REPORT TITLE	DOCUMENT NUMBER
Prediction of momentum imparted to the spacecraft by the scan mirror	SDL/09-240
PREPARED BY	**DATE**
Joel Cardon	4/22/2009

1. INTRODUCTION

The scan mirror is required to impart no more than 3e-4 N-m to the spacecraft (see Section 5.9 of the Spacecraft/Payload ICD). This report discusses the predicted torque, which is 9.5e-5 N-m.

2. DISCUSSION

The scanner will impart a torque to the payload about the z axis during periods of scanner acceleration

1) Scan to fly-back
2) Fly-back to scan

The maximum acceleration during these transitions is approximately 2200 arcmin/sec^2 (see scanner velocity memorandum from SSG-Tinsley in the Appendix). The rotational moment of inertia about the scanner z axis has been measured at SSG-Tinsley to be 2.1e-2 in-oz-sec^2.

Estimated torque about the scanner z axis:

Scanner rotational moment of inertia (measured): $I_{scanner} := 2.1 \cdot 10^{-2} \cdot in \cdot ozf \cdot sec^2$

Maximum scanner angular acceleration (measured): $\alpha_{scanner} := 2200 \cdot \frac{arcmin}{sec^2}$

$arcmin \equiv \frac{1}{60} \cdot deg$ $\tau_{scanner} := I_{scanner} \cdot \alpha_{scanner}$ $\tau_{scanner} = 0.013\ in \cdot ozf$ $\tau_{scanner} = 9.49 \times 10^{-5}\ N \cdot m$

The scanner z axis is parallel to the payload z axis, and the distance between the scanner axis and the parallel axis through the point [-0.012, -0.03, 0.709] meters (payload coordinate system) is Δx = -0.8008 inches and Δy = -2.0779 inches. The system was modeled using Adams as shown in Figure 1, and the torque FORCE_1 is found to be the same as the torque FORCE_2, i.e. the torque about the axis

parallel to the payload z axis and passing through the point [-0.012, -0.03, 0.709] meters is 9.5e-5 N-m.

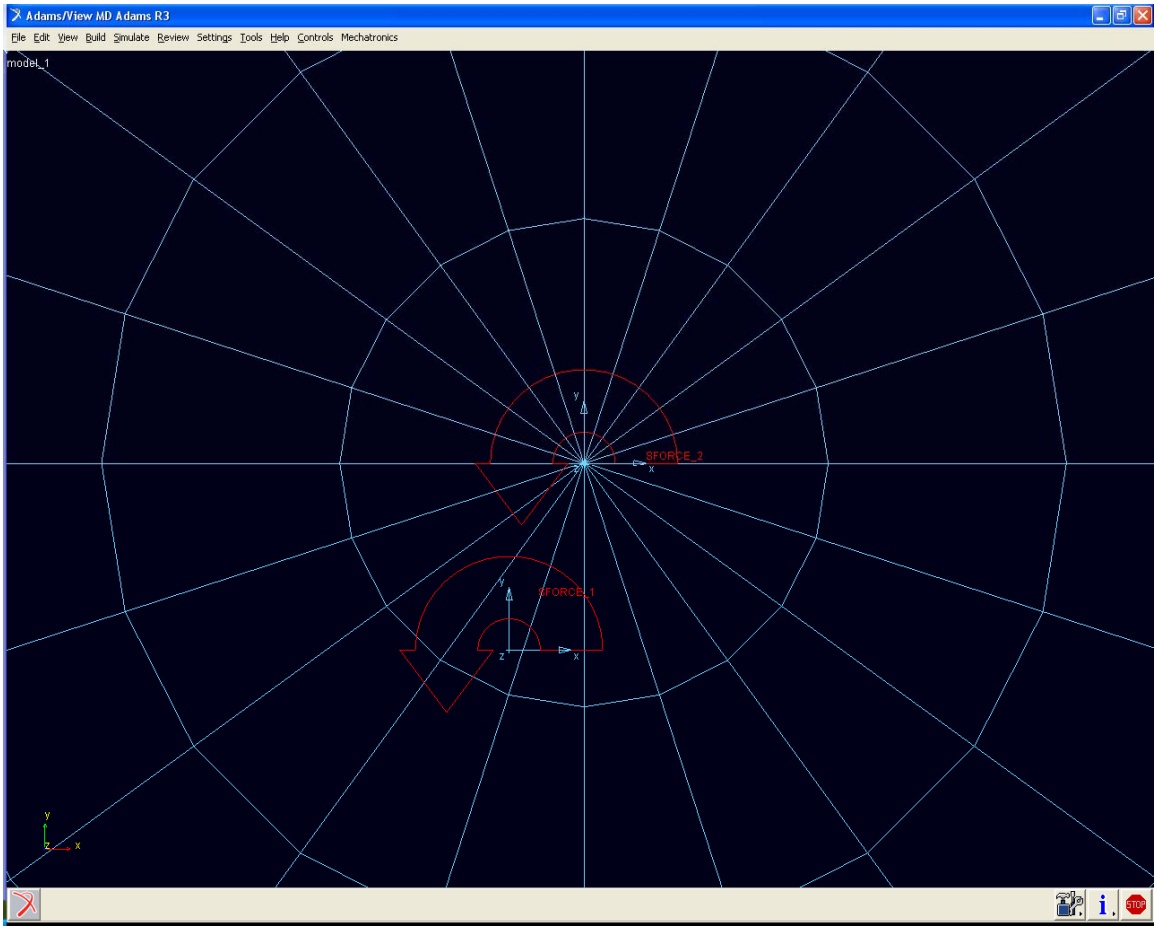


Figure 1. **Simulation of scanner torque (FORCE_2) and resultant torque about z-axis passing through point [0.012, -0.03, 0.709] meters in the payload coordinate system**

3. CONCLUSION

The payload complies with the requirement.

APPENDIX

Memorandum

To: Mark Larsen, SDL USU

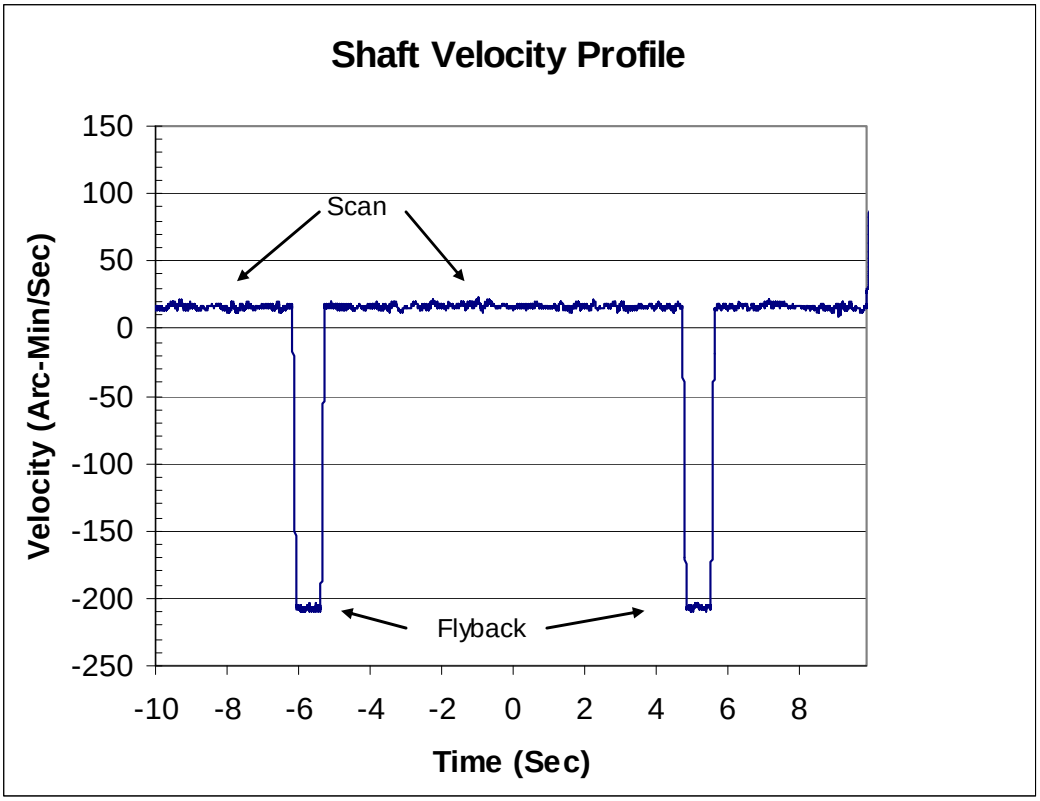
From: Mark Barry

Date: 05 FEB07

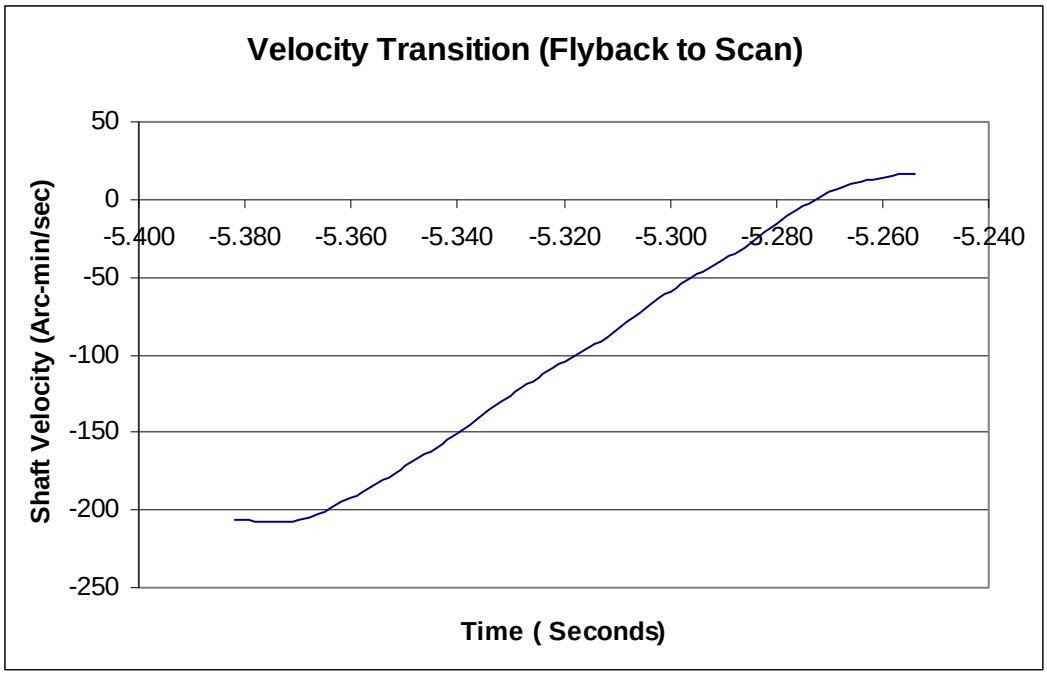
Subject: WISE Scanner Acceleration

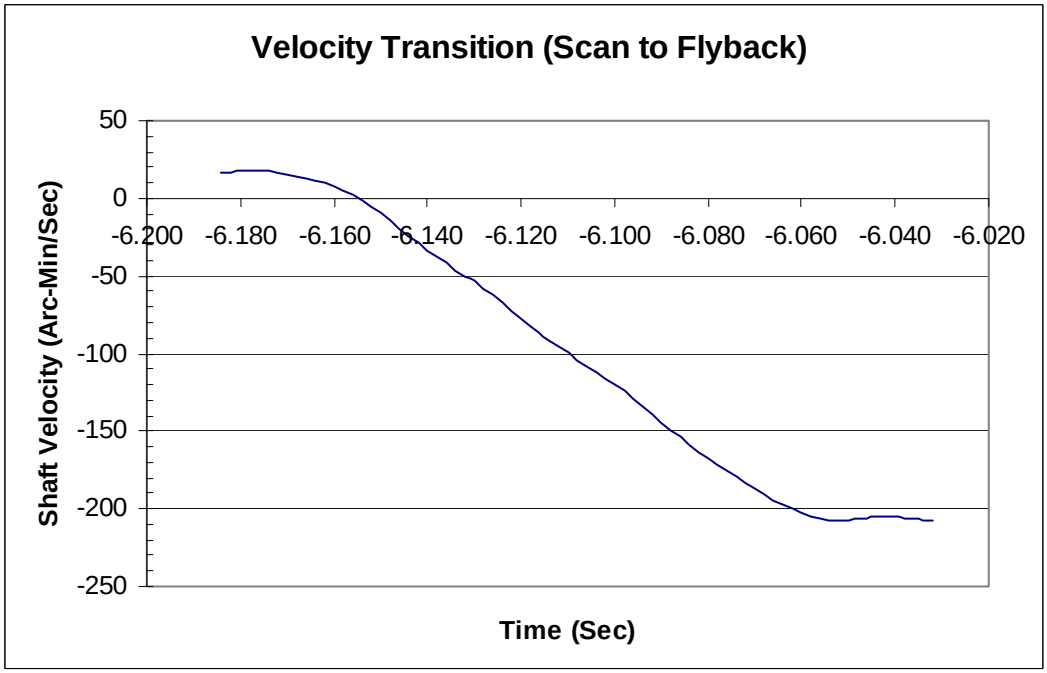
Mark,

Jack Regan was able to capture an analog signal from the AD2S80 during a scan that represents velocity. The scan is obtained with a 15 command. This results in a scan velocity of 15.8 Arc-Min / Sec and a fly-back velocity greater than 200 Arc-Min / Sec. Unfortunately the captured signal is extremely noisy by nature. The wave form below is the result of filtering the original signal and scaling to match the known amplitude.

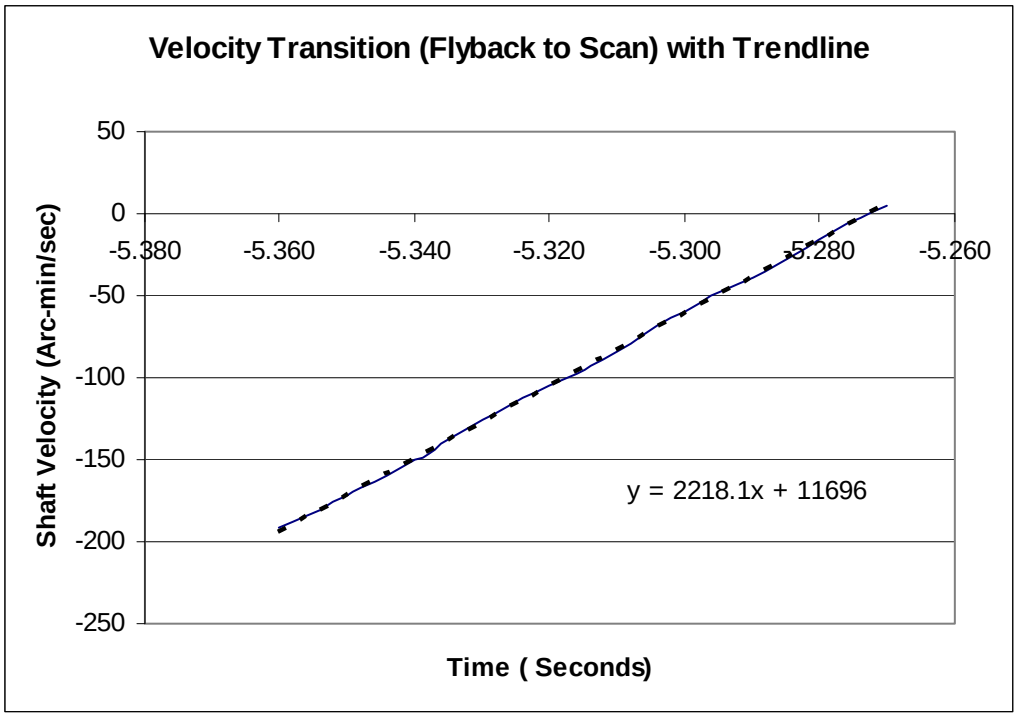


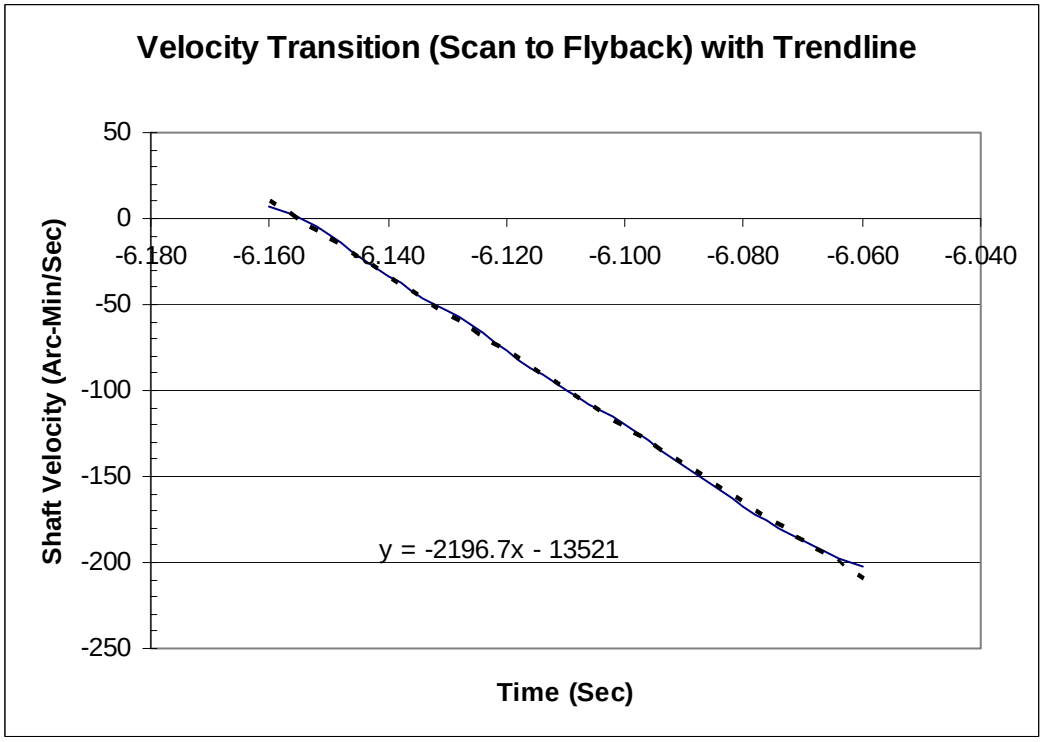
The areas of interest are the transitions from scan to fly-back and fly-back to scan shown in the next two charts.





As can be seen from the charts, the velocity profile is well behaved. This is consistent with observations of the scanner in motion. In the next two charts the steepest slope of the velocity profile is plotted with a trend line added. The equations of the trend line are on the chart. The maximum acceleration is approximately 2200 Arc-Min/ Sec^2


Velocity Transition (Flyback to Scan) with Trendline
Shaft Velocity (Arc-min/sec)
50
0
-50
-100
-150
-200
-250
-5.380
-5.360
-5.340
-5.320
-5.300
-5.280
-5.260
y = 2218.1x + 11696
Time (Seconds)


Velocity Transition (Scan to Flyback) with Trendline
Shaft Velocity (Arc-Min/Sec)
50
0
-50
-100
-150
-200
-250
-6.180
-6.160
-6.140
-6.120
-6.100
-6.080
-6.060
-6.040
y = -2196.7x - 13521
Time (Sec)