Jet Propulsion Laboratory
California Institute of Technology

Memorandum

AIRS ADF#837

To	AIRS Calibration Team	**From**	Margie Weiler
Department	JPL	Department	JPL/ATK Space
Location		Location	P.O. Box 767, Bradford, NH 03221
Date	February 19, 2013	cc	
Telephone	[redacted]	Ref	
Fax	[redacted]		
Email	[redacted]		
Subject	AIRS Correlated Noise: New Data from Space View Test 245		

I. SUMMARY

In an earlier memo, data from C7/8 space view noise tests were used to calculate the correlated noise of AIRS channels.[1] The following properties were shown:

1. The noise is correlated within each read-out integrated circuit (ROIC) module, not between modules.
2. The correlated noise is similar in all instrument environments.
3. The correlated noise is independent of the scene temperature.
4. Some modules have shown significant changes in the correlated noise with thermal cycles of the Focal Plane Array (FPA).
5. The temporal frequency spectrum of the correlated noise is approximately flat, i.e. it is not 1/f noise.
6. The strongest correlation is among channels with either A or B weights, and the correlation is weakest or even negative between channels with A and B weights.
7. The correlation of noisy channels shows a very broad distribution of values compared to low-noise channels.

The tests analyzed all used the flight gain tables (AB/Opt weights). Recently a new C7/8 test, 245, was conducted with the current AB/Opt weights. In this memo the correlated noise data are compared with the earlier data. There appears to be no significant change since the last flight C7/8 test.

Noise covariance matrices have been calculated from the test data associated with each in-flight gain table.[2] These matrices are available for use in adjusting the weights in regression calculations using AIRS measured radiances.[3]

II. RESULTS

Detailed descriptions of the tests and data analysis were given in Ref. 1. A revised script, *sv_nse_corr.m* , was called using a new input script for Test 245 using the STS routine *sts_exec* from the directories *netapp1/insttest/sts/ C7_sv_nse/corr/progs/v2p0*.

Figure 1 shows image plots of the covariance matrices for the most recent 2 tests. The blocks of correlated noise correspond, in approximate order of increasing wavelength down the diagonal, to the 13 distinct photovoltaic (PV) ROIC modules in the AIRS FPA (M1a, M1b, M2a, M2b, M3, M4ab, M4cd, M5, M6, M7, M8, M9, M10), and to the 3 separate "clips" within each of the 2 photoconductive (PC) modules M11, and M12. The independent PV detector modules M4a and M4b share a single ROIC, here denoted M4ab; similarly M4c and M4d share the ROIC denoted M4cd. This establishes the important point that the correlated noise arises within each PV ROIC module or PC clip.

Figure 1 shows only very small changes in the 10 years between Test 117 (conducted 10/23/02) and Test 245 (11/23/12). In both plots data for known "poor" channels (channel properties file States 3 or greater) have been set to zero; the location of dark cross-lines visible for these channels has changed slightly due to changes in the detector noise, due primarily to channel weight changes and degradation after radiation hits. There are also a few bright cross-lines in both plots due to noisy channels not in poor states; there are more of these in the lower plot for degraded channels not yet given poor states.

The results for the module-median variance and covariance values are summarized in Table 1.

Figure 2 shows image plots of the correlation coefficients for Test 111 and 245, again showing very little change. The effect of marginally-noisy channels is less visible in these plots because of the normalization by the diagonal (variance) values.

Apart from the small changes in marginally-noisy channels, the results show that the AIRS correlated noise has been stable over the 10 year flight mission.

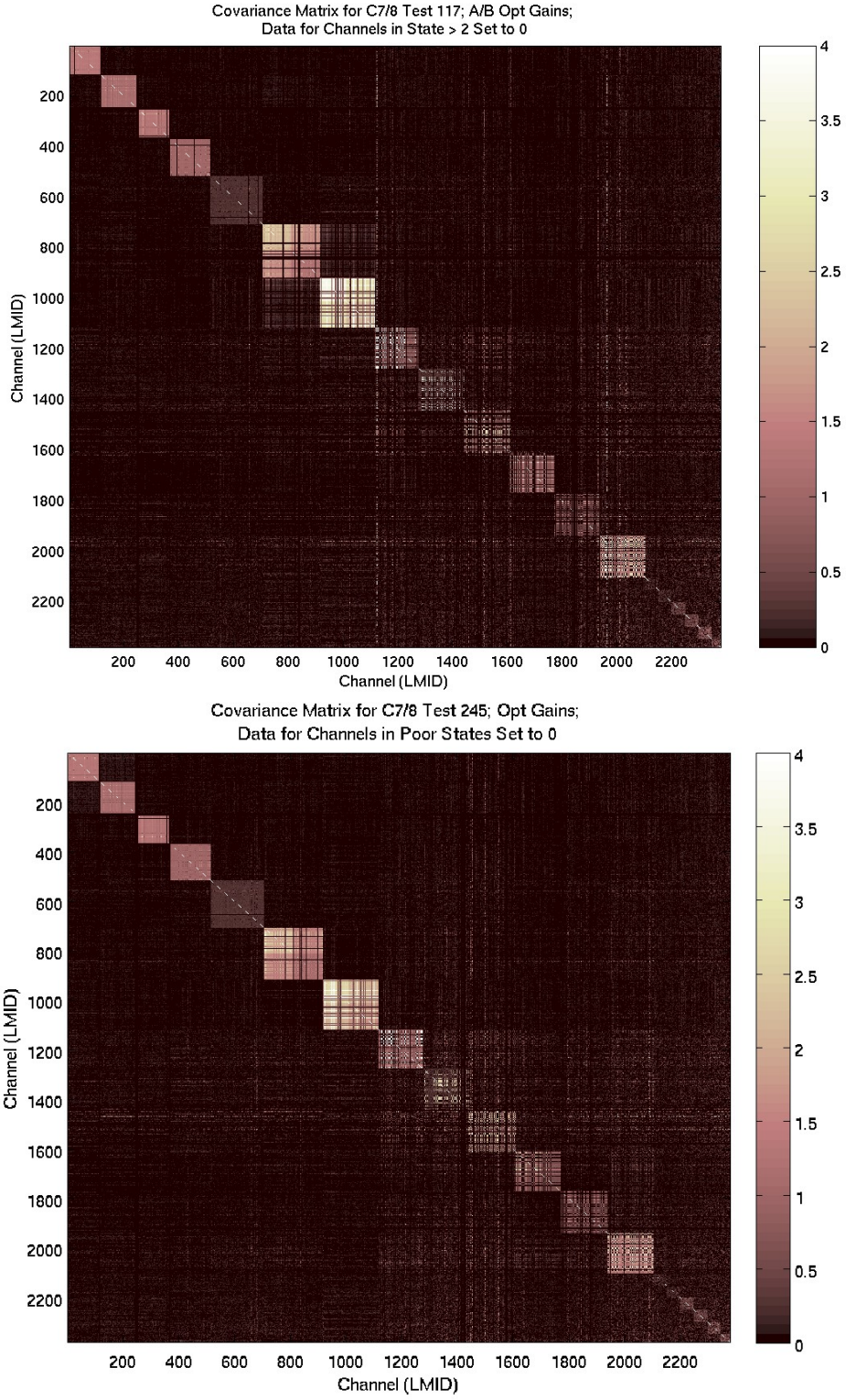

Figure 1. Image plots of the covariance matrix for in-flight C7 Space View Noise Test 117 (upper plot) and 245 (lower plot), with A/B Opt gains, showing blocks of within-module correlated noise.

Table 1. Summary by module of the median diagonal and off-diagonal elements of the covariance matrices for the flight C7/8 Tests 21, 31, 55, 94, 111, 117 and 245 (viewing space, A/B Opt gains).

	Diagonal Elements Variance (dn^2) Space							Off-Diagonal Elements Covariance (dn^2) Space						
Module\Test	21	31	55	94	111	117	245	21	31	55	94	111	117	245
M1a	4.03	3.97	3.94	3.95	4.04	4.00	4.00	1.39	1.36	1.34	1.29	1.37	1.36	1.32
M1b	4.65	4.55	4.54	4.85	4.80	4.78	4.93	1.15	1.11	1.12	1.16	1.15	1.12	1.14
M2a	3.95	3.93	3.94	4.07	4.03	4.08	4.07	1.29	1.26	1.29	1.32	1.28	1.31	1.26
M2b	3.88	3.88	3.78	4.16	4.17	4.13	4.22	1.07	1.08	1.02	1.05	1.06	1.02	1.00
M3	3.60	3.66	3.72	4.02	4.14	4.11	4.36	0.24	0.25	0.25	0.25	0.25	0.26	0.26
M4a	4.92	4.97	5.93	5.93	5.83	5.99	6.15	1.77	1.79	2.45	2.25	2.11	2.29	2.12
M4b	3.79	3.88	4.21	4.30	4.27	4.46	5.12	0.98	1.01	1.26	1.23	1.18	1.24	1.17
M4c	6.44	6.39	6.37	6.80	6.83	6.79	6.11	3.62	3.60	3.56	0.92	3.56	3.55	2.62
M4d	5.16	5.15	5.19	5.53	5.52	5.59	5.11	2.25	2.24	2.23	2.18	2.17	2.16	1.68
M5	15.30	15.13	15.08	16.49	16.94	18.08	19.18	0.70	0.69	0.54	0.41	0.41	0.61	0.88
M6	11.71	10.72	11.42	12.94	12.85	13.77	13.84	0.23	0.24	0.28	0.27	0.24	0.23	0.22
M7	11.87	11.57	10.95	12.24	12.78	13.31	13.53	0.55	0.56	0.64	0.60	0.56	0.56	0.53
M8	4.25	4.39	4.30	4.24	4.10	3.69	4.96	0.65	0.56	0.46	0.59	0.63	0.66	0.53
M9	6.73	6.80	7.01	6.94	7.04	7.55	7.88	0.45	0.42	0.39	0.40	0.43	0.41	0.40
M10	16.91	16.88	17.09	17.88	17.57	18.35	18.84	1.29	1.29	1.35	1.34	1.35	1.34	1.31
M11	17.27	17.50	17.60	17.92	17.71	17.94	18.36	0.07	0.07	0.06	0.07	0.06	0.06	0.07
M12	34.32	34.46	35.23	35.29	35.09	35.64	36.36	0.15	0.14	0.14	0.15	0.15	0.15	0.14

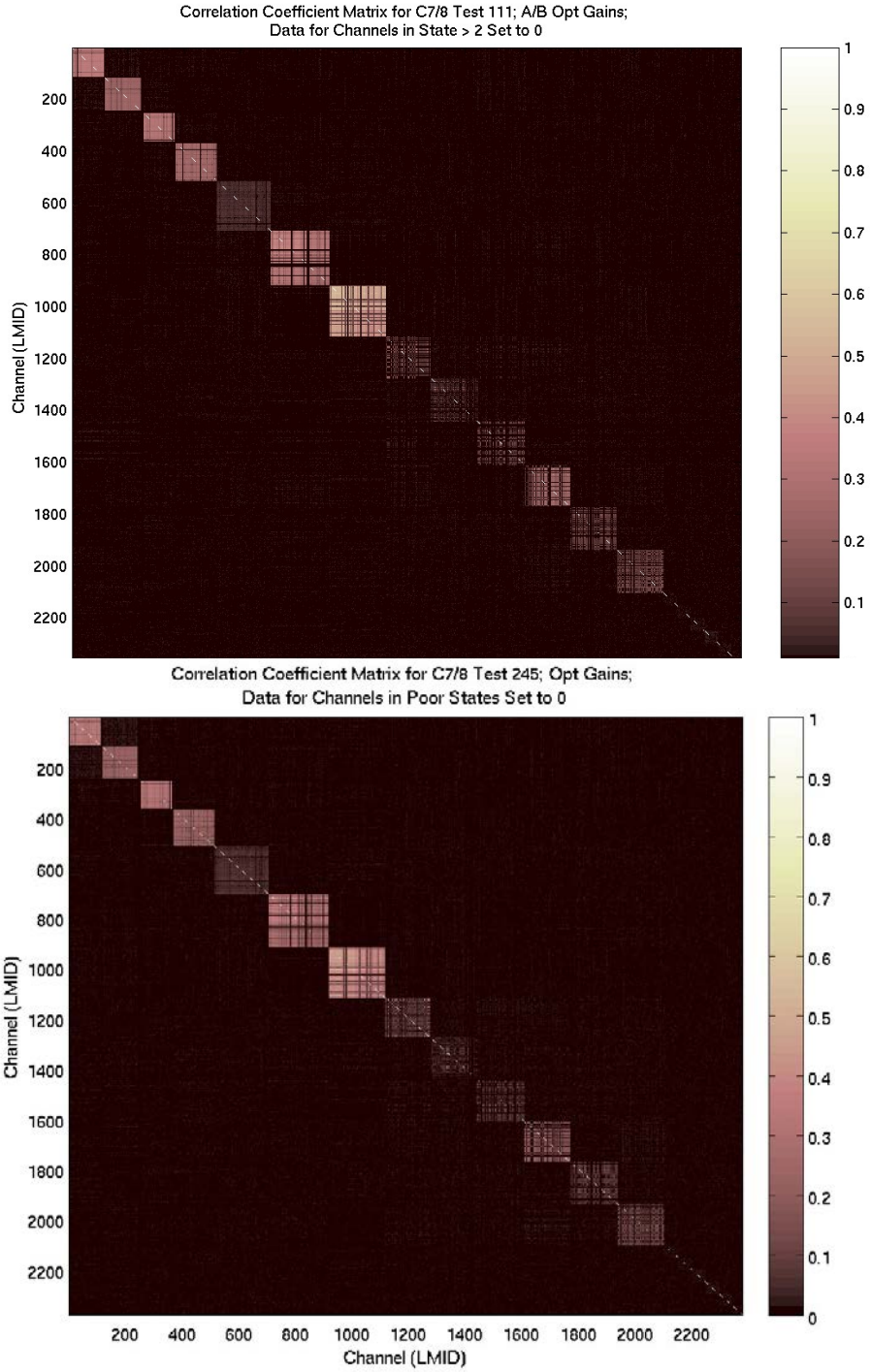

Figure 2. Image plots of the correlation coefficients for in-flight C7 Space View Noise Test 111 (upper plot) and 245 (lower plot).

[1] M. Weiler, “Investigation of AIRS Correlated Noise,” ADF#620.
[2] M. Weiler, “AIRS-C2/C7: A/B Opt Gain Selection,” ADF#602; the list of gain table uploads has not been updated to include the most recent one, #11, on January 21, 2012.
[3] The covariance matrix files for tests beginning with 111 are in the directory */netapp1/insttest/sts/ /C7_sv_nse/corr/outputs/flt/* with names *cov_mat_NNN.mat*, where *NNN* is the test number. The files contain 2378x2378 matrices of covariance values, in units of dn^2, for the channels in LMID order. Files from older tests are in the directory */home/mweiler/C7_corr/cov_mat.*