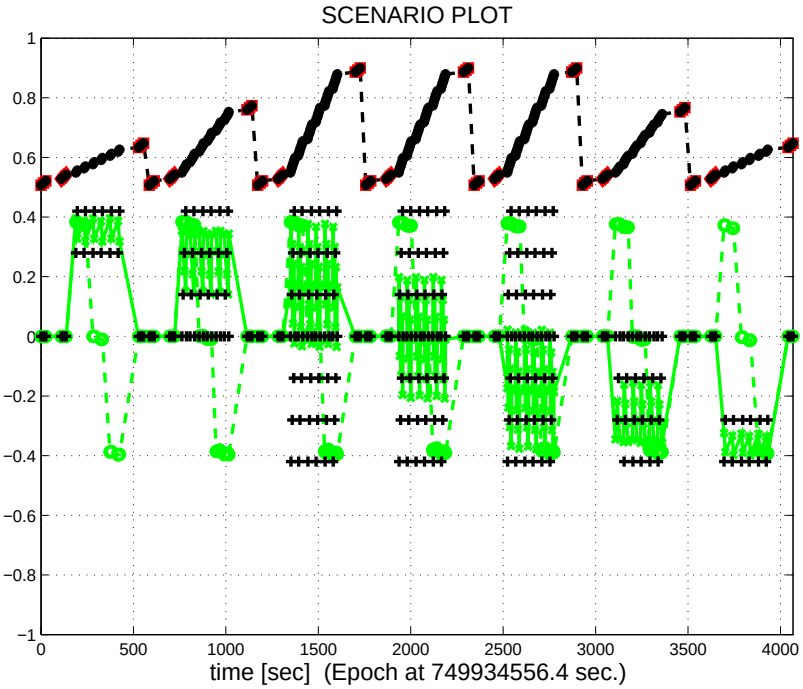

Figure 2.1: Scenario Plot

3 IPF EXECUTION RESULTS

3.1 IPF EXECUTION OUTPUT PLOTS

This subsection summarizes the IPF filter results. As shown in Table 3.1, the output plots are segmented to three groups: predicted performance, post-run results and IPF trending plots.

FIGURE NO.	DESCRIPTION
Predicted performance prior to IPF run	
Figure 3.1	Meas. and a-priori predicts in TPF coords
Figure 3.2	Meas. and a-priori predicts in Oriented Pixel Coords including rectangular array boundary approximation
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Figure 3.4	A-priori prediction error
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Figure 3.7	Oriented (W,V) Pixel Coords of A-Priori PCRS Prediction Error Quiver Plot
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Figure 3.10	IPF execution convergence, chart 2: parameter correction size vs. iteration number
Figure 3.11	Parameter uncertainty convergence: square-root of diagonal elements of covariance matrix vs. maneuver number
Figure 3.12	IPF parameter symbol table
Figure 3.13	KF parameter error sigma plot (a-priori-dashed, a-posteriori-solid). Includes true parameter errors (FLUTE runs only)
Figure 3.14	LS parameter error sigma plot. Includes true parameter errors (FLUTE runs only)
Figure 3.15	KF and LS parameter errors sigma plot (Figure 3.13 & Figure 3.14 combined)
Figure 3.16	Measurements and a-posteriori predicts in Oriented Pixel Coords including rectangular array boundaries (a-priori-dashed, a-posteriori-solid)
Figure 3.17	Attitude corrected meas. and a-posteriori predicts in Oriented Pixel Coords including rectangular array boundaries (a-priori-dashed, a-posteriori-solid)

Table 3.1: Table of figures I (IPF run)

FIGURE NO.	DESCRIPTION
IPF filter performance (post run results) - CONTINUE	
Figure 3.18	KF innovations with (o) and w/o (+) attitude corrections
Figure 3.19	Histograms of science a-posteriori residuals (or innovations)
Figure 3.20	KF innovations with (o) and w/o (+) attitude corrections (PCRS)
Figure 3.21	Histograms of PCRS a-posteriori residuals (or innovations)
Figure 3.22	A-Posteriori Science Centroid Prediction Error Quiver (Att. Cor.)
Figure 3.23	Normalized A-Posteriori Science Centroid Prediction Errors
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Figure 3.28	Array plot with (solid) and w/o (dashed) optical distortion corrections
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Figure 3.30	Optical Distortion Plot: constant plate scales (x5 magnification)
Figure 3.31	Optical Distortion Plot: linear plate scale (x5 magnification)
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Figure 3.38	Systematic error attributed to gyro drift bias (equiv. angle in (W,V) coords)
Figure 3.39	Systematic error attributed to gyro drift bias (equiv. angle in Body frame)

Table 3.2: Table of figures II (IPF run)

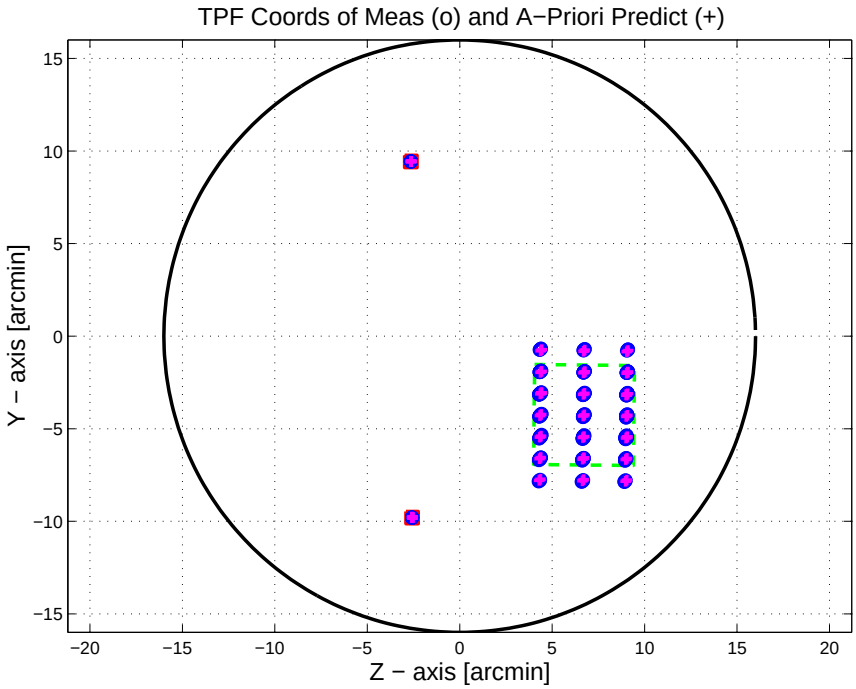

Figure 3.1: TPF coords of measurements and a-priori predicts

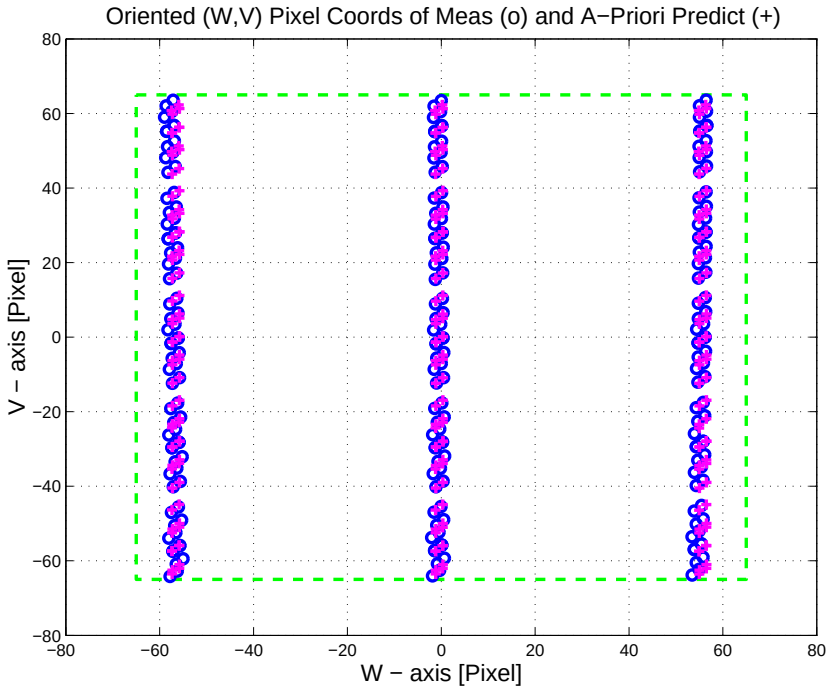

Figure 3.2: Oriented Pixel Coords of measurements and a-priori predicts

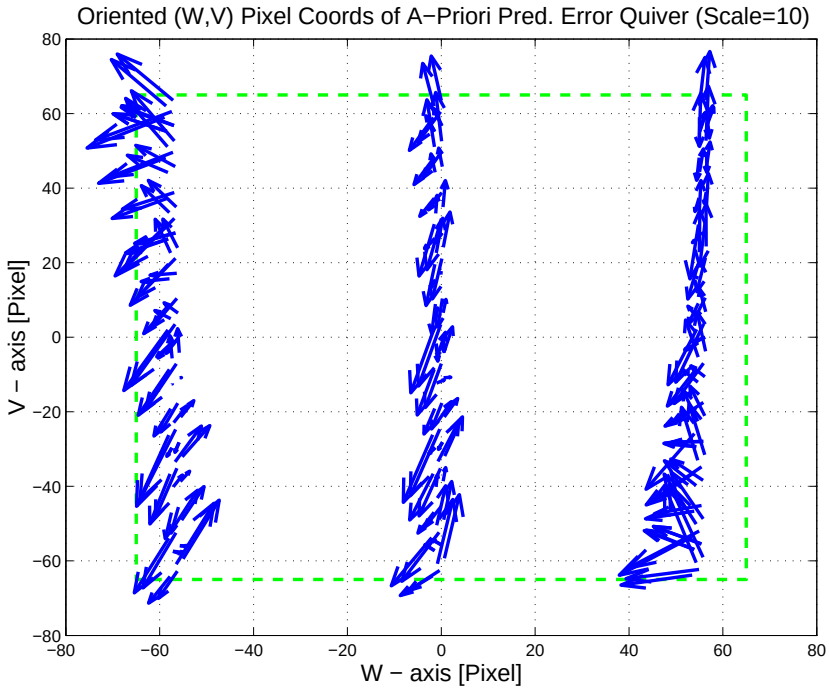

Figure 3.3: Oriented (W,V) Pixel Coords of A-Priori Prediction Error Quiver Plot

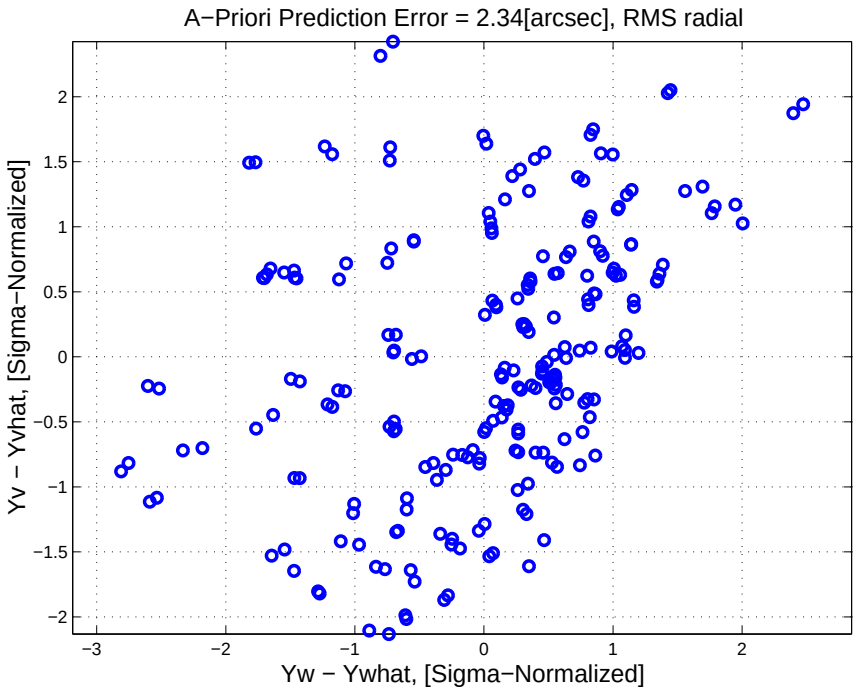

Figure 3.4: A-priori prediction error (Science Centroids)

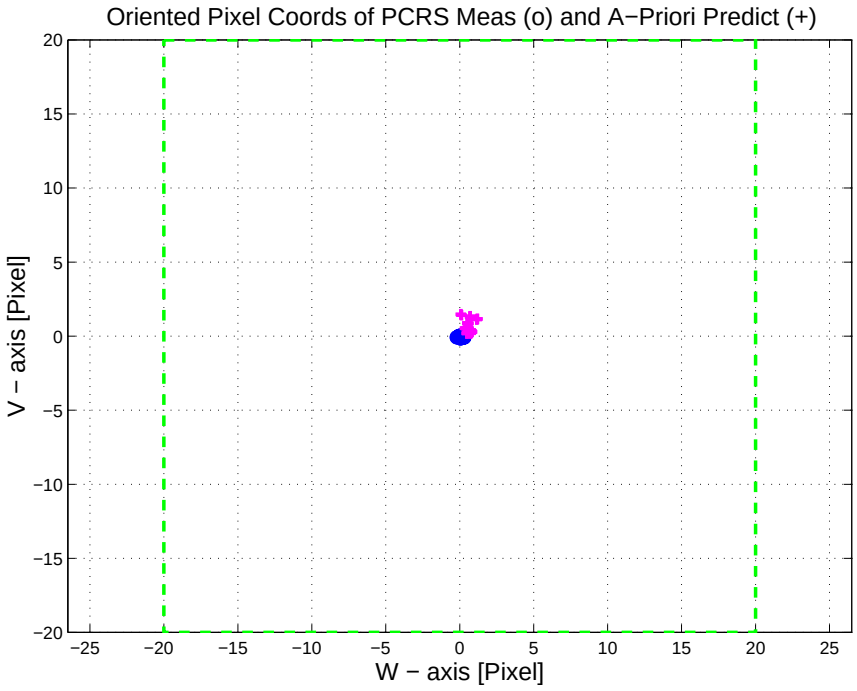

Figure 3.5: Oriented Pixel Coords of measurements and a-priori predicts (PCRS only)

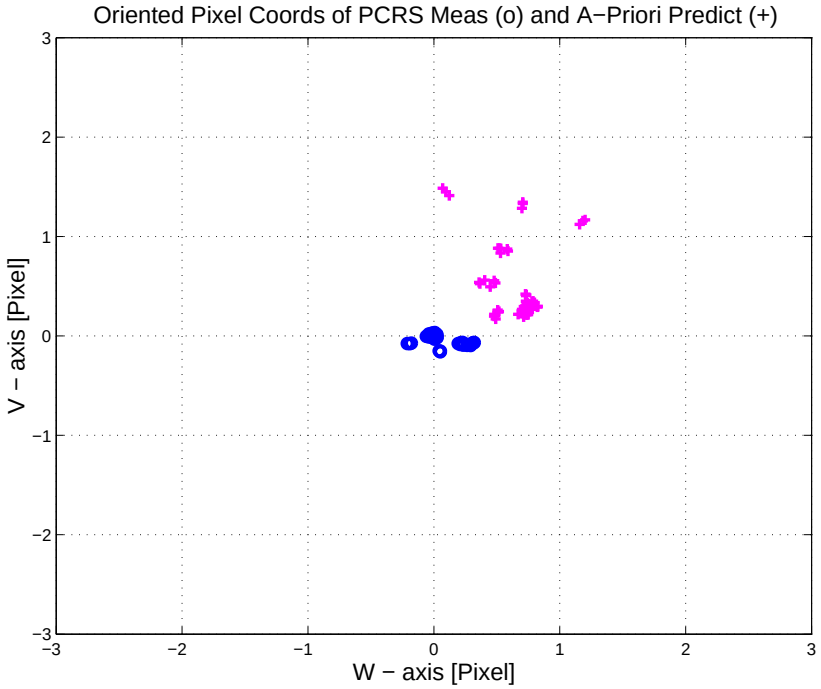

Figure 3.6: Oriented Pixel Coords of measurements and a-priori predicts (Zoomed, PCRS only)

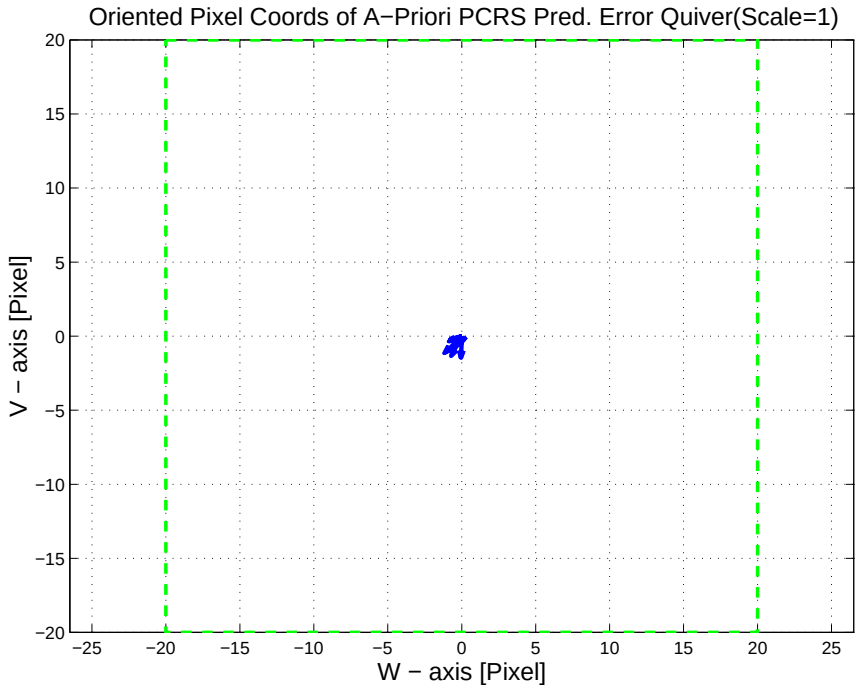

Figure 3.7: Oriented (W,V) Pixel Coords of A-Priori PCRS Prediction Error Quiver Plot

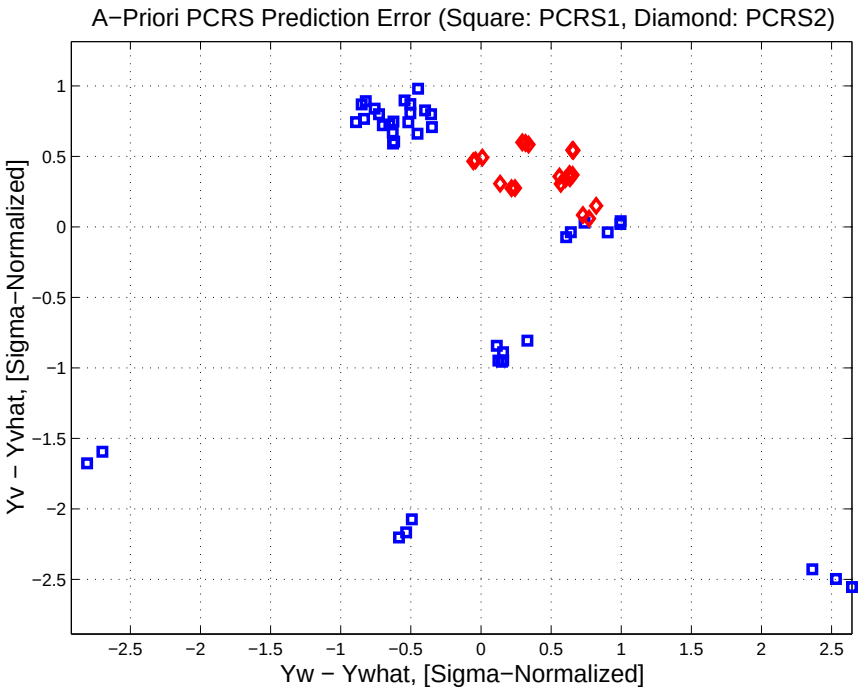

Figure 3.8: A-priori PCRS prediction error

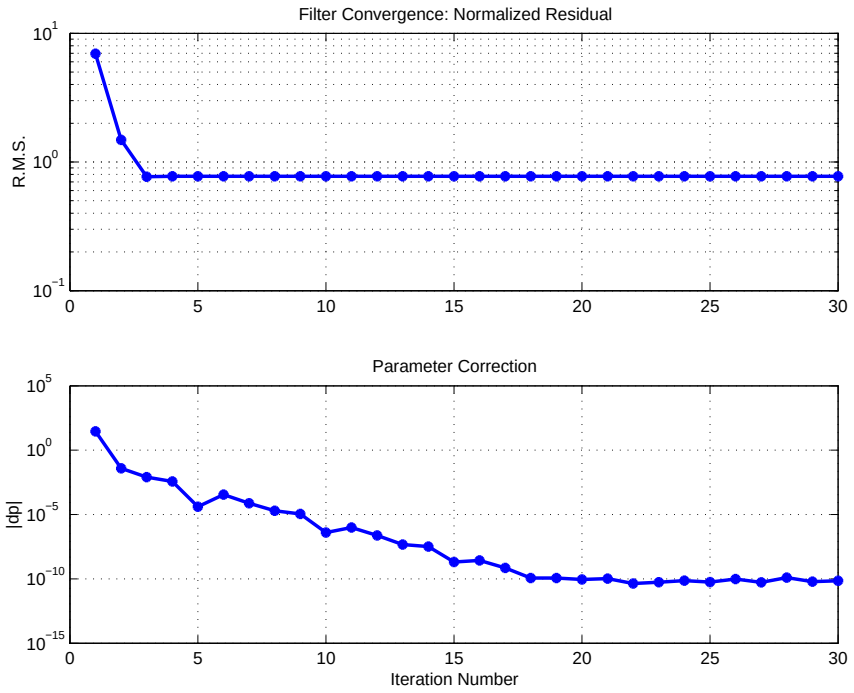

Figure 3.9: IPF execution convergence, chart 1

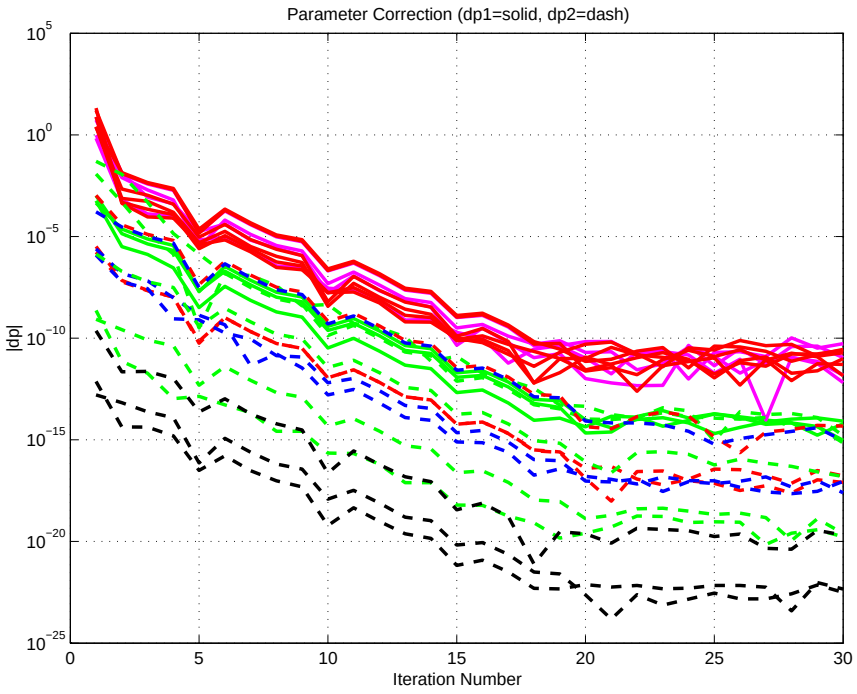

Figure 3.10: IPF execution convergence, chart 2

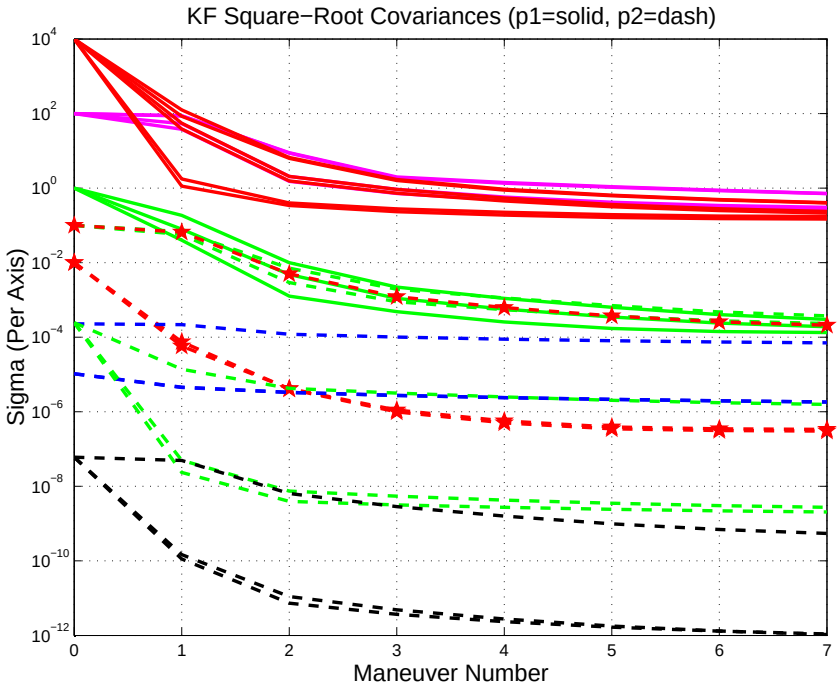

Figure 3.11: Parameter uncertainty convergence

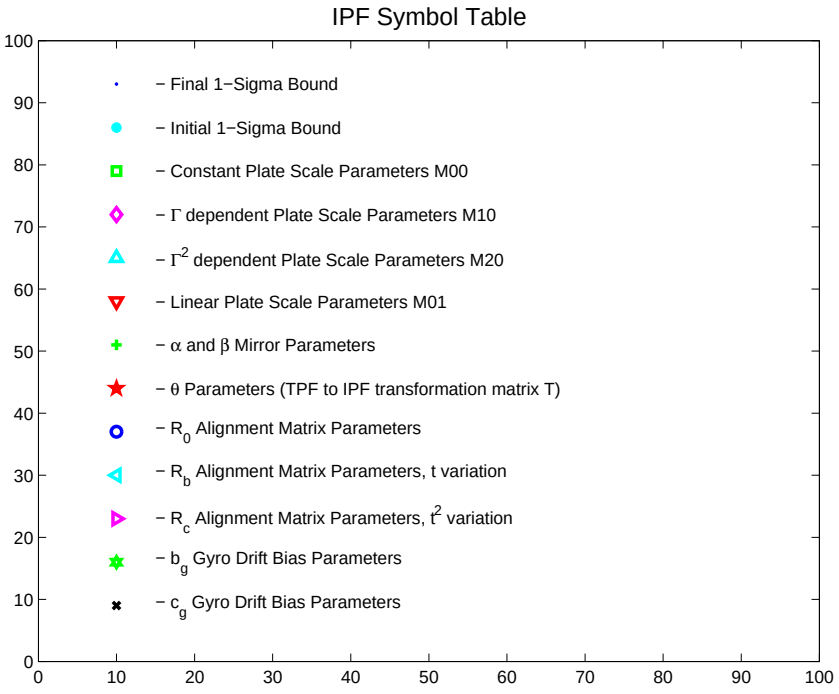

Figure 3.12: IPF parameter symbol table

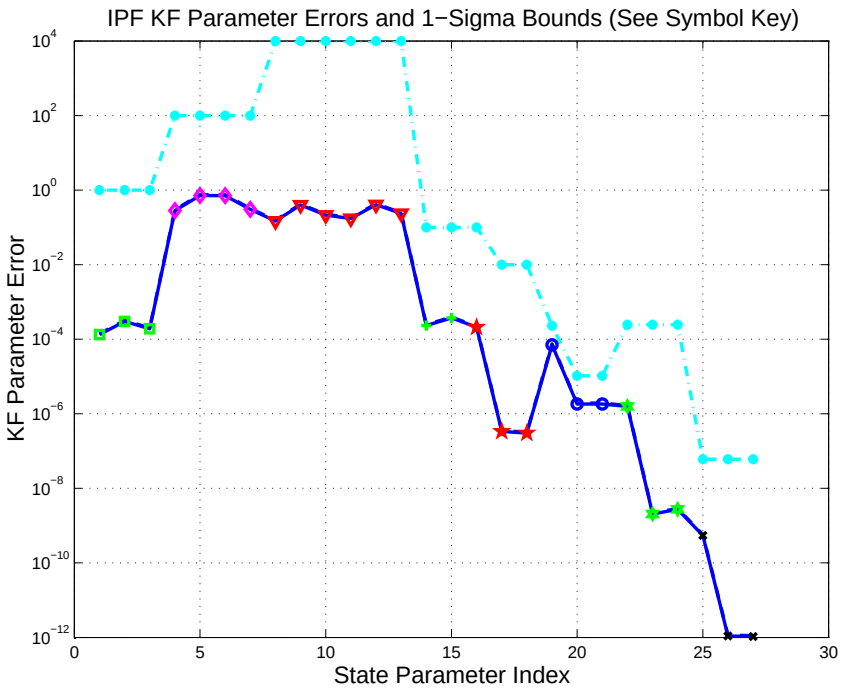

Figure 3.13: KF parameter error sigma plots

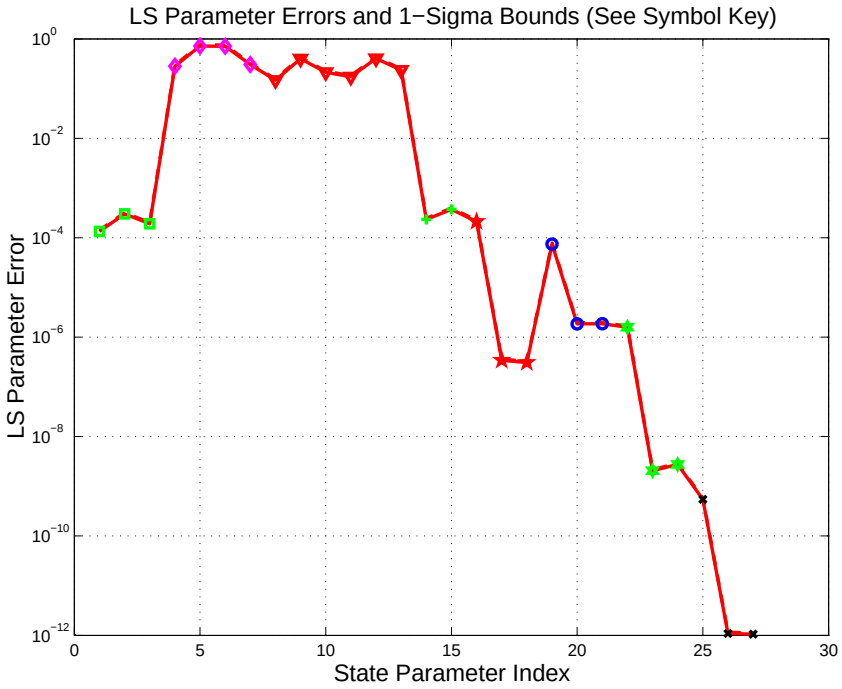

Figure 3.14: LS parameter error sigma plot

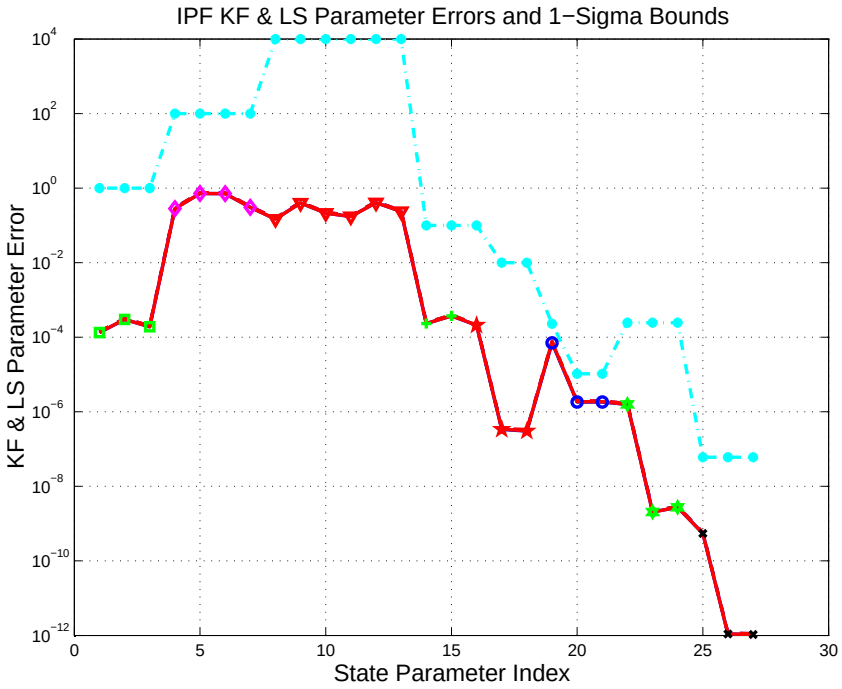

Figure 3.15: KF and LS parameter error sigma plot

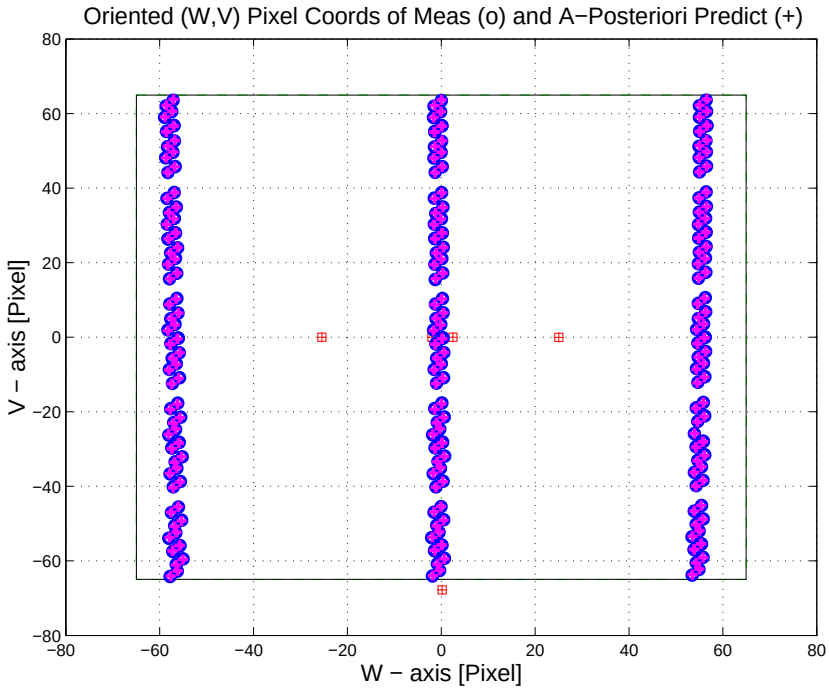

Figure 3.16: Oriented Pixel Coords of meas. and a-posteriori predicts

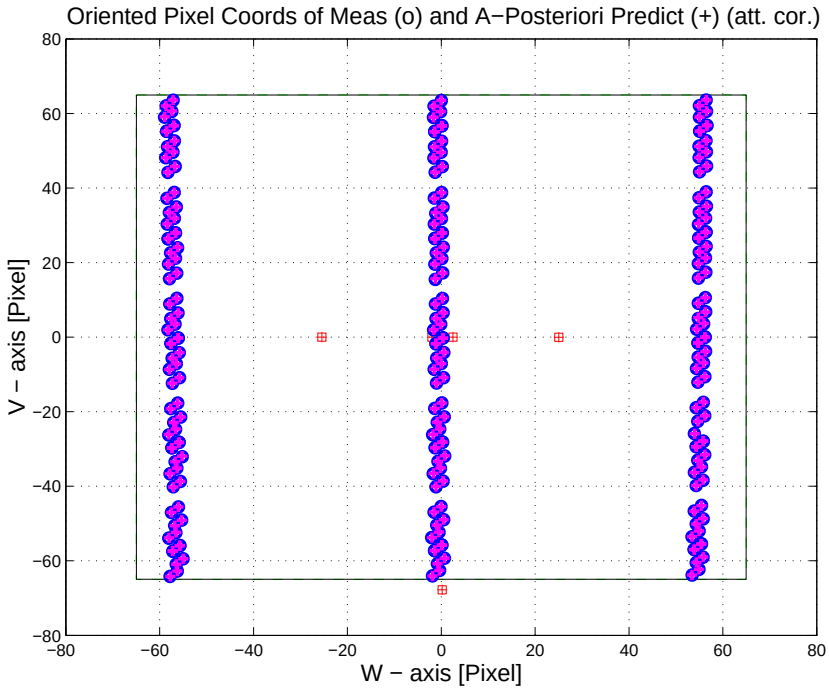

Figure 3.17: Oriented Pixel Coords of meas. and a-posteriori predicts (attitude corrected)

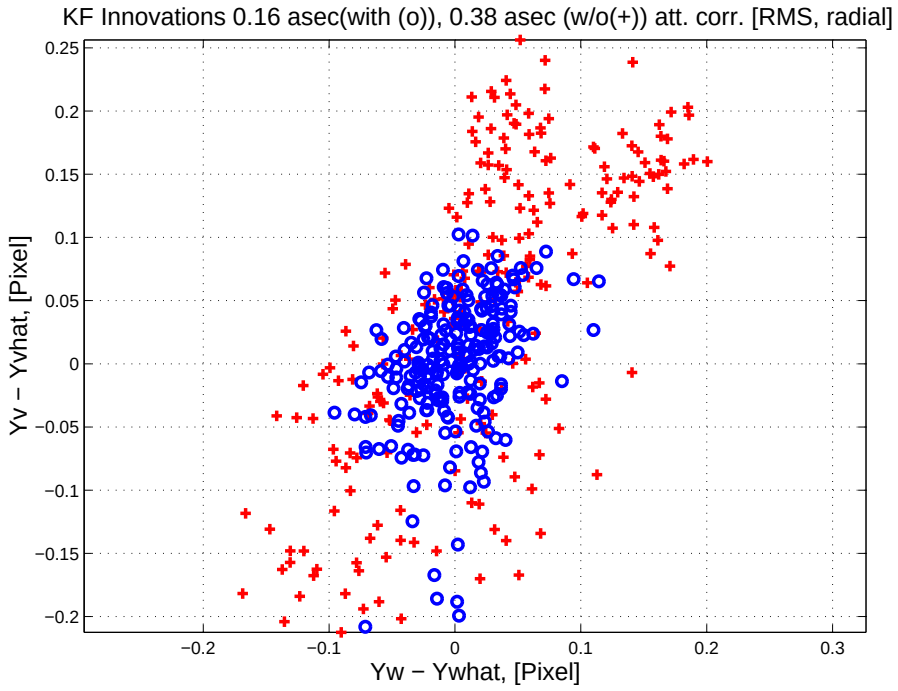

Figure 3.18: KF innovations with (o) and w/o (+) attitude corrections

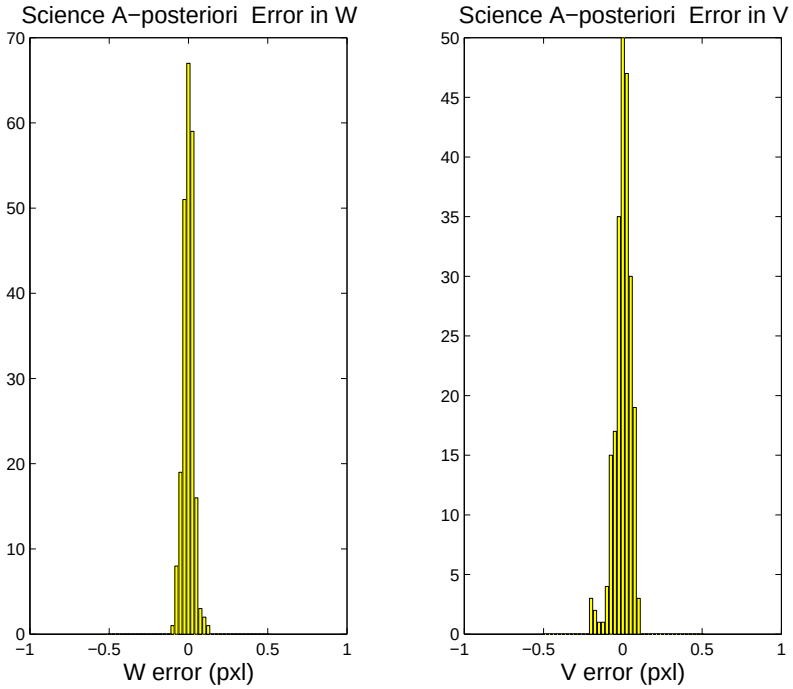

Figure 3.19: Histograms of science a-posteriori residuals (or innovations)

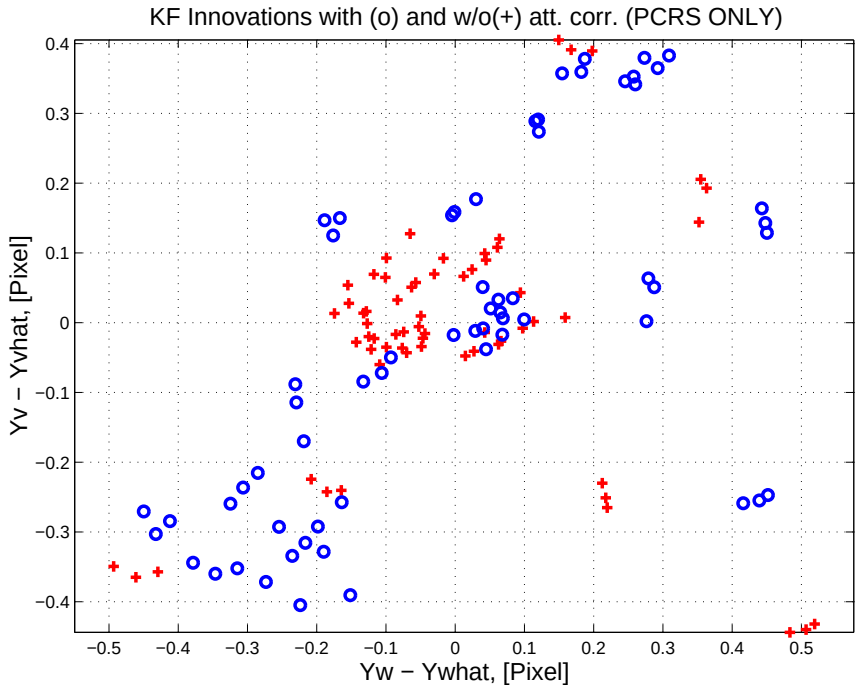

Figure 3.20: KF innovations with (o) and w/o (+) attitude corrections (PCRS)

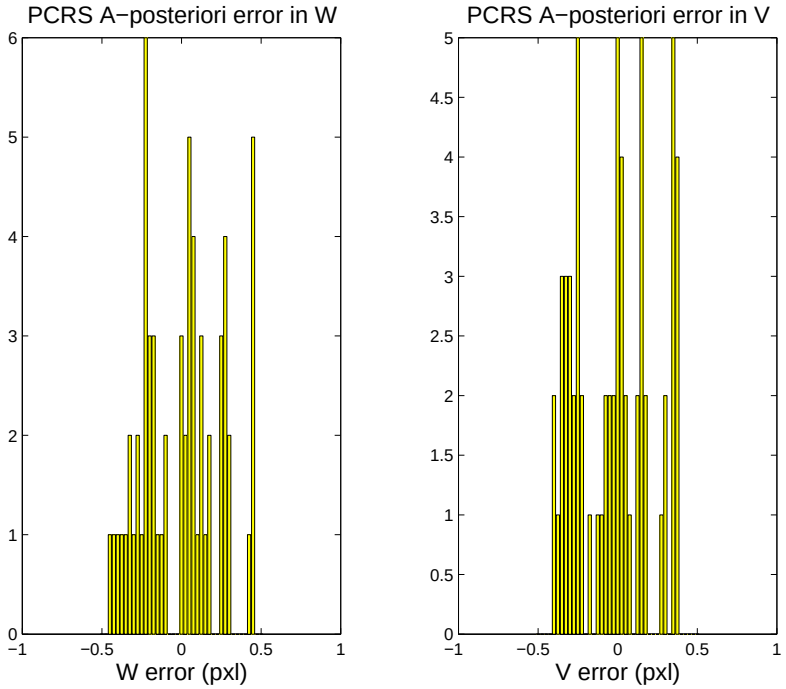

Figure 3.21: Histograms of PCRS a-posteriori residuals (or innovations)

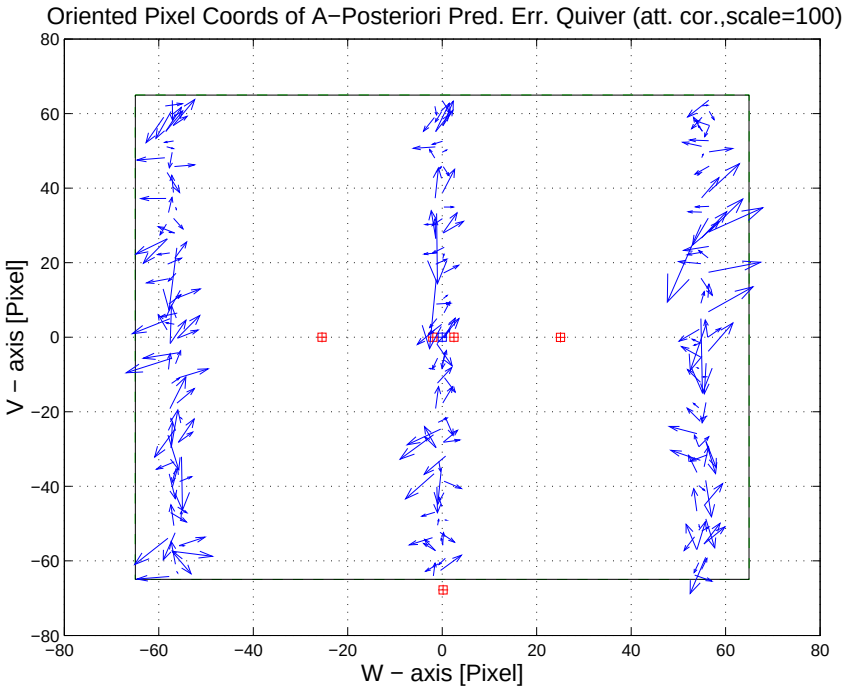

Figure 3.22: A-Posteriori Science Centroid Prediction Error Quiver (Att. Cor.)

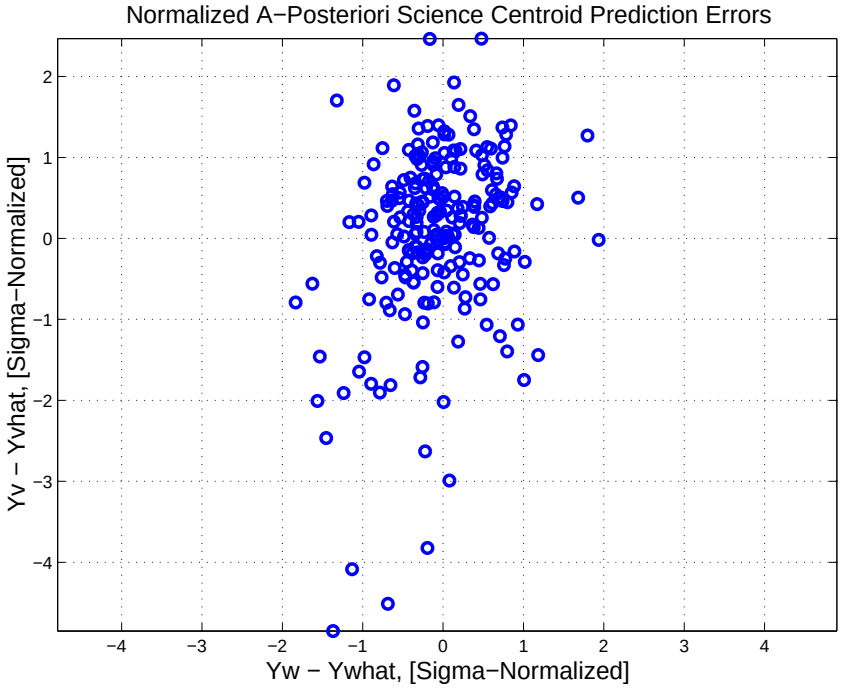

Figure 3.23: Normalized A-Posteriori Science Centroid Prediction Errors

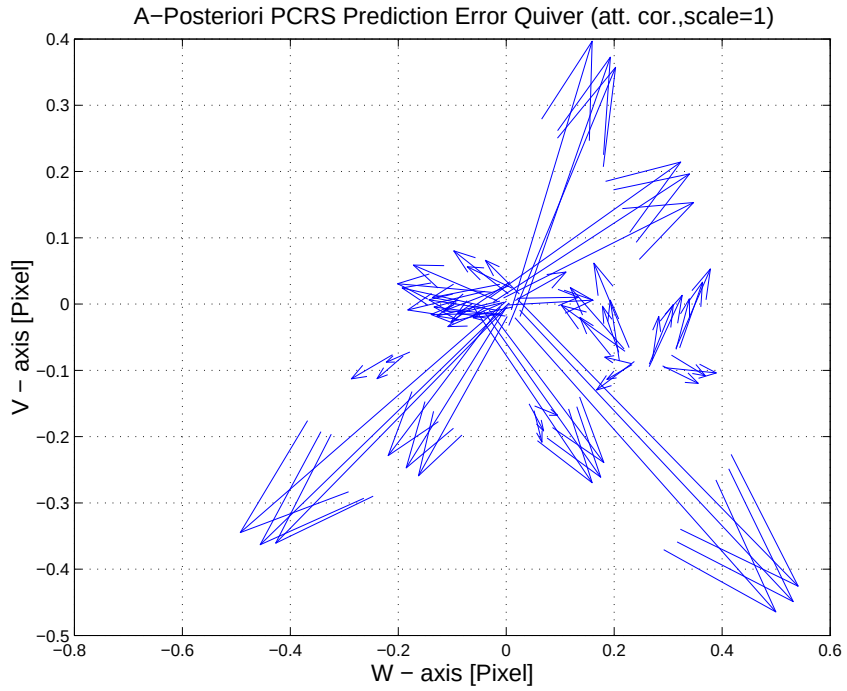

Figure 3.24: A-Posteriori PCRS Prediction Errors Quiver (Att. Cor.)

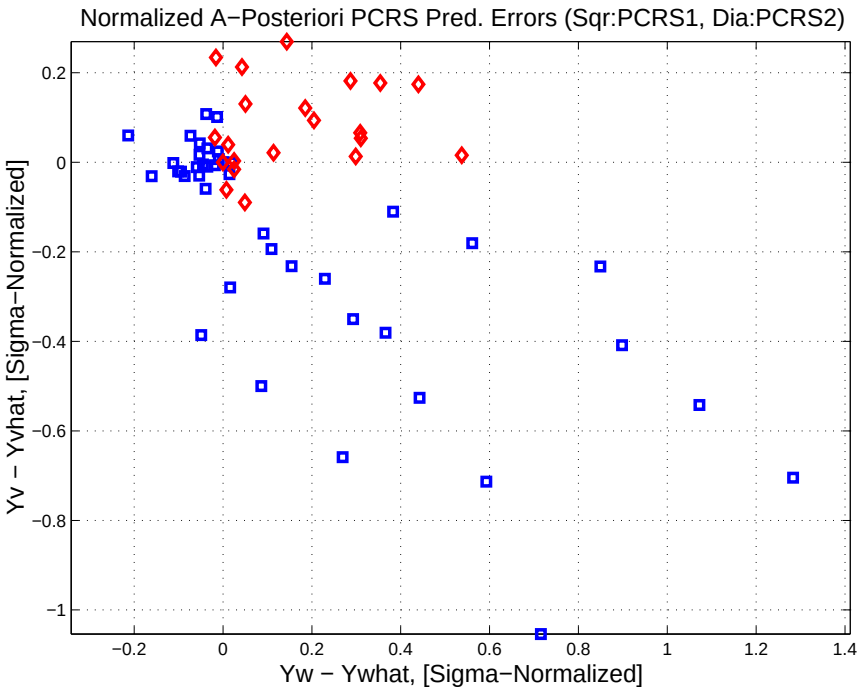

Figure 3.25: Normalized A-Posteriori PCRS Prediction Errors

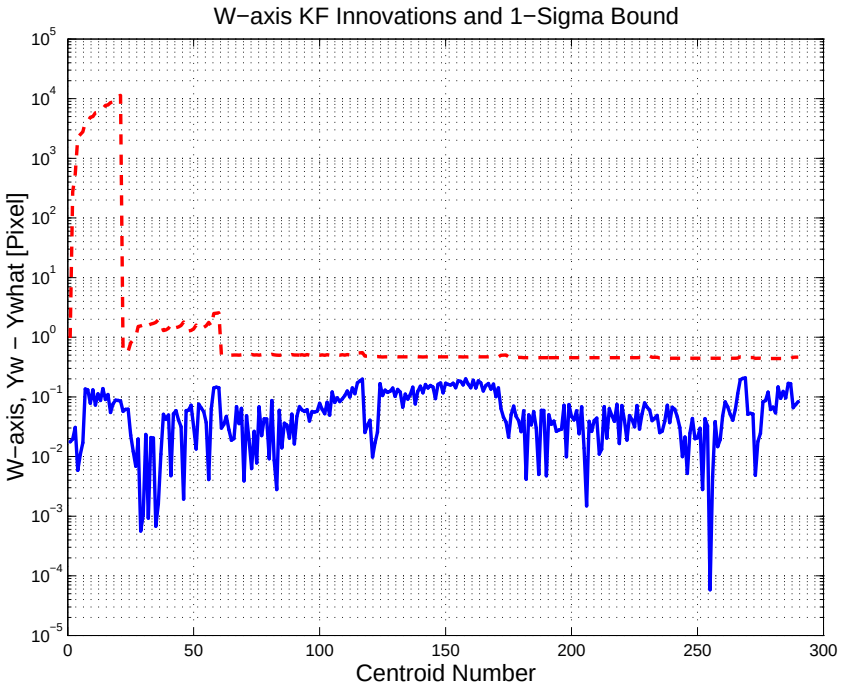

Figure 3.26: W-axis KF innovations and 1-sigma bound

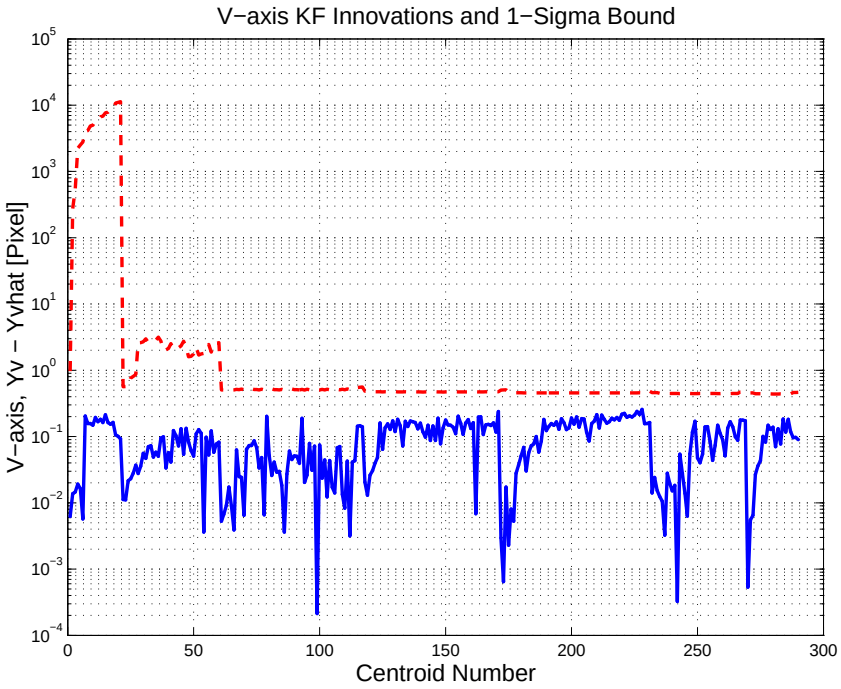

Figure 3.27: V-axis KF innovations and 1-sigma bound

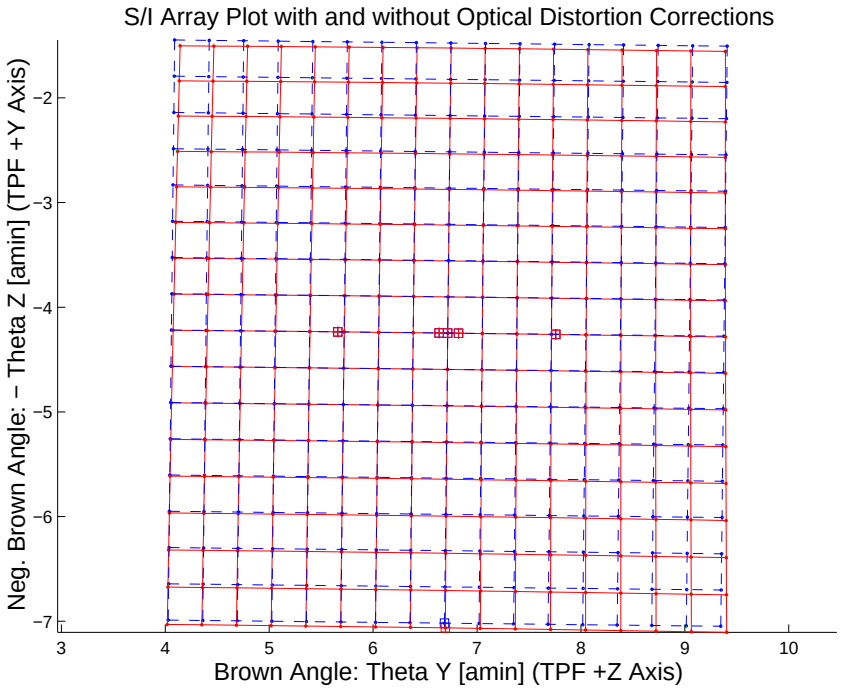

Figure 3.28: Array plot with (solid) and w/o (dashed) optical distortion corrections

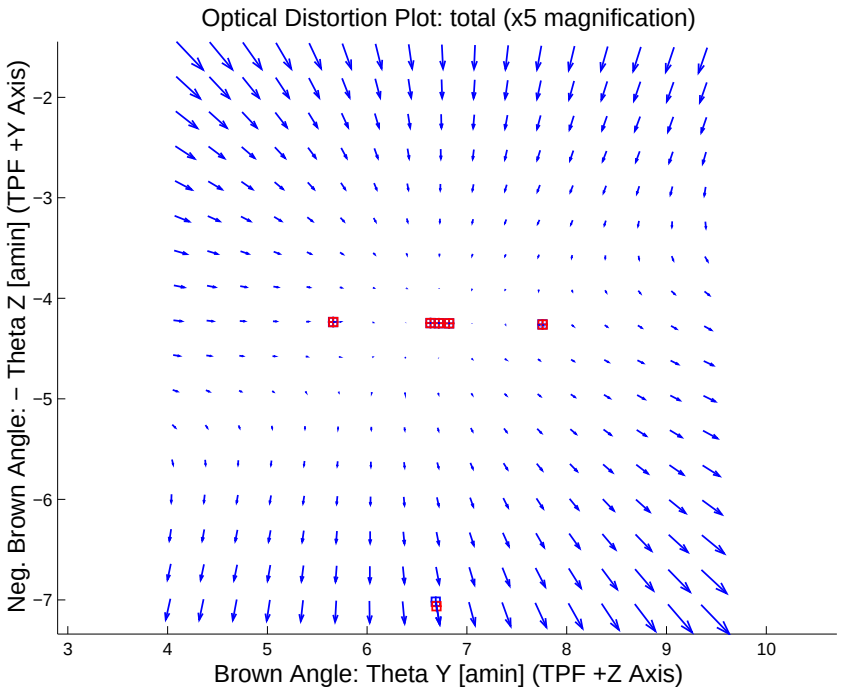

Figure 3.29: Optical Distortion Plot: total (x5 magnification)

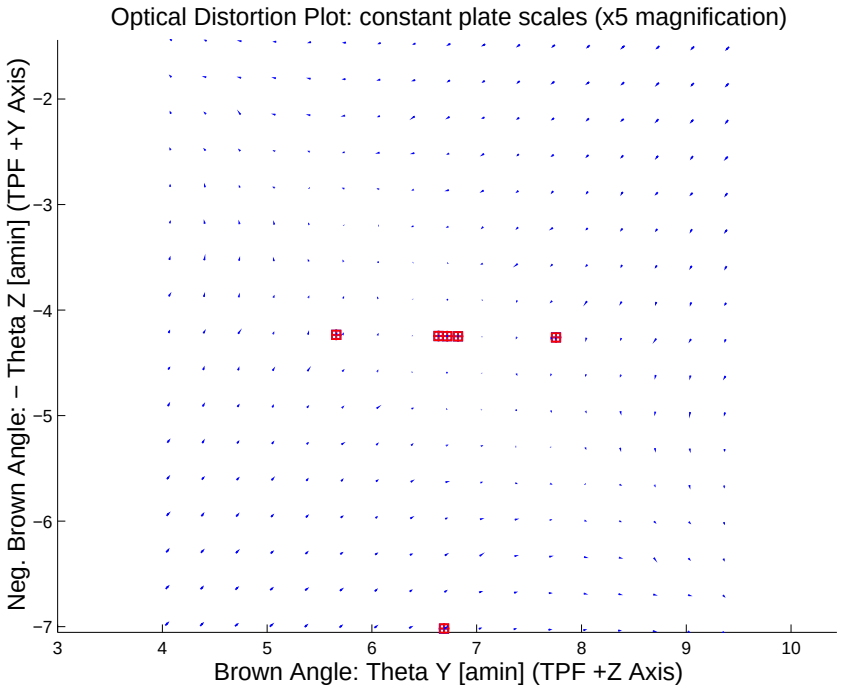

Figure 3.30: Optical Distortion Plot: constant plate scales (x5 magnification)

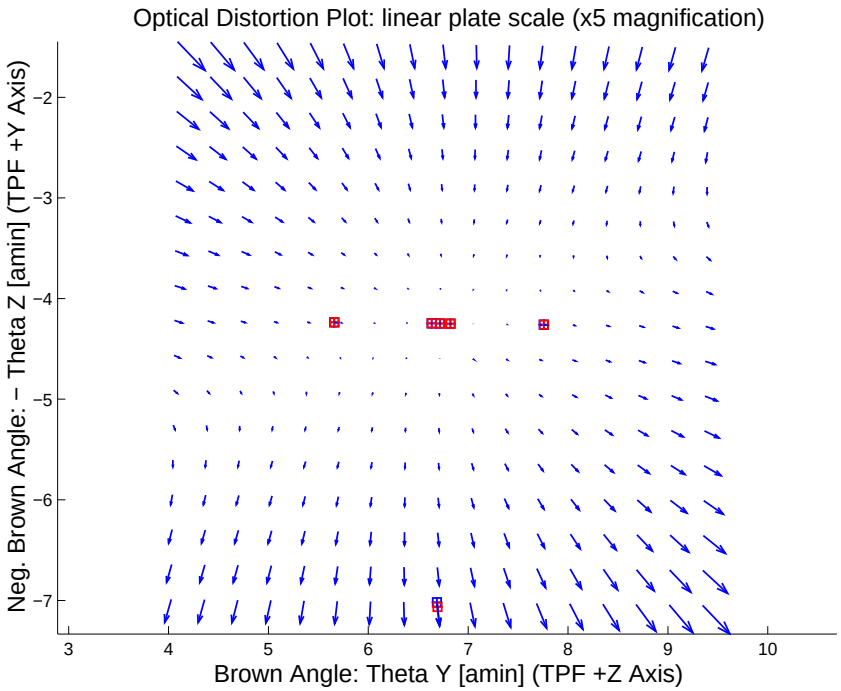

Figure 3.31: Optical Distortion Plot: linear plate scale (x5 magnification)

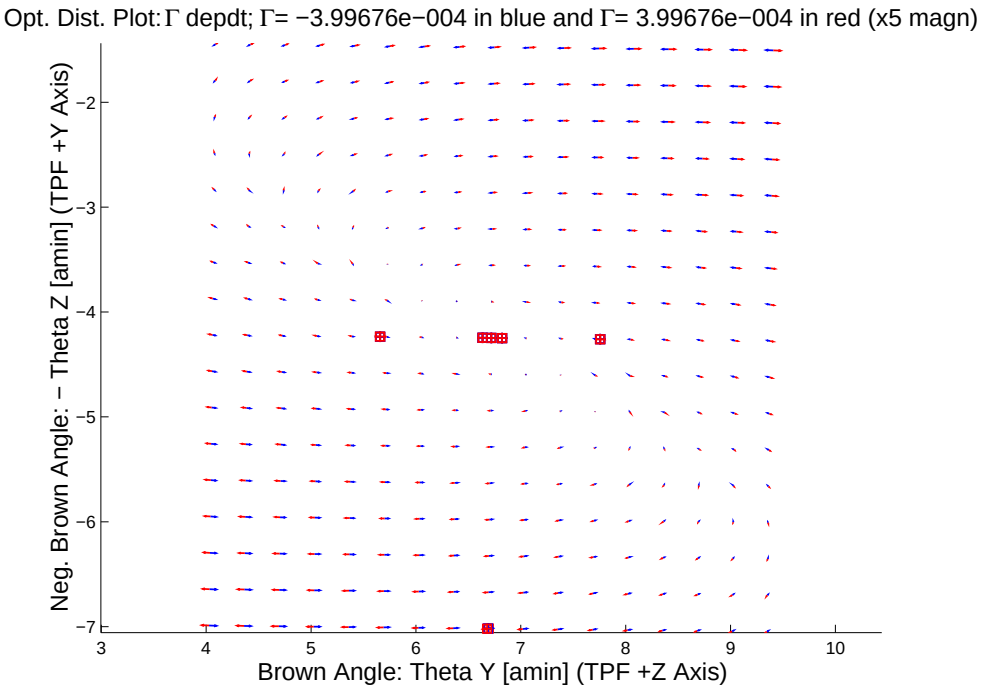

Figure 3.32: Optical Distortion Plot: gamma terms (x5 magnification)

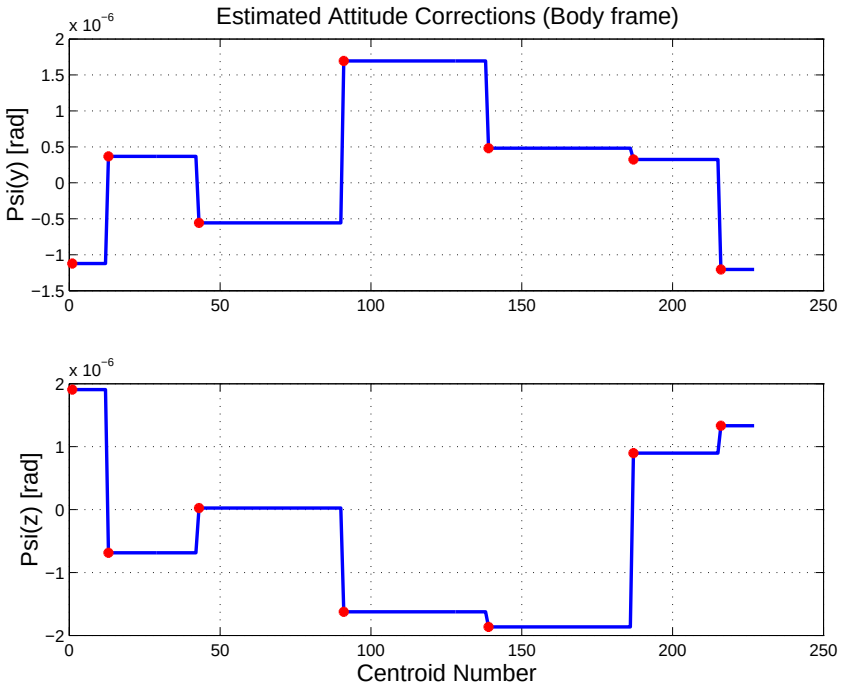

Figure 3.33: Estimated attitude corrections (Body frame)

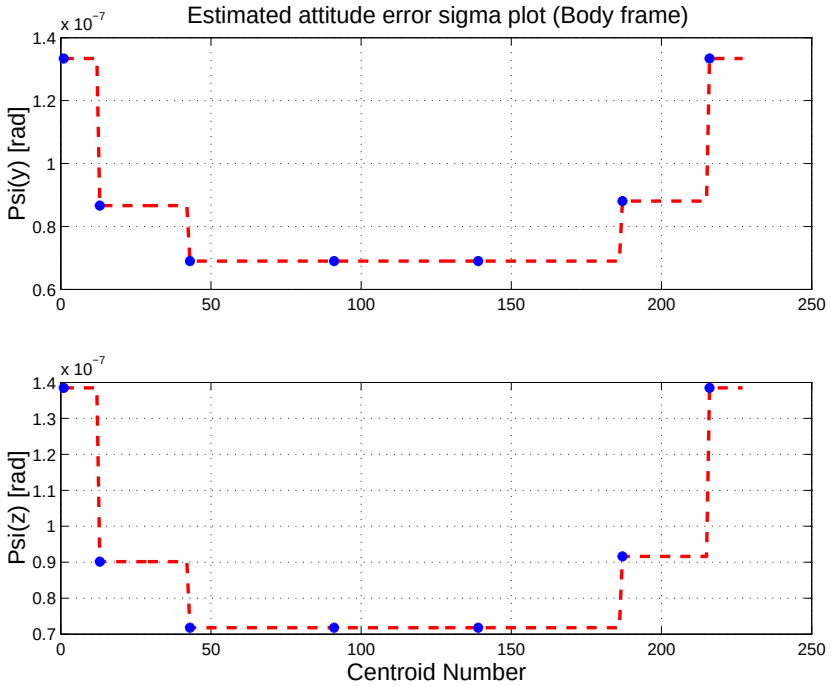

Figure 3.34: Estimated attitude error sigma plot (Body frame)

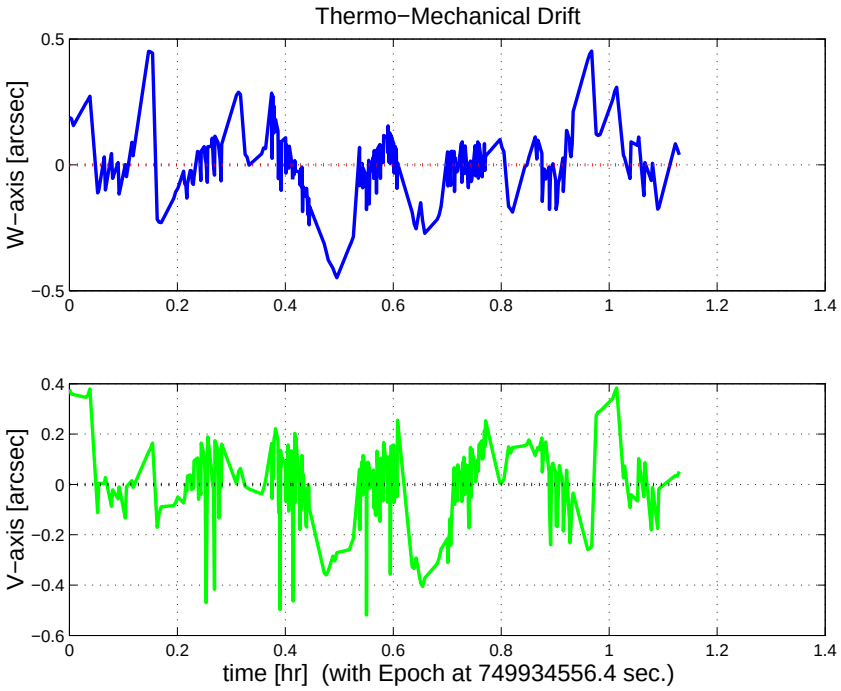

Figure 3.35: Thermo-mechanical boresight drift (equiv. angle in (W,V) coords)

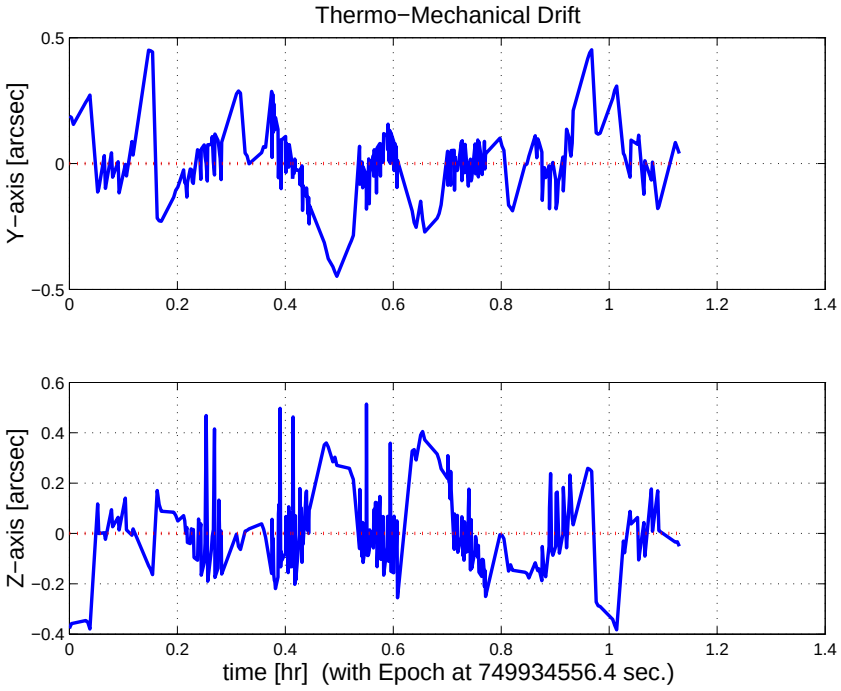

Figure 3.36: Thermo-mechanical boresight drift (equiv. angle in Body frame)

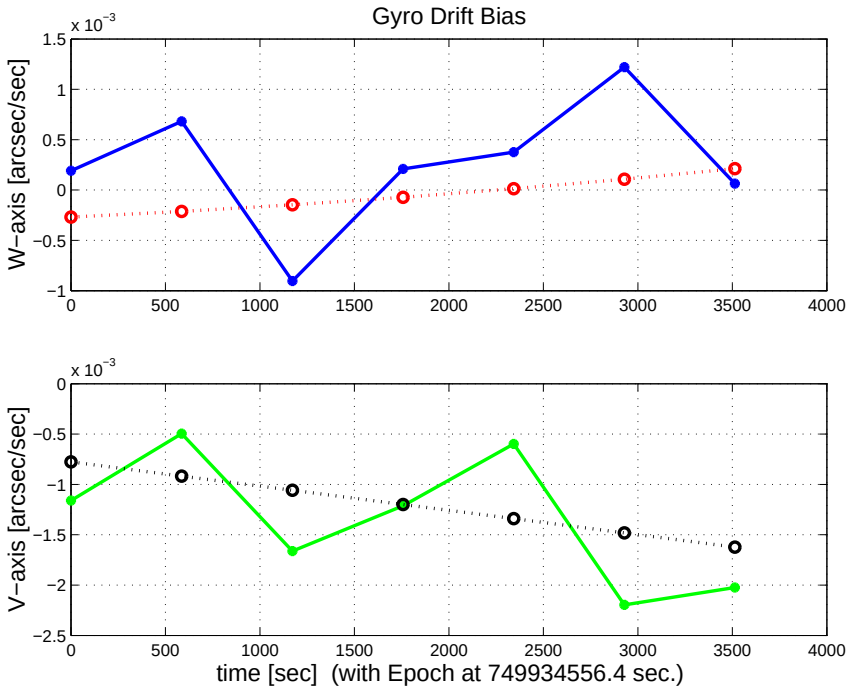

Figure 3.37: Gyro drift bias contribution (equiv. rate in (W,V) coords)

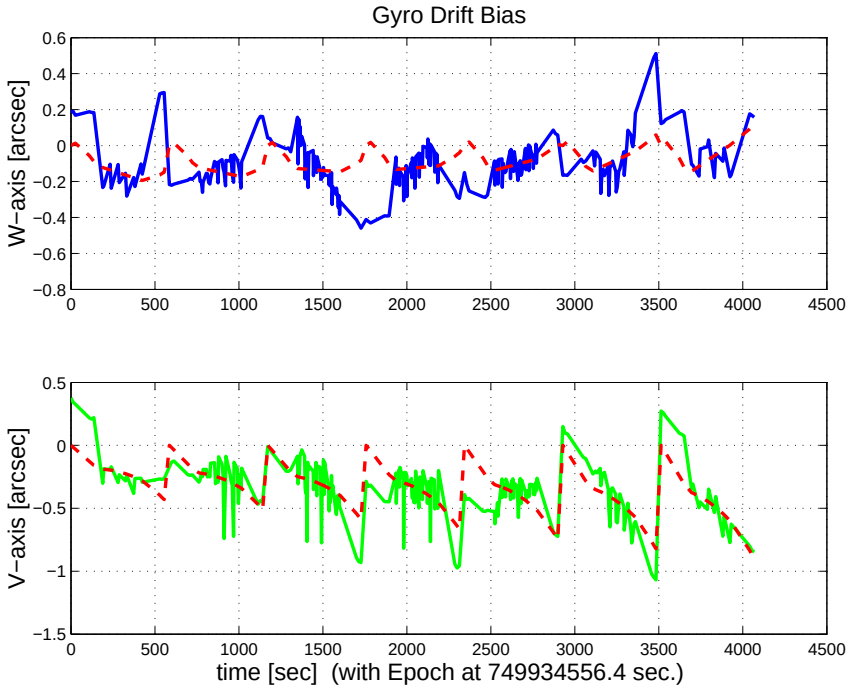

Figure 3.38: Gyro drift bias contribution (equiv. angle in (W,V) coords)

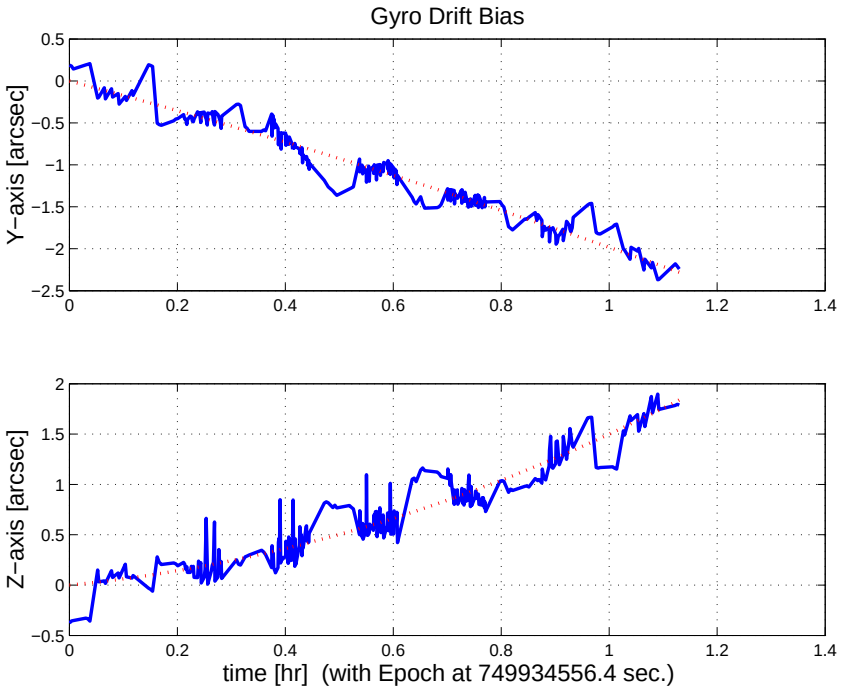

Figure 3.39: Gyro drift bias contribution (equiv. angle in Body frame)

3.2 IPF OUTPUT DATA (IF MINI FILE)

```
OUTPUT FILE NAME: IFmini001095.dat   DATE: 17-Oct-2003   TIME: 16:53
INSTRUMENT NAME:  MIPS_24um_center   NF: 95
IPF FILTER VERSION: IPF.V2.0.0D       SW RELEASE DATE: August 1, 2003
FRAME TABLE USED: BodyFrames_SPC_08a
-------------------------------------------------------------------------------
--------------------------- IPF BROWN ANGLE SUMMARY ---------------------------
-------------------------------------------------------------------------------
         ------------ WAS ------------           ------------ IS -------------
Frame    theta_Y     theta_Z     angle           theta_Y     theta_Z     angle
Number   (arcmin)    (arcmin)    (deg)           (arcmin)    (arcmin)    (deg)
------  ---------------------------------       ---------------------------------
 095     +6.724001  +4.258239   +0.577299        +6.718185  +4.247276   +0.638444
 096     +6.721218  +6.970374   +0.577299        +6.695268  +7.063358   +0.638444
 099     +7.758095  +4.277861   +0.577299        +7.758870  +4.260684   +0.638444
 100     +5.669225  +4.238226   +0.577299        +5.661628  +4.235185   +0.638444
 103     +6.827410  +4.260201   +0.577299        +6.822038  +4.248547   +0.638444
 104     +6.641274  +4.256670   +0.577299        +6.635138  +4.246270   +0.638444
-------------------------------------------------------------------------------
OFFSET           NF          Delta_CW          Delta_CV
  0              95            +0.000            +0.000     pixels
OFFSET FRAME NAME: MIPS_24um_center
Brown Angle       theta_Y(arcmin)  theta_Z(arcmin)  angle(deg)
WAS(FTB)            +6.724001        +4.258239       +0.577299
IS (EST)            +6.718185        +4.247276       +0.638444
dT_EST              -0.005816        -0.010963       +0.061144
T_sSIGMA            +0.001223        +0.001103       +0.012693
dT_EST/T_sSIGMA     -4.754046        -9.943254       +4.817071
-------------------------------------------------------------------------
OFFSET           NF          Delta_CW          Delta_CV
  1              96            +0.000           -64.000     pixels
OFFSET FRAME NAME: MIPS_24um_plusY_edge
Brown Angle       theta_Y(arcmin)  theta_Z(arcmin)  angle(deg)
WAS(FTB)            +6.721218        +6.970374       +0.577299
IS (EST)            +6.695268        +7.063358       +0.638444
dT_EST              -0.025950        +0.092984       +0.061144
T_sSIGMA            +0.001585        +0.001373       +0.012693
dT_EST/T_sSIGMA    -16.376267       +67.703517       +4.817075
-------------------------------------------------------------------------
OFFSET           NF          Delta_CW          Delta_CV
  2              99           +25.000            +0.000     pixels
OFFSET FRAME NAME: MIPS_24um_small_FOV1
Brown Angle       theta_Y(arcmin)  theta_Z(arcmin)  angle(deg)
WAS(FTB)            +7.758095        +4.277861       +0.577299
IS (EST)            +7.758870        +4.260684       +0.638444
dT_EST              +0.000775        -0.017177       +0.061144
T_sSIGMA            +0.001238        +0.001135       +0.012693
dT_EST/T_sSIGMA     +0.626247       -15.133114       +4.817071
-------------------------------------------------------------------------
OFFSET           NF          Delta_CW          Delta_CV
  3             100           -25.500            +0.000     pixels
OFFSET FRAME NAME: MIPS_24um_small_FOV2
Brown Angle       theta_Y(arcmin)  theta_Z(arcmin)  angle(deg)
WAS(FTB)            +5.669225        +4.238226       +0.577299
IS (EST)            +5.661628        +4.235185       +0.638444
dT_EST              -0.007597        -0.003040       +0.061144
T_sSIGMA            +0.001217        +0.001104       +0.012693
dT_EST/T_sSIGMA     -6.244673        -2.753512       +4.817071
-------------------------------------------------------------------------
OFFSET           NF          Delta_CW          Delta_CV
  4             103            +2.500            +0.000     pixels
OFFSET FRAME NAME: MIPS_24um_large_FOV1
Brown Angle       theta_Y(arcmin)  theta_Z(arcmin)  angle(deg)
WAS(FTB)            +6.827410        +4.260201       +0.577299
IS (EST)            +6.822038        +4.248547       +0.638444
```

```
dT_EST              -0.005373        -0.011654       +0.061144
T_sSIGMA            +0.001224        +0.001104       +0.012693
dT_EST/T_sSIGMA     -4.387862       -10.556857       +4.817071
-----------------------------------------------------------------
OFFSET           NF          Delta_CW          Delta_CV
  5             104            -2.000            +0.000     pixels
OFFSET FRAME NAME: MIPS_24um_large_FOV2
Brown Angle       theta_Y(arcmin)  theta_Z(arcmin)  angle(deg)
WAS(FTB)            +6.641274        +4.256670       +0.577299
IS (EST)            +6.635138        +4.246270       +0.638444
dT_EST              -0.006136        -0.010400       +0.061144
T_sSIGMA            +0.001223        +0.001102       +0.012693
dT_EST/T_sSIGMA     -5.019031        -9.439313       +4.817071
-----------------------------------------------------------------
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
VARNAME             MEAN                     SIGMA                SCALED_SIGMA
a00        -4.563148365035 1325E-004 +1.333840491809 9183E-004 +1.407841576930 0782E-004
b00        -5.751704404312 7019E-004 +3.008497584061 0734E-004 +3.175408160827 1188E-004
c00        -1.028191740493 0513E-003 +1.910651022821 7576E-004 +2.016653389553 7030E-004
a10        +5.327889684379 3770E+000 +2.817167937069 7927E-001 +2.973463600298 6131E-001
b10        +6.877153560764 4374E-001 +7.181163543289 1874E-001 +7.579572421930 7747E-001
c10        +7.590853190862 6875E+000 +7.110316842277 3022E-001 +7.504795166415 3678E-001
d10        -9.960198862877 8848E-001 +3.046632985833 8831E-001 +3.215659303672 4246E-001
a01        +7.666835559084 3884E+000 +1.475734085142 7464E-001 +1.557607385825 9382E-001
b01        +2.513826343909 7468E+000 +3.998998123009 5967E-001 +4.220861383506 8381E-001
c01        -1.597119947529 8295E+001 +2.127260165764 0774E-001 +2.245279945165 0063E-001
d01        -2.365264947589 8331E+000 +1.722756505709 4599E-001 +1.818334538917 4085E-001
e01        -2.079323757745 4605E+001 +4.049837203355 7489E-001 +4.274521001342 4628E-001
f01        +2.479224156307 9731E+000 +2.364719306759 4055E-001 +2.495913250697 4382E-001
del_alpha  +6.980093586461 6775E-016 +2.334236394210 0683E-004 +2.463739154966 8099E-004
beta       +9.623533447300 5052E-001 +3.727362784481 0553E-004 +3.934155794876 0394E-004
del_theta1 -4.752058122003 9659E-015 +2.098944687771 2882E-004 +2.215393532633 9207E-004
del_theta2 -8.052497384085 3176E-018 +3.371463180229 5598E-007 +3.558510983405 1192E-007
del_theta3 +1.670452204125 9269E-017 +3.038732575480 5143E-007 +3.207320580835 1918E-007
del_arx    +8.893303845083 9108E-016 +7.078671944800 3610E-005 +7.471394619169 0660E-005
del_ary    -8.985828430286 0502E-018 +1.826023337480 5136E-006 +1.927330584679 8665E-006
del_arz    +2.465143809195 8318E-018 +1.832173875005 5146E-006 +1.933822352249 7771E-006
bgx        +1.458850159923 2332E-006 +1.570852861065 6972E-006 +1.658003323955 9293E-006
bgy        -2.308290600356 2955E-009 +2.055379693396 2117E-009 +2.169411564957 4603E-009
bgz        +7.116440069870 8779E-010 +2.727395360825 3860E-009 +2.878710467460 7384E-009
cgx        +2.304302464243 0984E-010 +5.435871155417 9767E-010 +5.737451716620 2174E-010
cgy        -1.950773580236 6981E-013 +1.092572613526 9447E-012 +1.153188226465 6805E-012
cgz        +7.384121818506 7421E-013 +1.055841301985 2272E-012 +1.114419072371 8259E-012
-------------------------------------------------------------------------------
LSQF RESIDUAL SIGMA SCALE =         +1.055479711085 8032E+000
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------------------------
                    a_mirror(1)               a_mirror(2)               a_mirror(3)
a_mirror_ipf   +0.0000000000000000E+000  +1.2369426221784273E-002  +9.9992349572101968E-001
a_mirror_tpf   -1.9527210038709274E-003  +1.2292116851814160E-003  +9.9999733795611412E-001
beta                beta_0                    beta                      beta_total
               +2.8047410000000001E-006  +9.6235334473005052E-001  +2.6991518824515068E-006
-------------------------------------------------------------------------------------------------------------
qT               qT(1)                     qT(2)                     qT(3)                     qT(4)
FrmTbl:    +5.0372558129468097E-003 -9.8107368935810191E-004 -6.1440075534372396E-004 +9.9998664294079498E-001
Estim:     +5.5708354382570388E-003 -9.8054664932168962E-004 -6.1228736020785908E-004 +9.9998381458150465E-001
DelTheta         deltheta(1)               deltheta(2)               deltheta(3)
           +1.0671770433909459E-003 +1.7237789614618324E-006 +3.1719070281342866E-006       [rad]
EulAngT          theta(1)                  theta(2)                  theta(3)                  [rad]
Mean       +1.1142943166700541E-002 -1.9542408971711632E-003 -1.2354825017054239E-003
SigmaT     +2.0989446877712882E-004 +3.3714631802295598E-007 +3.0387325754805143E-007
-------------------------------------------------------------------------------------------------------------
qR               qR(1)                     qR(2)                     qR(3)                     qR(4)
ASFILE:    +7.0782797411084175E-004 +1.2707553105428815E-003 -1.6110119759105146E-004 +9.9999892711639404E-001
Estim:     +6.1824267536339441E-004 +1.2695077761671312E-003 -1.6037140276689942E-004 +9.9999899020299721E-001
DelThetaR        delthetaR(1)              delthetaR(2)              delthetaR(3)
```

```
          -1.7917194954967182E-004 -2.5229473426429052E-006 +1.2339185282886913E-006       [rad]
EulAngR         angR(1)                  angR(2)                  angR(3)                  [rad]
Mean      +1.2360812162895006E-003 +2.5392140139759685E-003 -3.1917378825308543E-004
SigmaR    +7.0786719448003610E-005 +1.8260233374805136E-006 +1.8321738750055146E-006
-------------------------------------------------------------------------------------------------------------
Initial Gyro Bias         Bg0(1)                   Bg0(2)                   Bg0(3)
                  +3.8798614809820720E-007 +1.7442596345063063E-007 -3.4433065820849146E-007
Gyro Bias Correction      Bg(1)                    Bg(2)                    Bg(3)
                  +1.4588501599232332E-006 -2.3082906003562955E-009 +7.1164400698708779E-010
Total Gyro Bias           BgT(1)                   BgT(2)                   BgT(3)
                  +1.8468363080214403E-006 +1.7211767285027434E-007 -3.4361901420150440E-007

Initial Gyro Bias Rate     Cg0(1)                   Cg0(2)                   Cg0(3)
                  +0.0000000000000000E+000 +0.0000000000000000E+000 +0.0000000000000000E+000
Gyro Bias Rate Correction  Cg(1)                    Cg(2)                    Cg(3)
                  +2.3043024642430984E-010 -1.9507735802366981E-013 +7.3841218185067421E-013
Total Gyro Bias Rate       CgT(1)                   CgT(2)                   CgT(3)
                  +2.3043024642430984E-010 -1.9507735802366981E-013 +7.3841218185067421E-013
-------------------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------------------------
OFFSET           NF          Delta_CW          Delta_CV
  1              96            +0.000           -64.000     pixels
OFFSET FRAME NAME: MIPS_24um_plusY_edge
qT               qT(1)                    qT(2)                    qT(3)                    qT(4)
WAS(FTB)  +5.0368688350518696E-003 -9.8265590121642096E-004 -1.0088615259627000E-003 +9.9998632317554204E-001
IS (EST)  +5.5704367984730288E-003 -9.7949520074086635E-004 -1.0218817857010993E-003 +9.9998348315391783E-001

DelTheta        deltheta(1)              deltheta(2)              deltheta(3)
Units             rad                      rad                      rad
          +1.0671179272267091E-003 +7.2756351445502054E-006 -2.7122483067172369E-005
EulAngT         theta(1)                 theta(2)                 theta(3)                 [rad]
Mean      +1.1142943166700541E-002 -1.9475746205400240E-003 -2.0546475894192605E-003
sSigmaT   +2.2153918499755209E-004 +4.6094399774150730E-007 +3.9950437695847479E-007
SigmaT    +2.0989430935593084E-004 +4.3671516647849214E-007 +3.7850502739412473E-007
-------------------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------------------------
OFFSET           NF          Delta_CW          Delta_CV
  2              99           +25.000            +0.000     pixels
OFFSET FRAME NAME: MIPS_24um_small_FOV1
qT               qT(1)                    qT(2)                    qT(3)                    qT(4)
WAS(FTB)  +5.0371586372862228E-003 -1.1314889056829706E-003 -6.1649671362086034E-004 +9.9998648325740958E-001
IS (EST)  +5.5707388424245064E-003 -1.1319165308581653E-003 -6.1339397774659132E-004 +9.9998365455718563E-001

DelTheta        deltheta(1)              deltheta(2)              deltheta(3)
Units             rad                      rad                      rad
          +1.0671820818558223E-003 -1.7514849635406710E-007 +4.9986352228126053E-006
EulAngT         theta(1)                 theta(2)                 theta(3)                 [rad]
Mean      +1.1142943166700539E-002 -2.2569638591662892E-003 -1.2393825998013033E-003
sSigmaT   +2.2153933287104183E-004 +3.6008791197714243E-007 +3.3017853420496915E-007
SigmaT    +2.0989444945667196E-004 +3.4116042989278245E-007 +3.1282319379242707E-007
-------------------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------------------------
OFFSET           NF          Delta_CW          Delta_CV
  3             100           -25.500            +0.000     pixels
OFFSET FRAME NAME: MIPS_24um_small_FOV2
qT               qT(1)                    qT(2)                    qT(3)                    qT(4)
WAS(FTB)  +5.0373539303327245E-003 -8.2765014547835373E-004 -6.1226286617559059E-004 +9.9998678251004891E-001
IS (EST)  +5.5709325898909414E-003 -8.2686934353415602E-004 -6.1138512180013941E-004 +9.9998395347395475E-001

DelTheta        deltheta(1)              deltheta(2)              deltheta(3)
Units             rad                      rad                      rad
          +1.0671722641028528E-003 +2.2186644793782625E-006 +8.6208602961888918E-007
EulAngT         theta(1)                 theta(2)                 theta(3)                 [rad]
Mean      +1.1142943166700541E-002 -1.6469009241840771E-003 -1.2319654714847928E-003
sSigmaT   +2.2153935314390716E-004 +3.5388015113679975E-007 +3.2118906635972370E-007
SigmaT    +2.0989446866392448E-004 +3.3527897070873374E-007 +3.0430624386830420E-007
-------------------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------------------------
```

```
OFFSET           NF          Delta_CW          Delta_CV
  4             103            +2.500            +0.000     pixels
OFFSET FRAME NAME: MIPS_24um_large_FOV1
qT               qT(1)                    qT(2)                    qT(3)                    qT(4)
WAS(FTB)  +5.0372461391393897E-003 -9.9611521251996506E-004 -6.1461035168427895E-004 +9.9998662799056104E-001
IS (EST)  +5.5708258405811261E-003 -9.9565218896179985E-004 -6.1238812774753505E-004 +9.9998379964725104E-001

DelTheta        deltheta(1)              deltheta(2)              deltheta(3)
Units             rad                      rad                      rad
          +1.0671775383011436E-003 +1.5968748685018884E-006 +3.3740858962661747E-006
EulAngT         theta(1)                 theta(2)                 theta(3)                 [rad]
Mean      +1.1142943166700541E-002 -1.9844504053522557E-003 -1.2358523715840183E-003
sSigmaT   +2.2153935214267053E-004 +3.5616383333283118E-007 +3.2111933749249559E-007
SigmaT    +2.0989446771531634E-004 +3.3744261456853104E-007 +3.0424018019460613E-007
-------------------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------------------------
OFFSET           NF          Delta_CW          Delta_CV
  5             104            -2.000            +0.000     pixels
OFFSET FRAME NAME: MIPS_24um_large_FOV2
qT               qT(1)                    qT(2)                    qT(3)                    qT(4)
WAS(FTB)  +5.0372635449913205E-003 -9.6904047066332906E-004 -6.1423307818932811E-004 +9.9998665473808712E-001
IS (EST)  +5.5708431067704916E-003 -9.6846724945368219E-004 -6.1220832924998865E-004 +9.9998382635882077E-001

DelTheta        deltheta(1)              deltheta(2)              deltheta(3)
Units             rad                      rad                      rad
          +1.0671766499396897E-003 +1.8152240486598044E-006 +3.0070429672854445E-006
EulAngT         theta(1)                 theta(2)                 theta(3)                 [rad]
Mean      +1.1142943166700539E-002 -1.9300833368531326E-003 -1.2351898281893709E-003
sSigmaT   +2.2153935401373698E-004 +3.5561326394840407E-007 +3.2048788761153380E-007
SigmaT    +2.0989446948803297E-004 +3.3692098503965957E-007 +3.0364192153143182E-007
-------------------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------------------------
              q(1)                     q(2)                     q(3)                     q(4)
PCRS1A: +5.3377191730804340E-007 +3.7444181445836429E-004 -1.4255121007937610E-003 +9.9999891385355677E-001
PCRS2A: -5.2784857378083422E-007 +3.8463011681657313E-004 +1.3723523317471205E-003 +9.9999898435372037E-001
-------------------------------------------------------------------------------------------
**********  CS-FILE PARAMETERS:  **********  **********  AS-FILE PARAMETERS:  **********
Row (01) PIX2RADX: +1.2087416876100000E-005  Row (1) TASTART:   +7.4993345329074097E+008
Row (02) PIX2RADY: +1.2595908372599999E-005  Row (2) TASTOP:    +7.4993958719077146E+008
Row (03) CX0:      +6.4500000000000000E+001  Row (3) S/C TIME:  +7.4938219429075623E+008
Row (04) CY0:      +6.4500000000000000E+001  Row (4) QR1:       +7.0782797411084175E-004
Row (05) BETA0:    +2.8047410000000001E-006  Row (5) QR2:       +1.2707553105428815E-003
Row (06) GAMMA_E0: +2.0070000000000000E+003  Row (6) QR3:       -1.6110119759105146E-004
Row (07) D11:      -1.0000000000000000E+000  Row (7) QR4:       +9.9999892711639404E-001
Row (08) D12:      +0.0000000000000000E+000
Row (09) D21:      +0.0000000000000000E+000
Row (10) D22:      -1.0000000000000000E+000
Row (11) DG:       -1.0000000000000000E+000
-------------------------------------------------------------------------------------------
-----------------------------------------------------------
INITIAL STA-TO-PCRS ALIGNMENT (R) KNOWLEDGE (1-SIGMA)
    SIGMA(X)        SIGMA(Y)         SIGMA(Z)
4.71429223E+000  2.15487256E-001  2.15829050E-001  [arcsec]
-----------------------------------------------------------
PIX2RADX = 1.208741687610E-005[rad/pixel]
XPIXSIZE = 2.4932[arcsec]
PIX2RADY = 1.259590837260E-005[rad/pixel]
YPIXSIZE = 2.5981[arcsec]
CX0 = 64.5[pixel] = 160.81[arcsec]
CY0 = 64.5[pixel] = 167.58[arcsec]
-----------------------------------------------------------
NOMINAL BETA0 = 2.804741000000E-006[rad/encoder unit]
ENCODER UNIT SIZE = 0.58[arcsec]
GAMMA_E0 = 2007.00[encoder unit] = 1161.09[arcsec]
-----------------------------------------------------------
                | -1 | +0 |
FLIP MATRIX D = |----|----|   and   DG = -1
                | +0 | -1 |
```

```
------------------------------------------------------------
```

3.3 IPF EXECUTION LOG

```
**********************************************************************
IPF EXECUTION-LOG FILE NAME:  LG001095.dat
INSTRUMENT TYPE:              MIPS_24um_center
IPF FILTER EXECUTION DATE:    17-Oct-2003    TIME: 16:48
IPF FILTER VERSION USED:      IPF.V2.0.0D
**********************************************************************

------------------- Loading & Preparing Input Files -------------------
AAFILE:  AA001095 Loaded!        AAFILE dimension = 61340 X 21
ASFILE:  AS001095 Loaded!
CAFILE:  CA003095 Loaded!        CAFILE dimension = 227 X 15
CBFILE:  CB002095 Loaded!        CBFILE dimension = 63 X 15
CCFILE:  CC001095 Created!       CCFILE dimension = 290 X 19
CSFILE:  CS003095 Loaded!
Loading Input Files Completed!
----------------------------------------------------------------------

------------------------ Selected Mask Vectors ------------------------
index =   1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20
----------------------------------------------------------------------
mask1 = [ 1  1  1  1  1  1  1  0  0  0  0  1  1  1  1  1  1 ]
mask2 = [ 1  1  1  1  1  1  1  1  0  0  0  0  0  0  1  1  1  1  1  1 ]
----------------------------------------------------------------------

---------------  Selected Initial Gyro Bias Parameters  ---------------
User Entered 1 : Use AFILE database - from S/C filter
IPF Linearized Using Following Nominal Gyro Bias Estimates
bg0 = [+3.879861480982072E-007 +1.744259634506306E-007 -3.443306582084914E-007 ]
cg0 = [+0.0000000000000000E+000 +0.0000000000000000E+000 +0.0000000000000000E+000 ]
----------------------------------------------------------------------

---------------  Gyro Pre-Processor Run Completed  --------------------
     AGFILE CREATED:  AG001095.m     ACFILE CREATED:  AC001095.m
----------------------------------------------------------------------
Total Gyro Preprocessor Execution Time: 29 seconds

FRAME TABLE ENTRIES FOR PCRS LOADED TO TPCRS
q_PCRS4 = [ +5.337719173080434E-007     q_PCRS5 = [ +7.3379987833742897E-007
            +3.744418144583643E-004                 +5.2236196154513707E-004
            -1.425512100793761E-003                 -1.4047712280184723E-003
            +9.999891385355677E-001 ];              +9.9999887687698918E-001 ];
q_PCRS8 = [ -5.278485737808342E-007     q_PCRS9 = [ -7.1963421681856818E-007
            +3.846301168165731E-004                 +5.3239763239987400E-004
            +1.372352331747120E-003                 +1.3516841804518383E-003
            +9.999898435372037E-001 ];              +9.9998944750503100E-001 ];
----------------------------------------------------------------------------
------ Initial Conditions for State -----  ------   Inital Square-Root Cov (diag)   -----
p1(01)  = a00  = +0.0000000000000000E+000  Sigma_initial(01,01) = 1.0000000000000000E+000
p1(02)  = b00  = +0.0000000000000000E+000  Sigma_initial(02,02) = 1.0000000000000000E+000
p1(03)  = c00  = +0.0000000000000000E+000  Sigma_initial(03,03) = 1.0000000000000000E+000
p1(04)  = a10  = +0.0000000000000000E+000  Sigma_initial(04,04) = 1.0000000000000000E+002
p1(05)  = b10  = +0.0000000000000000E+000  Sigma_initial(05,05) = 1.0000000000000000E+002
p1(06)  = c10  = +0.0000000000000000E+000  Sigma_initial(06,06) = 1.0000000000000000E+002
p1(07)  = d10  = +0.0000000000000000E+000  Sigma_initial(07,07) = 1.0000000000000000E+002
p1(08)  = a20  = +0.0000000000000000E+000  Sigma_initial(08,08) = 9.9999000000000000E+004
p1(09)  = b20  = +0.0000000000000000E+000  Sigma_initial(09,09) = 9.9999000000000000E+004
```

```
p1(10)  = c20  = +0.0000000000000000E+000  Sigma_initial(10,10) = 9.9999000000000000E+004
p1(11)  = d20  = +0.0000000000000000E+000  Sigma_initial(11,11) = 9.9999000000000000E+004
p1(12)  = a01  = +0.0000000000000000E+000  Sigma_initial(12,12) = 1.0000000000000000E+004
p1(13)  = b01  = +0.0000000000000000E+000  Sigma_initial(13,13) = 1.0000000000000000E+004
p1(14)  = c01  = +0.0000000000000000E+000  Sigma_initial(14,14) = 1.0000000000000000E+004
p1(15)  = d01  = +0.0000000000000000E+000  Sigma_initial(15,15) = 1.0000000000000000E+004
p1(16)  = e01  = +0.0000000000000000E+000  Sigma_initial(16,16) = 1.0000000000000000E+004
p1(17)  = f01  = +0.0000000000000000E+000  Sigma_initial(17,17) = 1.0000000000000000E+004
--------------------------------------------------------------------------------
p2f(01) = am1  = +0.0000000000000000E+000
p2f(02) = am2  = +0.0000000000000000E+000  Sigma_initial(18,18) = 1.0000000000000001E-001
p2f(03) = am3  = +1.0000000000000000E+000
p2f(04) = beta = +1.0000000000000000E+000  Sigma_initial(19,19) = 1.0000000000000001E-001
p2f(05) = qT1  = +5.0372558129468141E-003  Sigma_initial(20,20) = 1.0000000000000001E-001
p2f(06) = qT2  = -9.8107368935810278E-004  Sigma_initial(21,21) = 1.0000000000000000E-002
p2f(07) = aT3  = -6.1440075534372450E-004  Sigma_initial(22,22) = 1.0000000000000000E-002
p2f(08) = qT4  = +9.9998664294079587E-001
p2f(09) = qR1  = +7.0782797411084175E-004  Sigma_initial(23,23) = 2.2855533686591019E-004
p2f(10) = qR2  = +1.2707553105428815E-003  Sigma_initial(24,24) = 1.0447116979821692E-005
p2f(11) = qR3  = -1.6110119759105146E-004  Sigma_initial(25,25) = 1.0463687644985126E-005
p2f(12) = qR4  = +9.9998892711639404E-001
p2f(13) = brx  = +0.0000000000000000E+000  Sigma_initial(26,26) = 9.9999000000000000E+004
p2f(14) = bry  = +0.0000000000000000E+000  Sigma_initial(27,27) = 9.9999000000000000E+004
p2f(15) = brz  = +0.0000000000000000E+000  Sigma_initial(28,28) = 9.9999000000000000E+004
p2f(16) = crx  = +0.0000000000000000E+000  Sigma_initial(29,29) = 9.9999000000000000E+004
p2f(17) = cry  = +0.0000000000000000E+000  Sigma_initial(30,30) = 9.9999000000000000E+004
p2f(18) = crz  = +0.0000000000000000E+000  Sigma_initial(31,31) = 9.9999000000000000E+004
p2f(19) = bgx  = +0.0000000000000000E+000  Sigma_initial(32,32) = 2.4585125629856917E-004
p2f(20) = bgy  = +0.0000000000000000E+000  Sigma_initial(33,33) = 2.4585125629856917E-004
p2f(21) = bgz  = +0.0000000000000000E+000  Sigma_initial(34,34) = 2.4585125629856917E-004
p2f(22) = cgx  = +0.0000000000000000E+000  Sigma_initial(35,35) = 6.0442840223584758E-008
p2f(23) = cgy  = +0.0000000000000000E+000  Sigma_initial(36,36) = 6.0442840223584758E-008
p2f(24) = cgz  = +0.0000000000000000E+000  Sigma_initial(37,37) = 6.0442840223584758E-008
--------------------------------------------------------------------------------

--------------------   IPF KALMAN FILTER STARTED  ----------------------
Iteration#001: |dp|= +2.923388906087E+001   RMS(|Res|)=+1.263420341113E-005
Iteration#002: |dp|= +3.858069924280E-002   RMS(|Res|)=+3.458261468810E-006
Iteration#003: |dp|= +8.135580395357E-003   RMS(|Res|)=+1.857705116763E-006
Iteration#004: |dp|= +3.720174933893E-003   RMS(|Res|)=+1.837909443886E-006
Iteration#005: |dp|= +4.026198439453E-005   RMS(|Res|)=+1.835089495760E-006
Iteration#006: |dp|= +3.572071580738E-004   RMS(|Res|)=+1.835513614107E-006
Iteration#007: |dp|= +7.484717612068E-005   RMS(|Res|)=+1.835609380301E-006
Iteration#008: |dp|= +1.932631415950E-005   RMS(|Res|)=+1.835601464970E-006
Iteration#009: |dp|= +1.108714693758E-005   RMS(|Res|)=+1.835599066272E-006
Iteration#010: |dp|= +4.007790316182E-007   RMS(|Res|)=+1.835599491009E-006
Iteration#011: |dp|= +9.854353929778E-007   RMS(|Res|)=+1.835599559417E-006
Iteration#012: |dp|= +2.369416479233E-007   RMS(|Res|)=+1.835599511436E-006
Iteration#013: |dp|= +4.669538442751E-008   RMS(|Res|)=+1.835599501356E-006
Iteration#014: |dp|= +3.216327688216E-008   RMS(|Res|)=+1.835599504983E-006
Iteration#015: |dp|= +2.058164015948E-009   RMS(|Res|)=+1.835599506577E-006
Iteration#016: |dp|= +2.678714638851E-009   RMS(|Res|)=+1.835599506494E-006
Iteration#017: |dp|= +7.088286598531E-010   RMS(|Res|)=+1.835599506334E-006
Iteration#018: |dp|= +1.146764322744E-010   RMS(|Res|)=+1.835599506306E-006
Iteration#019: |dp|= +1.173380003192E-010   RMS(|Res|)=+1.835599506319E-006
Iteration#020: |dp|= +8.867601264758E-011   RMS(|Res|)=+1.835599506320E-006
Iteration#021: |dp|= +1.034337608083E-010   RMS(|Res|)=+1.835599506330E-006
Iteration#022: |dp|= +4.294929288901E-011   RMS(|Res|)=+1.835599506319E-006
Iteration#023: |dp|= +5.533254747774E-011   RMS(|Res|)=+1.835599506317E-006
Iteration#024: |dp|= +7.371086871788E-011   RMS(|Res|)=+1.835599506320E-006
Iteration#025: |dp|= +5.640050254276E-011   RMS(|Res|)=+1.835599506324E-006
Iteration#026: |dp|= +9.805338326027E-011   RMS(|Res|)=+1.835599506323E-006
Iteration#027: |dp|= +5.364746679925E-011   RMS(|Res|)=+1.835599506320E-006
Iteration#028: |dp|= +1.250474616073E-010   RMS(|Res|)=+1.835599506326E-006
Iteration#029: |dp|= +6.057809671472E-011   RMS(|Res|)=+1.835599506315E-006
Iteration#030: |dp|= +7.013390751722E-011   RMS(|Res|)=+1.835599506314E-006
IPF Kalman Filter Completed with Error |dp1| + |dp2| = +7.0133907517224141E-011
--------------------------------------------------------------------
```

```
-----------------  IPF LEAST SQUARES FILTER STARTED  ------------------
Iteration#001   COND#=+2.241783314396E+009,   |dp|=+2.923244960994E+001
Iteration#002   COND#=+2.241837830694E+009,   |dp|=+2.742962119457E-002
Iteration#003   COND#=+2.241837921822E+009,   |dp|=+1.131932286882E-003
Iteration#004   COND#=+2.241837934419E+009,   |dp|=+2.786972451794E-005
Iteration#005   COND#=+2.241837933467E+009,   |dp|=+3.639443929191E-007
Iteration#006   COND#=+2.241837930999E+009,   |dp|=+4.547957415594E-009
Iteration#007   COND#=+2.241837931670E+009,   |dp|=+1.863471791048E-010
Iteration#008   COND#=+2.241837931036E+009,   |dp|=+1.659433592044E-010
Iteration#009   COND#=+2.241837938096E+009,   |dp|=+7.392008244009E-011
Iteration#010   COND#=+2.241837920784E+009,   |dp|=+5.737788159571E-011
Iteration#011   COND#=+2.241837931601E+009,   |dp|=+7.943787703054E-011
Iteration#012   COND#=+2.241837930092E+009,   |dp|=+7.785593879279E-011
Iteration#013   COND#=+2.241837928544E+009,   |dp|=+8.032647097817E-011
Iteration#014   COND#=+2.241837913887E+009,   |dp|=+1.045905604328E-010
Iteration#015   COND#=+2.241837934703E+009,   |dp|=+9.728263571348E-011
Iteration#016   COND#=+2.241837934492E+009,   |dp|=+3.904117803119E-011
Iteration#017   COND#=+2.241837916185E+009,   |dp|=+7.049777087051E-011
Iteration#018   COND#=+2.241837931420E+009,   |dp|=+8.562747042633E-011
Iteration#019   COND#=+2.241837919051E+009,   |dp|=+1.026086601150E-010
Iteration#020   COND#=+2.241837935361E+009,   |dp|=+7.829338403282E-011
Iteration#021   COND#=+2.241837950348E+009,   |dp|=+9.657880804700E-011
Iteration#022   COND#=+2.241837924051E+009,   |dp|=+6.240762424867E-011
Iteration#023   COND#=+2.241837932627E+009,   |dp|=+8.858056834637E-011
Iteration#024   COND#=+2.241837917653E+009,   |dp|=+9.290808205005E-011
Iteration#025   COND#=+2.241837921687E+009,   |dp|=+9.106463191514E-011
Iteration#026   COND#=+2.241837941935E+009,   |dp|=+6.850803194340E-011
Iteration#027   COND#=+2.241837932393E+009,   |dp|=+7.287268794382E-011
Iteration#028   COND#=+2.241837939396E+009,   |dp|=+6.498314953930E-011
Iteration#029   COND#=+2.241837942302E+009,   |dp|=+1.178951062537E-010
Iteration#030   COND#=+2.241837925631E+009,   |dp|=+1.045577717947E-010
IPF Least Squares Filter Completed with Error |dp1| + |dp2| = +1.0455777179468052E-010
-----------------------------------------------------------------------
Total Execution Time: 280 seconds
```

4 COMMENTS

The data set looked clean and filter converged nicely. Comments:

1. The run was performed in normal IPF operating mode. This decision was made based on seeing systematic errors at about 0.4 arcseconds in the observer at centroid times, implying that Lite Mode 3 (observer-based) would not be adequate.

2. This run estimated 27 total parameters consisting of: 3 constant and 6 linear plate scales,4 Gamma Dependent parameters, 2 mirror parameters, 3 IPF alignment angles, 3 STA-to-PCRS alignment angles, and 3 gyro bias and 3 gyro bias-drift parameters.

3. Amy Mainzer has indicated that the PCRS measurements for this run were based on a simple center-of-mass algorithm which was accurate to about 0.5 arcseconds (looked like .4" average), which will limit the accuracy of this IPF run. The errors on the PCRS appeared mostly systematic and field dependent, being repeatable and larger the further they were located from the center. This will further limit the accuracy of the IPF run.

4. The linear plate scales were helpful in this run to estimate centroids accurately (see quiver plots in Figures 3-28 through 3-32). The constant plate scales were much smaller than the linear terms.

5. The scan mirror parameter estimates indicate that the mirror spin axis is tilted by 0.7 deg and the scan mirror scale factors are off by 4 percent.

6. There were 227 science centroids in the science data set, and 63 PCRS measurements. The data set was coordinated as 7 sandwich maneuvers. The number of science and PCRS centroids was sufficient to identify all 27 parameters.

7. This run was made using BodyFrames_SPC_08a which was a special frame table incorporating the 40 star Stage 2 PAC filter run results.

We recommend updating frames 95, 96, 99, 100, 103 and 104 with the new quaternions listed in the IF file IF001095.dat. This contains adjustments of 0.35 and 0.6 arcseconds in Y and Z, and .06 deg in twist (for the prime frame). In our best judgment, these frames will be accurate to better than 0.3 arcsecond (disregard the accuracies quoted in the the tables).

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References

[1] D.S. Bayard, B.H. Kang, *SIRTF Instrument Pointing Frame Kalman Filter Algorithm*, JPL D-Document D-24809, September 30, 2003.

[2] B.H. Kang, D.S. Bayard, *SIRTF Instrument Pointing Frame (IPF) Software Description Document and User's Guide*, JPL D-Document D-24808, September 30, 2003.

[3] D.S. Bayard, B.H. Kang, *SIRTF Instrument Pointing Frame (IPF) Kalman Filter Unit Test Report*, JPL D-Document D-24810, September 30, 2003.

[4] *Space Infrared Telescope Facility In-Orbit Checkout and Science Verification Mission Plan*, JPL D-Document D-22622, 674-FE-301 Version 1.4, February 8, 2002.

[5] *Space Infrared Telescope Facility Observatory Description Document*, Lockheed Martin LMMS/P458569, 674-SEIT-300 Version 1.2, November 1, 2002.

[6] *SIRTF Software Interface Specification for Science Centroid INPUT Files (CAFILE, CSFILE)*, JPL SOS-SIS-2002, November 18, 2002.

[7] *SIRTF Software Interface Specification for Inferred Frames Offset INPUT Files (OFILE)*, JPL SOS-SIS-2003, November 18, 2002.

[8] *SIRTF Software Interface Specification for PCRS Centroid INPUT Files (CBFILE)*, JPL SIS-FES-015, November 18, 2002.

[9] *SIRTF Software Interface Specification for Attitude INPUT Files (AFILE, ASFILE)*, JPL SIS-FES-014, January 7, 2002.

[10] *SIRTF Software Interface Specification for IPF Filter Output Files (IFFILE, LGFILE, TARFILE)*, JPL SOS-SIS-2005, November 18, 2002.

[11] R.J. Brown, *Focal Surface to Object Space Field of View Conversion.* Systems Engineering Report SER No. S20447-OPT-051, Ball Aerospace & Technologies Corp., November 23, 1999.