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FINAL REPORT

TASK MSC/STL A-1

LEM POWERED ASCENT ERROR ANALYSIS STUDY (U)

NAS 9-2938

21 JUNE 1965

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Prepared by J. L. Knoedler
J. L. Knoedler, Task Manager

Approved by C. V. Stableford
C. V. Stableford, Manager
Manned Spaceflight Department

Approved by J. G. Reid
J. G. Reid, Manager
Mission Design and Analysis
Mission Trajectory Control Program

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FOREWORD

This final report is submitted to MSC in accordance with Task MSC/STL A-1 of the Mission Trajectory Control Program, Phase II, Contract NAS9-2938. It contains all the results of the error analysis of the LEM powered ascent. The primary use of the covariances generated in this error analysis is to serve as initial data for the LEM midcourse and rendezvous error analysis (Task MSC/STL A-2). The results of the safe pericynthion analysis will aid in evaluating the direct ascent and the parking orbit modes of the LEM powered ascent.

SUMMARY

The purpose of this study was to conduct an error analysis of the LEM ascent to determine the dispersions at injection resulting from uncertainties in the LEM initial position and in the parameters associated with the guidance and propulsion systems. The results of the error analysis were to be summarized in a set of covariance matrices which imply the probabilities associated with the dispersions. The ascent simulation was to be made with the STL Multivehicle-N-Stage (MVNS) program including a simulation of the LEM guidance equations. The initial task assignment also requested an analysis of the probability of maintaining a safe pericynthion altitude during ascent trajectories.

The transformation sensitivity matrices were generated for several direct ascent and parking orbit cases. These and the resulting covariance matrices appeared to be, to a large extent, trajectory independent. It was concluded that for studies which did not demand extreme accuracy a single covariance matrix could be used with reasonable success.

The safe pericynthion analysis showed that all direct ascent cases which injected into the transfer orbit at pericynthion at a nominal altitude of 50,000 feet were in no danger of having a pericynthion altitude of lower than 35,000 feet. However, in the parking orbit cases there was indication that further study should be made concerning the nominal parking orbit altitude of 50,000 feet. The probability of having a pericynthion altitude of 35,000 feet with a nominal circular altitude of 50,000 feet was somewhat greater than 81 per cent.

In addition to the above analysis, the error source magnitudes were varied to determine if the partial derivatives were linear over a wide range. It was determined that, indeed, the partials due to the error sources were linear and that Monte Carlo methods were not needed.

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1. INTRODUCTION

1.1 PURPOSE

TRW/Space Technology Laboratories has conducted an error analysis of the LEM ascent at the request of the NASA Manned Spacecraft Center under MSC-STL Task A-1. The purpose of the study was to provide covariance matrices of the actual errors from a reference state vector, and covariance matrices of the errors in the estimate of the actual state vector at injection. These matrices were computed from the linear transformation matrices (partial derivatives); and from initial covariance matrices of uncertainties in the LEM lift-off state vector, in the Inertial Measurement Unit (IMU), and in the propulsion system. The results of an analysis of the pericynthion altitude were also to be provided.

This document contains the transformation sensitivity matrices and the covariance matrices of errors at injection for the several representative ascent trajectories as requested by MSC. The results of the study of the safe pericynthion problem are also presented. This document is supplemented by a companion volume which describes the ascent guidance equations as programmed into a version of TRW/STL's Multivehicle-N-Stage Program (Reference 1).

1.2 METHOD OF APPROACH

As indicated in the initial Task Implementation Plan (Reference 2), the task was divided into several subtasks, many of which were carried on concurrently. However, it was evident from the time schedule that there were two distinct phases. The first of the phases was essentially the modification of existing programs in order to generate sensitivity matrices for the LEM ascent. It became evident early in the study that it would be desirable to use only one program, instead of the two originally planned, to propagate all errors from lift-off to injection. Therefore, the LEM ascent guidance equations were programmed in such a manner that all IMU and propulsion system errors could be simulated at the same time as the errors in the initial state vector.

The second phase was the generation of the covariance matrices by the use of a matrix manipulation program which output the covariance matrices of the dispersions of the state vectors at insertion. The inputs

to this program were the sensitivity matrices as generated by the MVNS and the initial covariance matrices at lift-off.

The output of the safe pericynthion analysis was the probability of having an acceptable pericynthion altitude after considering all the effects of all the errors upon the trajectory being analyzed. A covariance matrix at insertion for a direct ascent gives little physical understanding of the actual miss at the target. Therefore, this miss distance was calculated and presented as a physical measurement which can be used in comparing one ascent trajectory with another. For the parking orbit cases a set of orbital elements was devised which separates the elements describing the miss of the burnout point from those describing the extent to which a circular orbit was achieved.

1.3 CASES CONSIDERED

The specific direct ascent trajectories analyzed were ones which were considered to be representative of those used over a launch window. Such trajectories were identified by the size of the angle to be coasted through from injection to intercept or rendezvous. The trajectories finally studied were those with transfer angles of 140°, 180°, and 220°, with an additional trajectory which was launched 1° out of the CSM plane and had a 180° transfer angle.

The parking orbit cases were simply an in-plane case and a 1° out-of-plane case. Both ascent trajectories injected the LEM into a circular orbit of 50,000 feet after a powered flight angle of 10°.

1.4 ERROR SOURCES CONSIDERED

The original list of error sources which were to be considered in the LEM ascent simulation included the following:

- Gyro constant drift (each gyro)
- Gyro mass unbalance (each gyro)
- Gyro anisoelasticity (each gyro)
- Gyro misalignment (each gyro)
- Accelerometer bias (each accelerometer)
- Accelerometer scale factor (each accelerometer)
- Accelerometer linearity (each accelerometer)

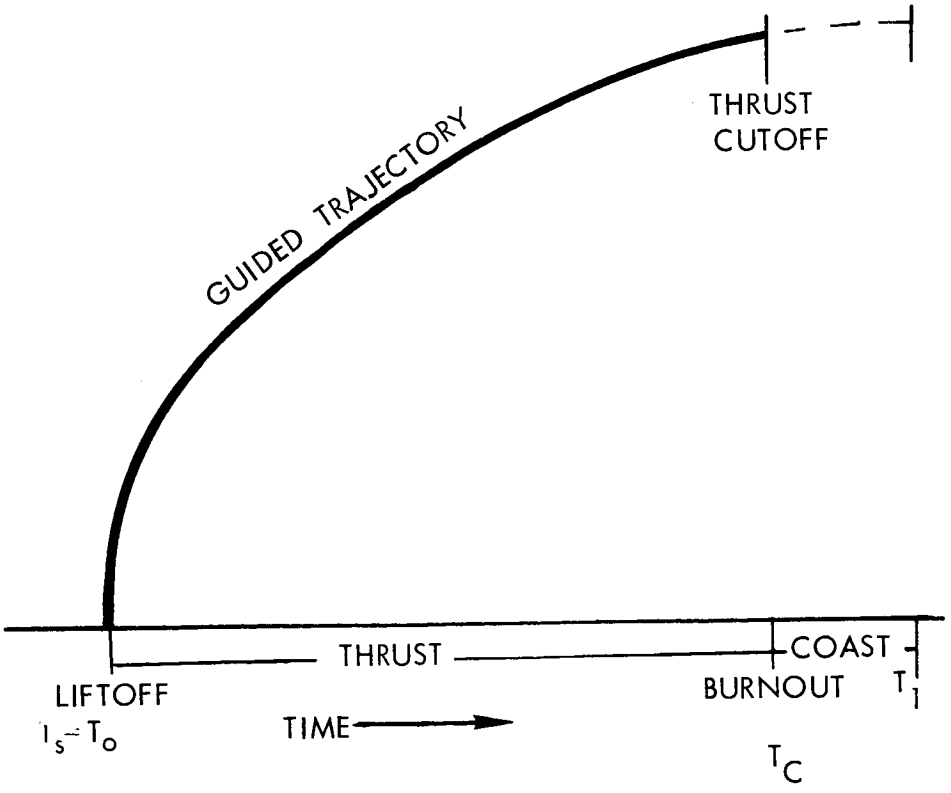
- Accelerometer misalignment (each accelerometer)
- Initial platform misalignment (about each axis)
- I_{SP}
- Weight flow
- Weight
- Total estimate of initial LEM position deviation in each direction
- Total estimate of initial LEM velocity deviation in each direction
- Time to go

During the preliminary check out of the simulation program, it was found that the effect of several of these error sources (namely, gyro mass unbalance, gyro anisoelasticity, gyro misalignment and accelerometer linearity) were insignificant and could be neglected in the final analysis (Reference 1). The small effect of these error sources was expected, and the exclusion of them is common practice. The magnitudes and effects of the error sources will be discussed further in the following sections.

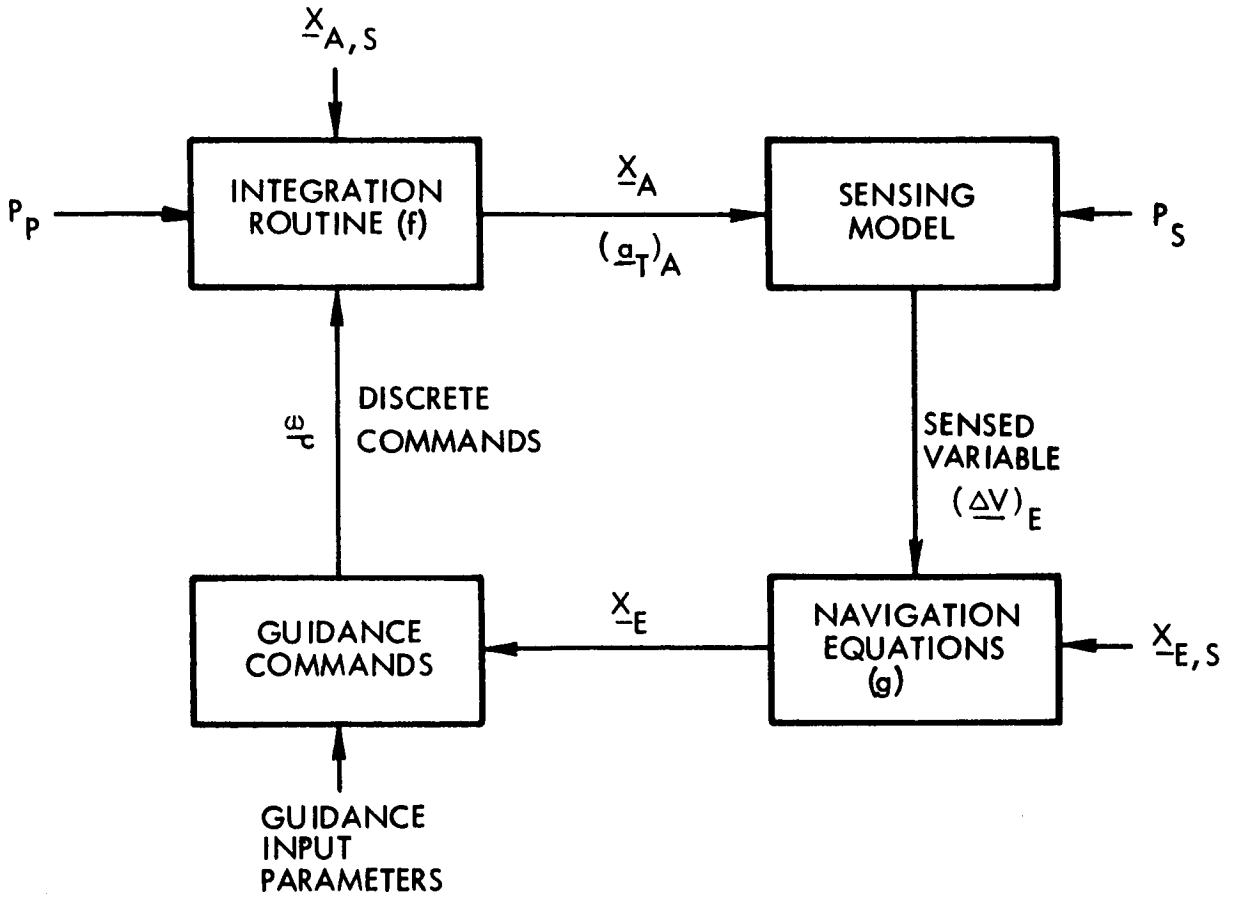
2. GENERATION OF SENSITIVITY MATRICES

2.1 GENERAL DESCRIPTION

The state transition (sensitivity) matrix to be used in the generation of covariance matrices is evaluated between two fixed time points on a guided reference trajectory. A time (T_o) is selected at thrust initiation time ($T_S = T_o$). The end time (T_1) is selected safely beyond the thrust cutoff time (T_C). During the free flight interval (T_C to T_1) the actual state vector ($\underline{X}_A$) is determined by the usual integration procedures of MVNS, while the estimated state vector ($\underline{X}_E$) is updated independently by a more approximate procedure. However, this free flight segment is designed to be of sufficiently short duration (less than 30 seconds) such that the state vector uncertainty ($\underline{X}_A - \underline{X}_E$) does not change significantly. The guided trajectory may be illustrated as:



The guided powered flight simulation of the LEM ascent used in the transformation sensitivity matrices is described in the following flow diagram:



The integration routine used to update the actual state vector ($\underline{X}_A$) is located in the dynamics section of MVNS. This block represents the description of the real world. Required inputs include the vehicle performance parameters (P_p), such as thrust level, mass flow rate, etc., the vehicle attitude, and the turning rates ($\underline{\omega}_c$) commanded by the steering equations. All computations are performed in the selenocentric inertial Cartesian coordinate system.

The sensing model operates on the actual thrust acceleration $(\underline{a}_T)_A$ to compute the velocity increment ($\Delta \underline{V}$) sensed over the previous computation cycle. This vector quantity is first transformed into platform coordinates. It is then mapped by the various error sources considered into the estimated velocity increment due to thrust $(\Delta \underline{V})_E$. The navigation equations update the estimated state of the vehicle based on this estimated velocity increment, the previous estimated state, and the time interval between computations. This block represents the best estimate of the real world as known by the computer.

The implementation of the basic guidance scheme is based on the estimated state, the estimated thrust acceleration, and the guidance input parameters associated with the LEM ascent. A more detailed description of the simulation is presented in Reference 1.

The updating of the estimated state vector (position and velocity) through a powered flight phase is explicitly a function of only the initial estimated state, the vehicle performance parameters, and sensor model. This statement follows from the fact that the only forces which are sensitive to the sensing system are nonpotential forces. The only nonpotential forces which are dependent upon the state vector are small and, therefore, can be neglected. The actual state, however, is affected by not only the initial actual state but also by the estimated state through the guidance commands which are generated. The formal expression of these relationships is:

$$\underline{X}_{A1} = f(\underline{X}_{A0}, \underline{X}_{E0}, P)$$

$$\underline{X}_{E1} = g(\underline{X}_{A0}, \underline{X}_{E0}, P)$$

where P represents collectively the vehicle performance and sensing

parameters P_p and P_s. $\underline{X}_{A0}$ has been included in the expression for $\underline{X}_{E1}$ only for completeness. An earlier statement implies:

$$\frac{\delta X_{E1}}{\delta X_{A0}} = 0.$$

The transformation matrices will be used to propagate deviations from a reference trajectory at time T_o to deviations at injection at time T_1. Time T_o is some time just prior to lift-off and time T_1 is some fixed time shortly after burnout. T_1 is fixed so that all the elements of the sensitivity matrix will be calculated at the same time on the trajectory regardless of burnout time variations due to errors. The actual state vector ($\underline{X}_{A0}$), the estimate ($\underline{X}_{E0}$) and the vehicle performance and sensing parameters (P) at T_o are used in the simulations to compute the actual state vector ($\underline{X}_{A1}$), the estimate ($\underline{X}_{E1}$) and the spacecraft weight (W_1) at T_1. The deviations of these quantities from the reference values lead to the development of the sensitivity matrix which takes the form of:

$$\begin{bmatrix} \frac{\delta \underline{X}_{E1}}{\delta \underline{X}_{E0}} & \frac{\delta \underline{X}_{E1}}{\delta \underline{X}_{A0}} & \frac{\delta \underline{X}_{E1}}{\delta P} \\ \frac{\delta \underline{X}_{A1}}{\delta \underline{X}_{E0}} & \frac{\delta \underline{X}_{A1}}{\delta \underline{X}_{A0}} & \frac{\delta \underline{X}_{A1}}{\delta P} \\ \frac{\delta W_1}{\delta \underline{X}_{E0}} & \frac{\delta W_1}{\delta \underline{X}_{A0}} & \frac{\delta W_1}{\delta P} \end{bmatrix}_{13 \times (12 + N)}$$

The matrix has 13 rows and 12 + N columns, where N is the total number of vehicle performance and sensing perturbations. The 12 + N perturbations are applied one at a time, with each simulation run producing a single column of the matrix. This procedure is repeated with the magnitudes or sign of the perturbations varied. The matrices developed in this study are presented in Appendix C. A comparison of the resulting matrices then gives an indication of the linearity of the individual matrix elements. This linearity will be discussed further in a following section.

By introducing a new notation, the transformation sensitivity matrix can be written symbolically as:

$$\begin{bmatrix} \theta_1 & \theta_2 & \theta_3 \\ \psi_1 & \psi_2 & \psi_3 \\ W_E & W_A & W_P \end{bmatrix} \qquad 13 \times (12 + N)$$

where θ_2 is zero.

The propagation of errors across a powered flight segment can then be represented by the following set of equations:

$$\delta \underline{X}_{E1} = \theta_1 \, \delta \underline{X}_{E0} + \theta_2 \, \delta \underline{X}_{A0} + \theta_3 \delta P$$

$$\delta \underline{X}_{A1} = \psi_1 \, \delta \underline{X}_{E0} + \psi_2 \, \delta \underline{X}_{A0} + \psi_3 \delta P$$

$$\delta W_1 = W_A \, \delta \underline{X}_{E0} + W_E \, \delta \underline{X}_{A0} + W_P \delta P$$

2.2 CASES CONSIDERED

2.2.1 Direct Ascent Trajectories

The initial reference trajectories to be used in the check of the modified MVNS program were furnished by MPAD of MSC. The MVNS program generated trajectories which nearly matched those supplied. The discrepancies between the STL generated and MSC supplied trajectories were attributed to a more detailed lunar model in the MVNS program. After the trajectory generation capability of the MVNS program had been demonstrated, STL calculated the target vectors to be used in all cases analyzed.

The specific direct ascent trajectories decided upon were ones which would be flown during a typical launch window. These trajectories were identified by the size of the angle to be coasted through from injection to intercept, and by the fact whether they were launched into or out of the CSM orbit plane.

The trajectories considered for this report were those with transfer angles of 140°, 180°, and 220° and launched in the CSM plane. The out-of-plane trajectory considered was launched 1° out of the CSM plane

and had a transfer angle of 180°. The 140° case was originally designed to intercept the CSM at apocynthion since this would require the longest transfer time and, therefore, the least fuel. However, such a transfer proved not to be acceptable because of its inherent low pericynthion and its low probability of having a "safe" pericynthion. Therefore, an additional 140° transfer case, which injected at pericynthion and intercepted the CSM orbit before apocynthion, was considered in the pericynthion analysis. All results given in this report for the 140° transfer describe the second trajectory unless otherwise specified.

The 220° case requires that pericynthion be at the burnout altitude to avoid colliding with the moon before interception. If interception of the CSM after a 220° transfer had been designed to be at apocynthion, the trajectory's pericynthion would be between the injection and intercept points. This trajectory consistently intercepted with the moon's surface. Therefore, a trajectory which injected at pericynthion and intercepted the CSM orbit after apocynthion was the one considered in this study.

The launch point for the direct ascent, in-plane cases was at $+0.5^{\circ}$ latitude, $+10^{\circ}$ longitude. The out-of-plane trajectory was launched from $+1.5^{\circ}$ latitude, $+10^{\circ}$ longitude. In all cases the CSM plane had a 0.5° inclination and the launch azimuth was 90° (and parallel to the CSM plane).

These launch coordinates were taken from the reference trajectories furnished by MSC. The launch coordinates were transformed into selenographic coordinates, the burnout vector calculated 10° downrange, and the target vector at the prescribed angle beyond that. All vectors were changed to selenocentric coordinates so that all the sensitivity matrices and, consequently, the covariance matrices were calculated in selenocentric coordinates.

2.2.2 Parking Orbit Ascent Trajectories

The two trajectories which were considered sufficient to represent the LEM ascents into a 50,000 feet circular parking orbit were an ascent trajectory which was launched from a point in the CSM plane and one which was launched from a point 1° out of the CSM plane. Both ascent trajectories were designed to establish a circular parking orbit in the plane of the CSM.

The launch coordinates for the in-plane case were 0° latitude, 0° longitude. For the out-of-plane case they were $+1^{\circ}$ latitude, 0° longitude. In both trajectories the launch azimuth was 90°.

2.3 ERROR SOURCES

The error sources and magnitudes used in this error analysis were selected by TRW/STL and approved by MSC. The ones specifically used in this analysis are summarized in Table 2-1. All of the errors are assumed to be Gaussian with a zero mean and are random in the sense that they are independent from one simulated flight to the next.

The deviations in the actual and estimated state vectors are measured with respect to the nominal guided reference trajectory. Perturbations as large as 5 sigma were used in developing the sensitivity matrices to test the linearity of the partials over a reasonably large range.

The errors in the vehicle performance and sensing parameters are specified by their 3 sigma values. The weight, weight flow, and specific impulse errors (3 sigma) are specified by percentages of the nominal values. (A complete summary of the basic hardware used in the simulation is presented in Appendix A).

As in the case of all other error sources the perturbations in weight flow and specific impulse are applied individually in generating the sensitivity matrices. This implies that a partial derivative with respect to one of the parameters is evaluated while the other is held equal to its nominal value.

2.4 LINEARITY OF PARTIAL DERIVATIVES

The state transition sensitivity matrices for all cases considered in this study are presented in Appendix C in both selenocentric and orbit plane coordinates. The matrices corresponding to +3 and -3 sigma perturbations in the same coordinate system for each trajectory are quite similar. This fact indicates that the partial derivatives which are the elements of the state transition matrix for any particular trajectory are linear. If the partial derivatives are linear, the sensitivity matrices used in the calculation of the covariance matrices can be generated by any set of perturbations , and there would be no need to generate sample

Table 2-1. Magnitude of $\pm 3\sigma$ Perturbations in the LEM Error Sources

Error Source	Symbol	Magnitude
Estimated x Position Component	(x_e)	$\pm$ 3000 ft
Estimated y Position Component	(y_e)	$\pm$ 3000 ft
Estimated z Position Component	(z_e)	$\pm$ 3000 ft
Estimated x Velocity Component	$(\dot{x}_e)$	$\pm$ 0.3 ft/sec
Estimated y Velocity Component	$(\dot{y}_e)$	$\pm$ 0.3 ft/sec
Extimated z Velocity Component	$(\dot{z}_e)$	$\pm$ 0.3 ft/sec
Actual x Position Component	(x_a)	$\pm$ 3000 ft
Actual y Position Component	(y_a)	$\pm$ 3000 ft
Actual z Position Component	(z_a)	$\pm$ 3000 ft
Actual x Velocity Component	$(\dot{x}_a)$	$\pm$ 0.3 ft/sec
Actual y Velocity Component	$(\dot{y}_a)$	$\pm$ 0.3 ft/sec
Actual z Velocity Component	$(\dot{z}_a)$	$\pm$ 0.3 ft/sec
Initial Platform Misalignment Angle	(PHIS)	$\pm$ 0.114 deg
Initial Platform Misalignment Angle	(PHIT)	$\pm$ 0.114 deg
Initial Platform Misalignment Angle	(PHIU)	$\pm$ 0.114 deg
Platform Drift Rate Component	(OMX)	$\pm 0.125 \times 10^{-3}$ deg/sec
Platform Drift Rate Component	(OMY)	$\pm 0.125 \times 10^{-3}$ deg/sec
Platform Drift Rate Component	(OMZ)	$\pm 0.125 \times 10^{-3}$ deg/sec
Accelerometer Misalignment Angle	(EXY)	$\pm$ 0.0172 deg
Accelerometer Misalignment Angle	(EYX)	$\pm$ 0.0172 deg
Accelerometer Misalignment Angle	(EXZ)	$\pm$ 0.0172 deg
Accelerometer Misalignment Angle	(EZX)	$\pm$ 0.0172 deg
Accelerometer Misalignment Angle	(EYZ)	$\pm$ 0.0172 deg
Accelerometer Misalignment Angle	(EZY)	$\pm$ 0.0172 deg
Accelerometer Bias Term	(DBX)	$\pm$ 0.0193 ft/sec^2
Accelerometer Bias Term	(DBY)	$\pm$ 0.0193 ft/sec^2
Accelerometer Bias Term	(DBZ)	$\pm$ 0.0193 ft/sec^2
Accelerometer Scale Factor Term	(KS1)	$\pm 0.3 \times 10^{-3}$
Accelerometer Scale Factor Term	(KS2)	$\pm 0.3 \times 10^{-3}$
Accelerometer Scale Factor Term	(KS3)	$\pm 0.3 \times 10^{-3}$
Specific Impulse	(ISP)	$\pm$ 1%
Weight Flow Rate	(WTFLO)	$\pm$ 1%
Weight	(WT)	$\pm$ 25 lbs
Termination Time	(DTGO)	$\pm$ 0.03 sec

covariance matrices using Monte Carlo techniques. To graphically demonstrate the linearity of the partial derivatives the following figures are presented. Figures 2-1 through 2-11 illustrate the linearity of the deviations in orbit plane position components, orbit plane velocity components, and weight. (See Appendix B, Section 3.) The deviations resulted from representative perturbations in the 180° in-plane direct ascent trajectory. The derivatives were calculated by multiplying the partial derivatives by the value of the perturbation used to generate the partial derivative. The deviations were then plotted against the multiple of the one sigma value of the perturbations. Figures 2-12 through 2-15 illustrate the linearity of deviations in the orbit plane state vector for representative perturbations in the in-plane parking orbit case.

If the state transition sensitivity matrices for all the trajectories are compared in the same coordinate system, it can be seen that the matrices are quite similar; and, therefore, they could be considered to be trajectory independent.

It should be noted that the variation between the elements of the matrices of the in- and out-of-plane cases is greater than the variation between the elements of the matrices of different trajectories. This greater difference eventually leads to greater variation in the covariances and correlations.

In analyses not requiring extreme accuracy the matrices for all the trajectories studied could be summarized by two matrices, one for in-plane cases and one for out-of-plane cases. These matrices would have fewer columns since many of the perturbations which do not cause large deviations at injection could be ignored. It is quite probable for approximate studies that one matrix could be developed to satisfactorily represent all cases.

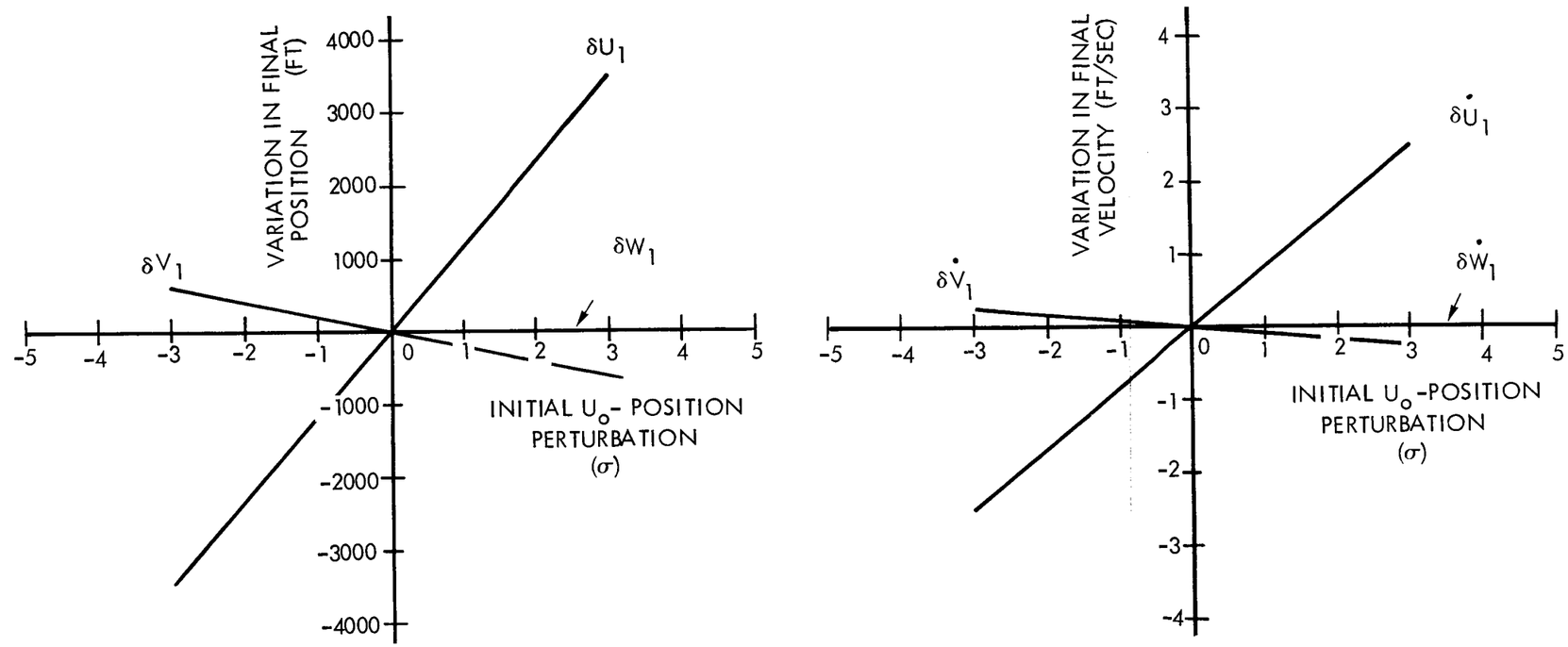


Figure 2-1. Linearity of Position Perturbation

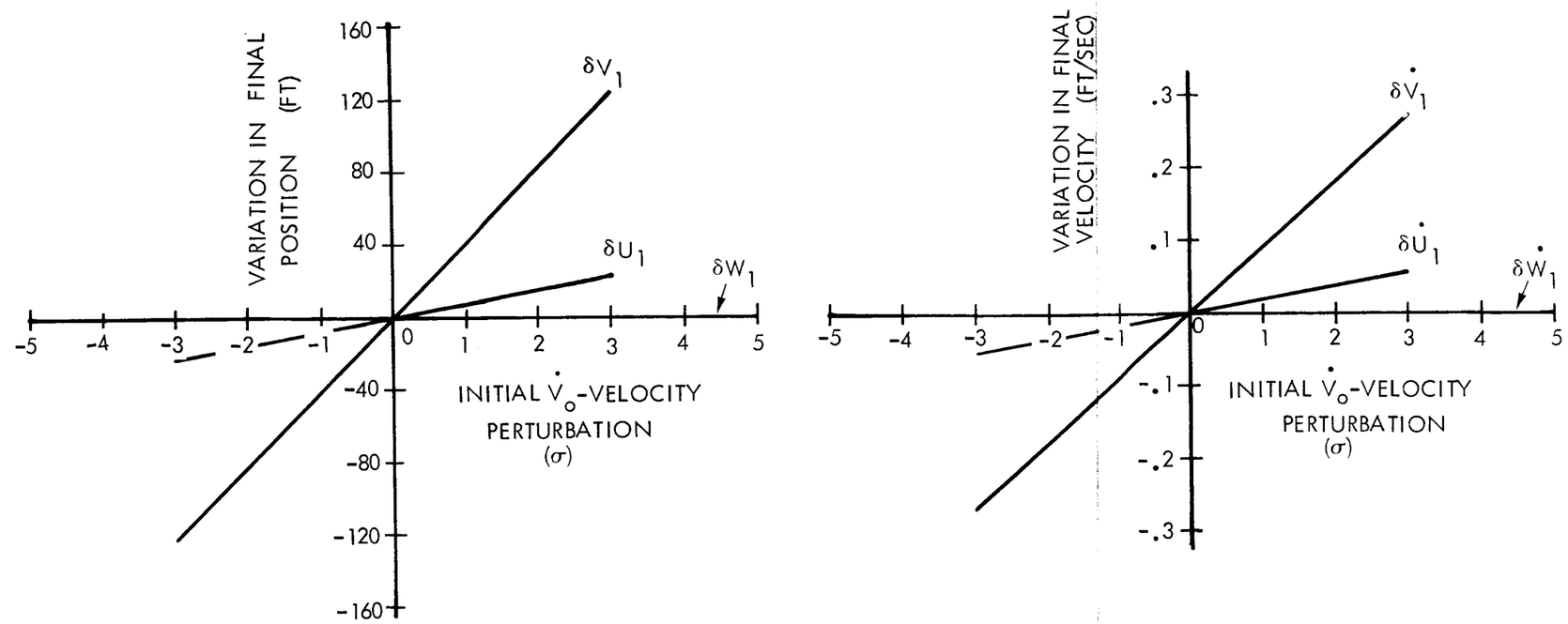


Figure 2-2. Linearity of Velocity Perturbation

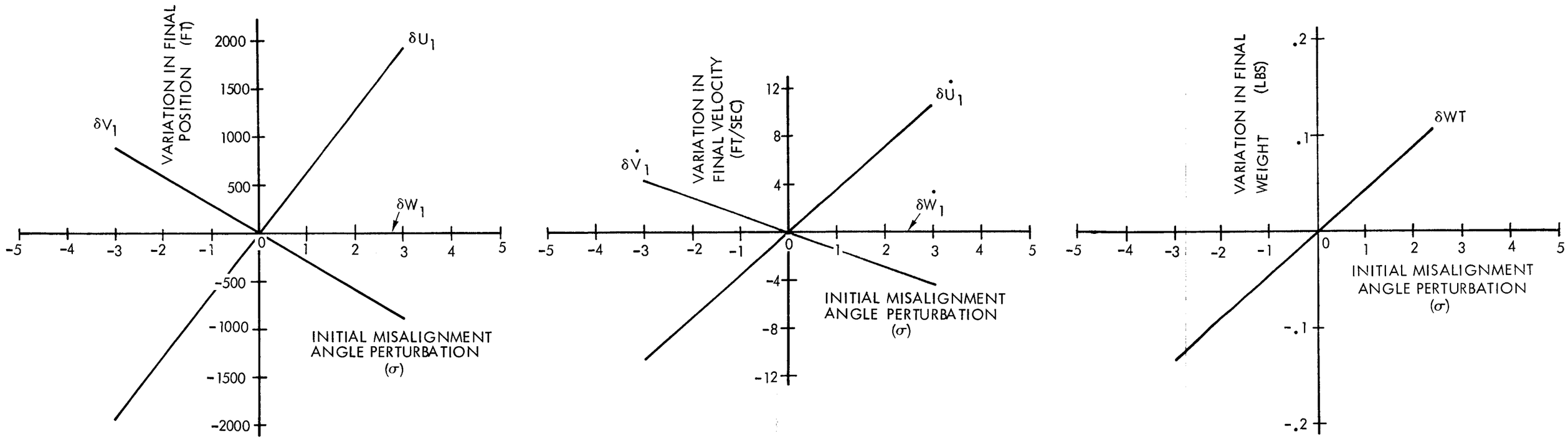


Figure 2-3. Linearity of Platform Misalignment Perturbation

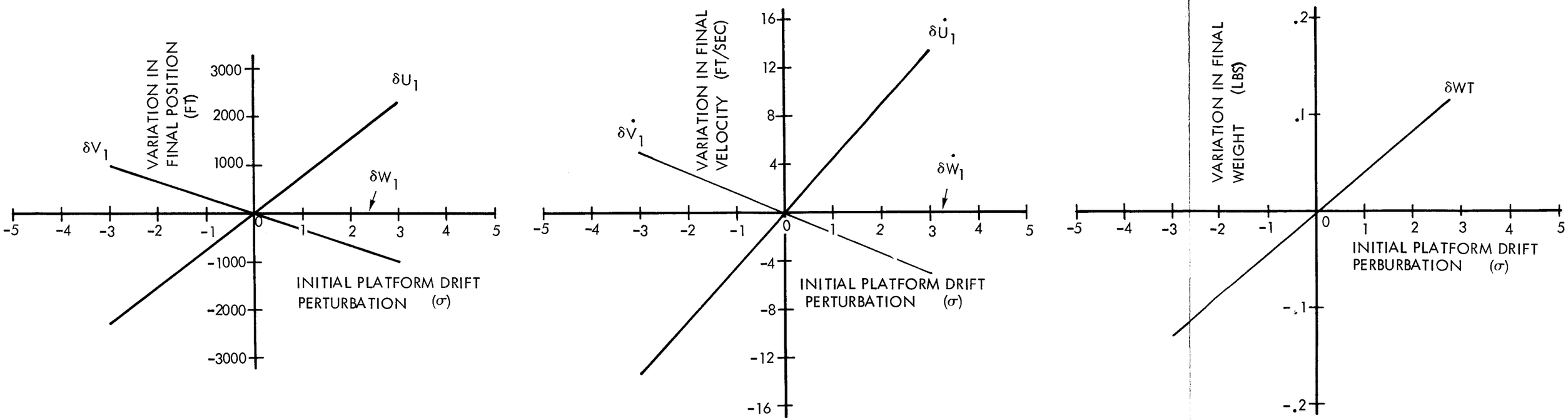


Figure 2-4. Linearity of Platform Drift Perturbation

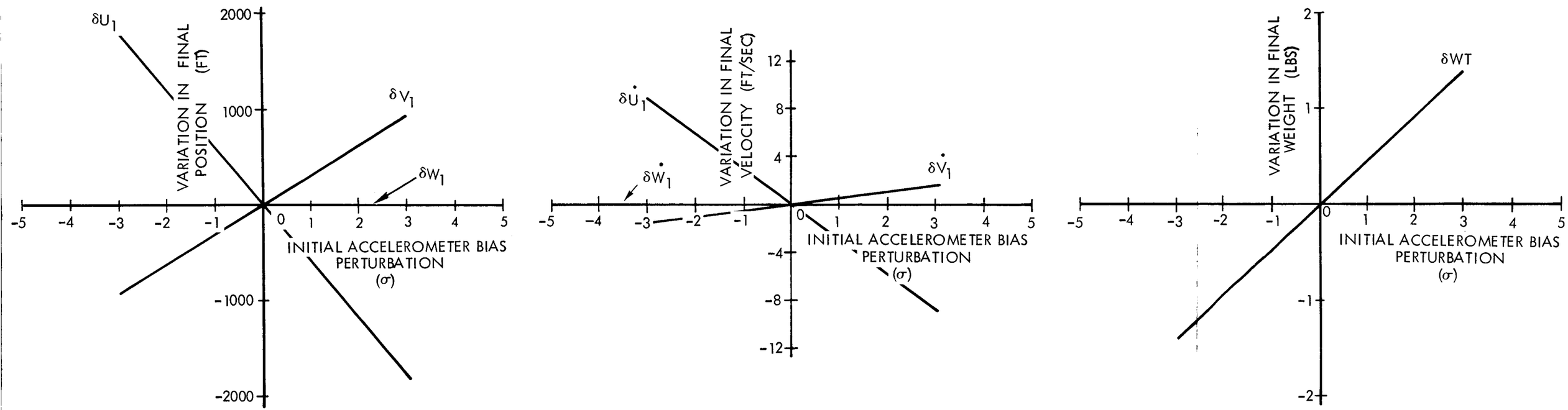


Figure 2-5. Linearity of Accelerometer Bias Perturbation

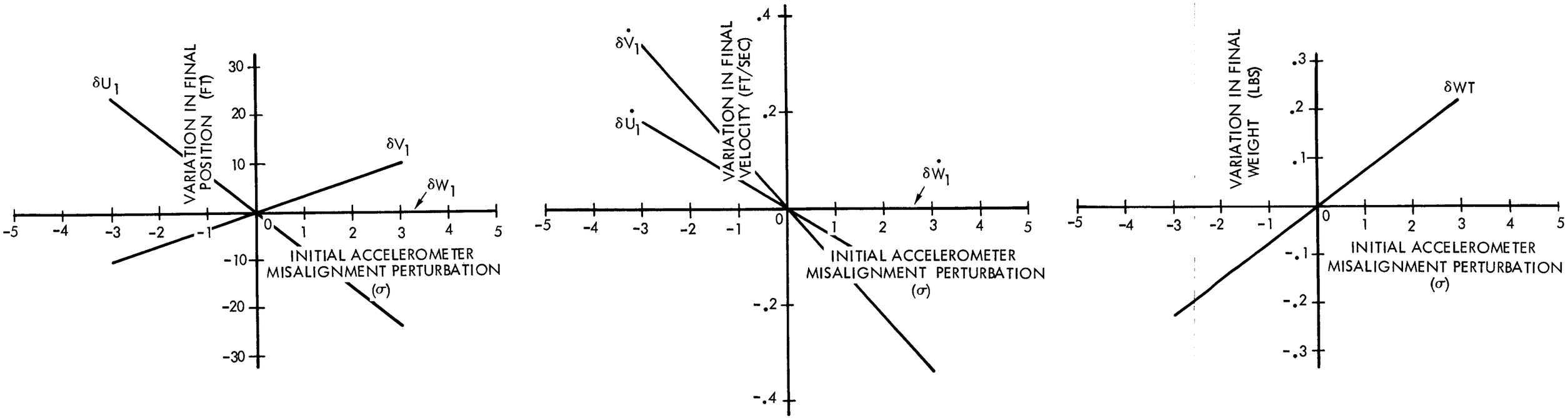


Figure 2-6. Linearity of Accelerometer Misalignment Perturbation

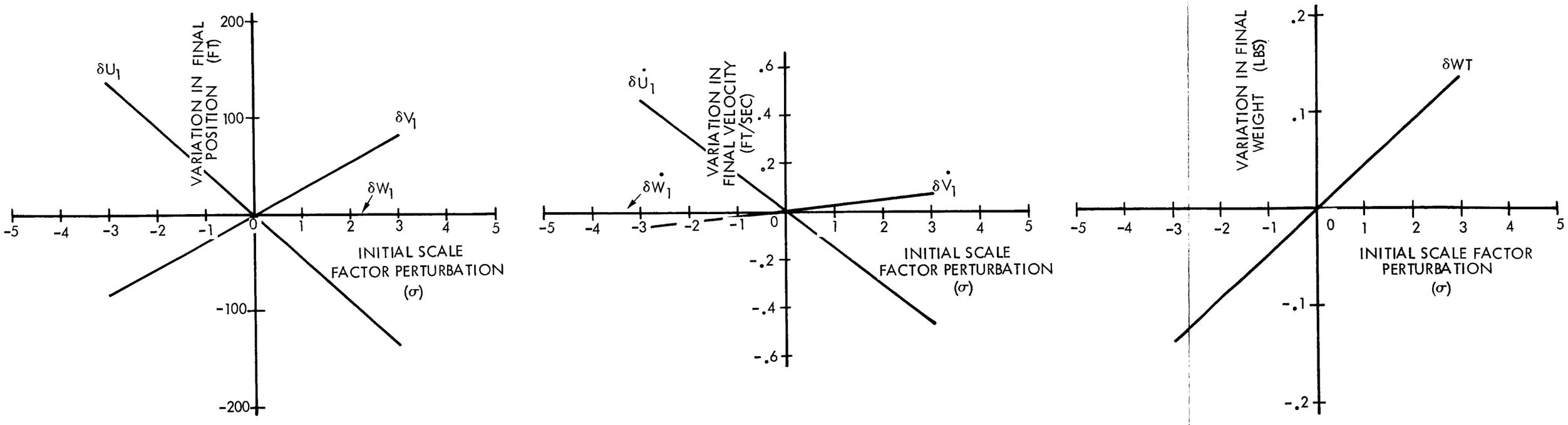


Figure 2-7. Linearity of Accelerometer Scale Factor Perturbation

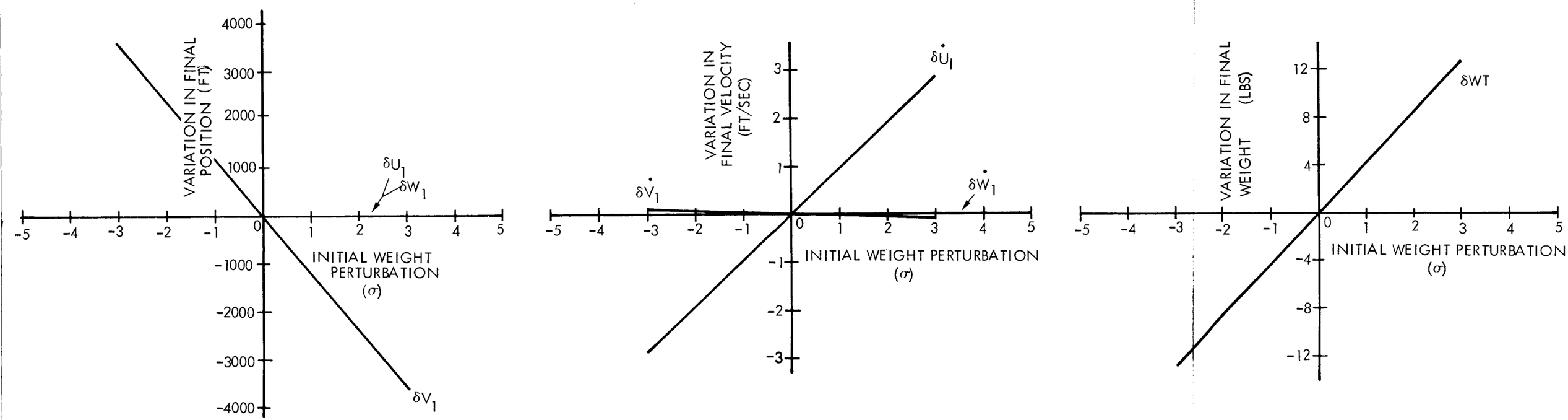


Figure 2-9. Linearity of Weight Perturbation

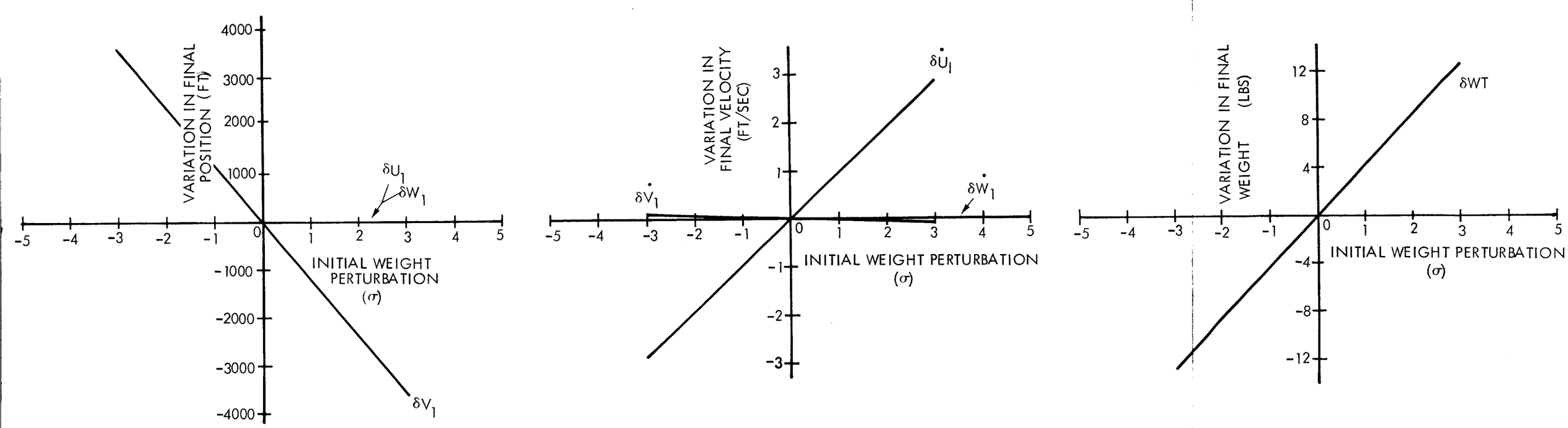


Figure 2-9. Linearity of Weight Perturbation

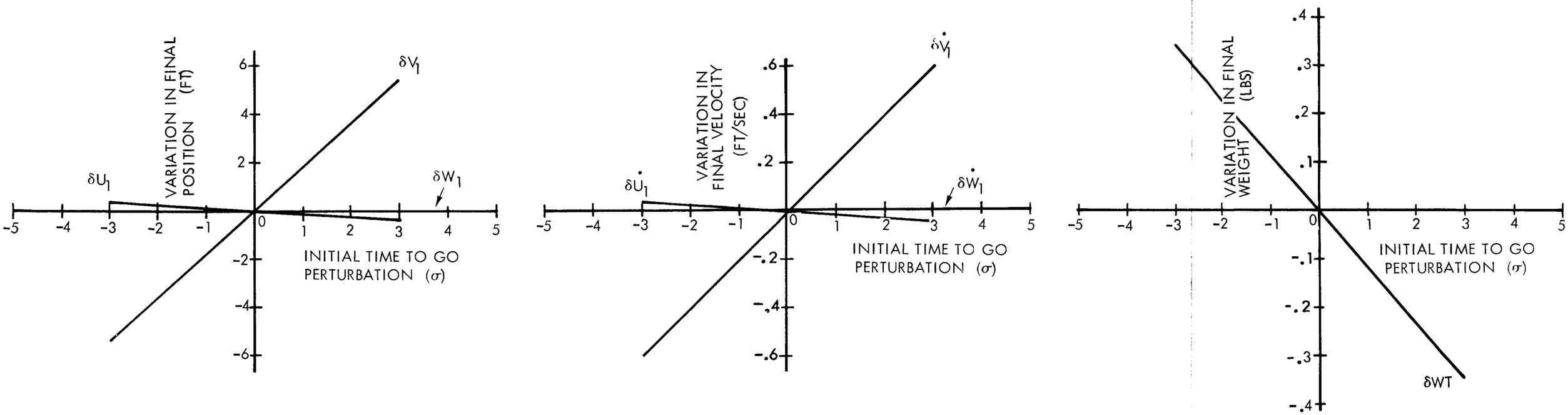


Figure 2-10. Linearity of Time To Go Perturbation

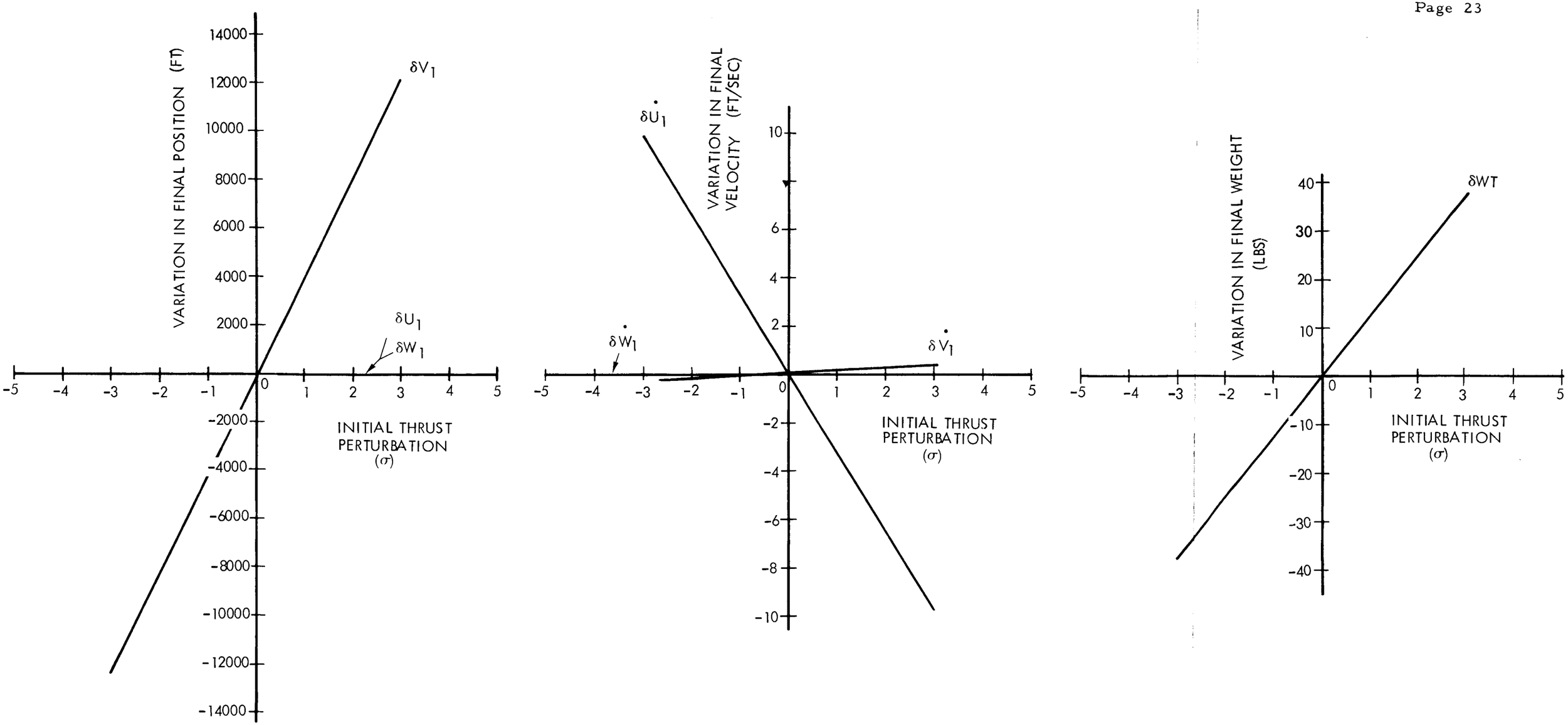


Figure 2-11. Linearity of Thrust (ISP) Perturbation

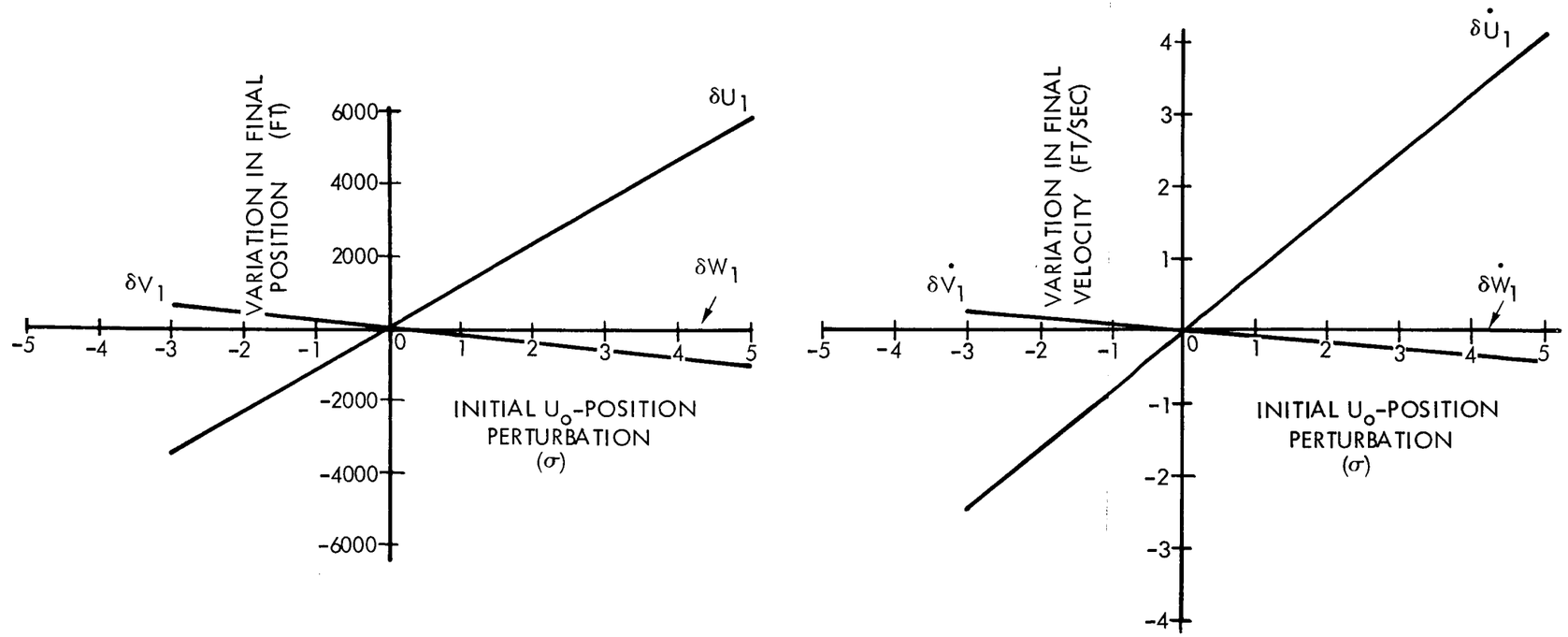


Figure 2-12. Linearity of Position Perturbation (Parking Orbit)

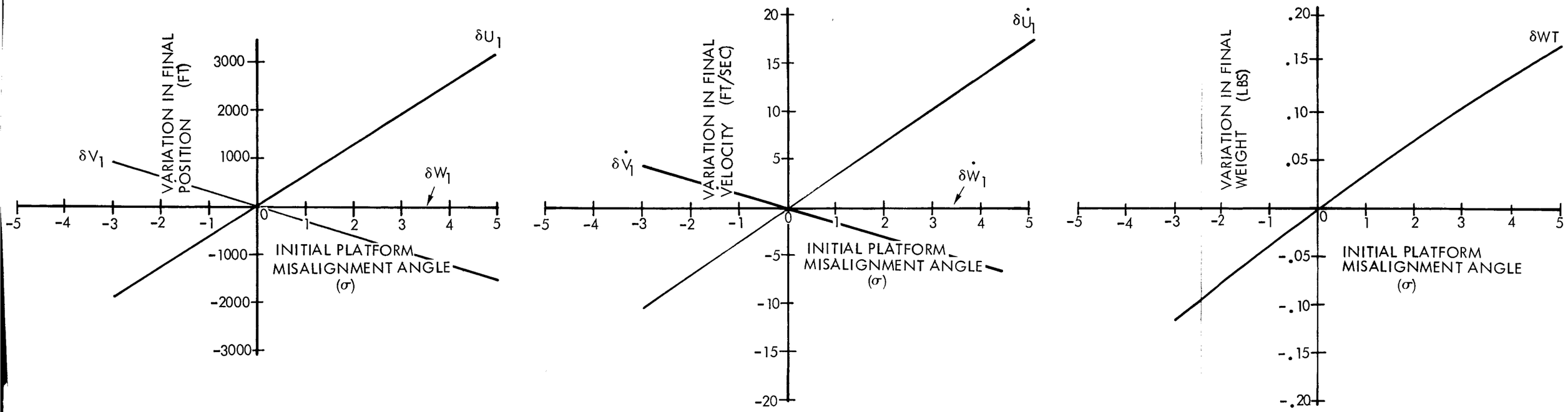


Figure 2-13. Linearity of Initial Platform Misalignment Perturbation (Parking Orbit)

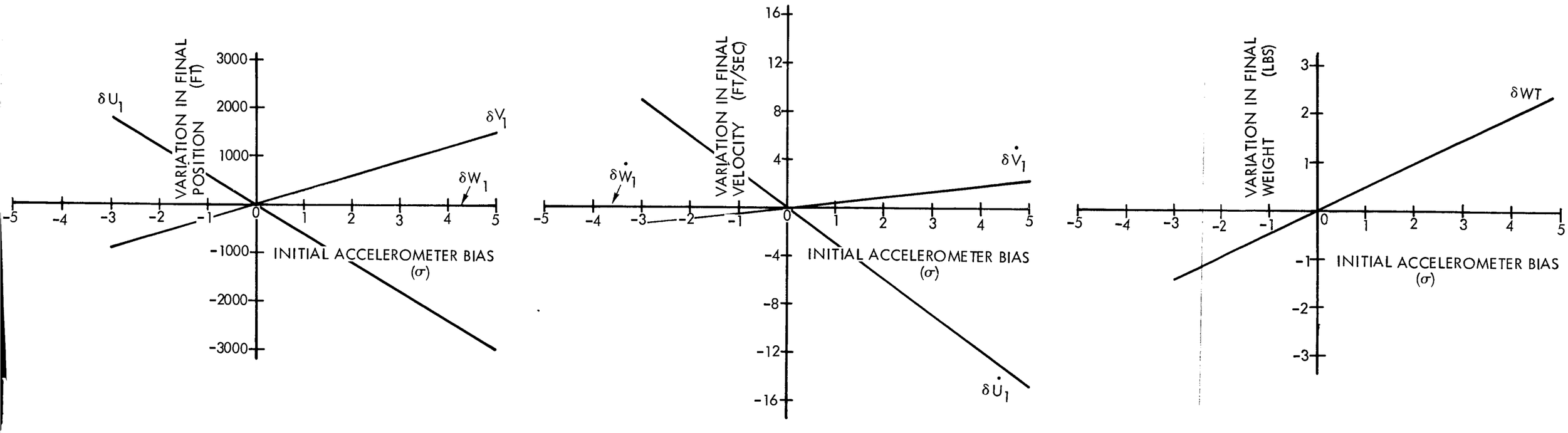


Figure 2-14. Linearity of Accelerometer Bias Perturbation (Parking Orbit)

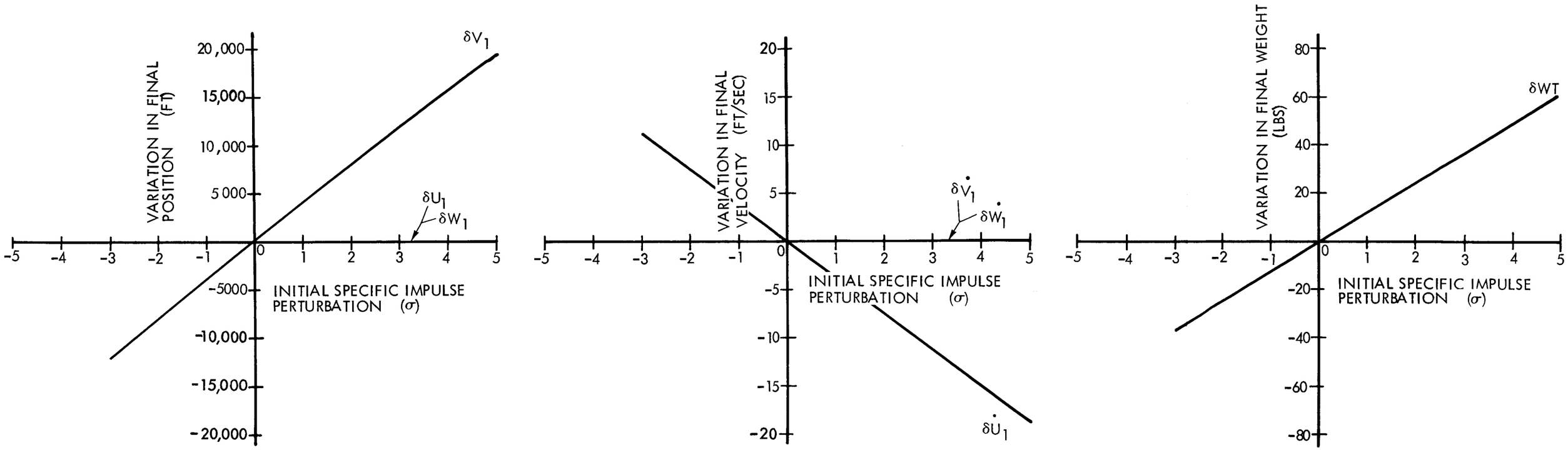
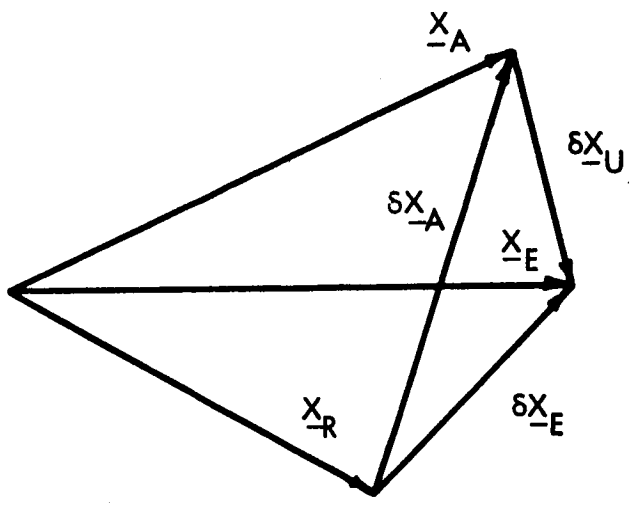


Figure 2-15. Linearity of Thrust (ISP) Perturbation (Parking Orbit)

3. GENERATION OF COVARIANCE MATRICES

3.1 THEORY AND PROCEDURE

The errors $\delta \underline{X}_{A0}$ and $\delta \underline{X}_{E0}$ are equivalent to the actual and estimated state vector deviations from the reference trajectory at time T_o. However, the state vector uncertainty, that is, the difference between the actual and estimate at a given time, can be propagated by using the same transformation sensitivity matrix elements. This state vector uncertainty is also referred to as the error in the estimate. Referring to the following vector diagram:



$$\delta \underline{X}_A = \underline{X}_A - \underline{X}_R$$

$$\delta \underline{X}_E = \underline{X}_E - \underline{X}_R$$

$$\delta \underline{X}_U = \underline{X}_E - \underline{X}_A = \delta \underline{X}_E - \delta \underline{X}_A$$

Therefore, put in terms of the actual state vector deviations and the uncertainty, the error propagation equations of Section 2.1 can be written in the form:

$$\delta \underline{X}_{A1} = -\psi_2 \, \delta \underline{X}_{U0} + (\psi_1 + \psi_2) \, \delta \underline{X}_{E0} + \psi_3 \delta \underline{P}$$

$$\delta \underline{X}_{U1} = (\theta_2 - \psi_2) \, \delta \underline{X}_{U0} + (\theta_1 + \theta_2 - \psi_1 - \psi_2) \, \delta \underline{X}_{E0}$$

$$+ (\psi_3 - \theta_3) \, \delta \underline{P}$$

$$\delta W_1 = (W_A + W_E) \, \delta \underline{X}_{E0} - W_A \, \delta \underline{X}_{U0} + W_P \delta \underline{P}$$

In this analysis the ESTIMATED trajectory was considered to be the REFERENCE so that the actual state vector deviations about the LEM ascent trajectory, based upon the estimate of the landing site, could be found. This assumption leads to the fact that $\delta \underline{X}_{E0} = 0$ and that $\delta \underline{X}_{U0} = -\delta \underline{X}_{A0}$. The error propagation equations become, upon incorporating the fact that $\theta_2 = 0$:

$$\delta \underline{X}_{A1} = \psi_2 \, \delta \underline{X}_{A0} + \psi_3 \, \delta \underline{P}$$

$$\delta \underline{X}_{U1} = \psi_2 \, \delta \underline{X}_{A0} + (\psi_3 - \theta_3) \, \delta \underline{P}$$

$$\delta W_1 = W_A \, \delta \underline{X}_{A0} + W_P \delta \underline{P}$$

The covariance matrices of the actual errors from the reference trajectory $\left[E(\delta \underline{X}_{A1})(\delta \underline{X}_{A1})^T\right]$ and of the errors in the estimate from the actual trajectory $\left[E(\delta \underline{X}_{E1} - \delta \underline{X}_{A1})(\delta \underline{X}_{E1} - \delta \underline{X}_{A1})^T\right] = \left[E(\delta \underline{X}_{U1})(\delta \underline{X}_{U1})\right]$ can be written as:

$$\Sigma_{A1} = \psi_2 \, \Sigma_{A0} \psi_2^T + \psi_3 \Sigma_P \psi_3^T$$

$$\Sigma_{U1} = (\psi_2) \, \Sigma_{A0} \psi_2^T + (\psi_3 - \theta_3) \, \Sigma_P (\psi_3 - \theta_3)^T$$

where Σ_{A0} and Σ_P are the covariance matrices of the actual state vector and of the vehicle parameters specified prior to lift-off. For convenience in handling, the weight was included as a seventh parameter in the actual state vector so that the covariance matrices generated in this analysis are 7 X 7 matrices with the 7th row and 7th column pertaining to weight.

3.2 PRESENTATION

The covariance matrices were computed using a matrix manipulation program which calculated the matrices in both selenocentric and orbit plane coordinates for the direct ascent cases. For the parking orbit cases the matrices were calculated in selenocentric and orbit plane (u, v, w, $\dot{u}$, $\dot{v}$, $\dot{w}$) coordinates, and a special set of elements designed to give a better understanding of the trajectory (R, λ, β, θ, w, $\dot{w}$). These various coordinate systems are discussed in Appendix B and the covariance matrices are tabulated in Appendix D.

4. PERICYNTHION ANALYSIS

4.1 STATEMENT OF PROBLEM

The problem considered in this analysis is one of determining the probability that the LEM trajectories after insertion or burnout will have a pericynthion altitude greater than 35,000 feet. Each trajectory, whether parking orbit or direct ascent, will have a unique probability associated with it. This probability in turn can serve as a measure of the desirability of that particular trajectory.

4.2 DIRECT ASCENT

The probability that a direct ascent trajectory will have a pericynthion of 35,000 feet will be determined in the following manner:

Let

$$R_P = R_{P0} + \delta R_P$$

Where

R_P = actual pericynthion altitude

R_{P0} = nominal pericynthion altitude

δR_P = error in pericynthion altitude

The expected value of the pericynthion altitude will be the nominal altitude.

$$E(R_P) = R_{P0}$$

$$E(R_P - R_{P0})(R_P - R_{P0})^T = E(\delta R_P)(\delta R_P)^T$$

$$\sigma^2_{R_P} = \sigma^2_{\delta R_P}$$

The variation of altitude is calculated by using a row vector of the partial derivatives of pericynthion altitude with respect to each of the error sources considered in this analysis. This calculation can be stated analogously to that in Section 2 as:

$$\delta R_P = \frac{\delta R_P}{\delta \underline{X}_{A0}} \delta \underline{X}_{A0} + \frac{\delta R_P}{\delta \underline{P}} \delta \underline{P}$$

The variance of R_P ($\sigma^2_{R_P}$) can be calculated as:

$$\sigma^2_{R_P} = \frac{\delta R_P}{\delta \underline{X}_{A0}} \Sigma_{A0} \frac{\delta R_P}{\delta \underline{X}_{A0}}^T + \frac{\delta R_P}{\delta \underline{P}} \Sigma_P \frac{\delta R_P}{\delta \underline{P}}^T$$

when Σ_{A0} and Σ_P are the same as described in Section 3.

The probability that R_P will be greater than 35,000 feet can be written as:

$$\Pr \left\{ R_P \geq 35,000 \text{ ft} \right\} =$$

$$\Pr \left\{ \delta R_P \leq R_{P0} - 35,000 \right\} =$$

$$\Pr \left\{ \frac{\delta R_P}{\sigma_{R_P}} \leq \frac{R_{P0} - 35,000}{\sigma_{R_P}} \right\} =$$

$$\Pr \left\{ \frac{\delta R_P}{\sigma_{R_P}} \leq \frac{15,000}{\sigma_{R_P}} \right\}$$

This probability, which corresponds to the probability of having a safe pericynthion altitude, is the area under the univariate normal distribution curve from:

$$-\infty \quad \text{to} \quad \frac{15,000}{\sigma_{R_P}}$$

4.3 PARKING ORBIT

In a nominally circular parking orbit the variation of pericynthion is no longer a Gaussian distribution even though the perturbations causing the variation have Gaussian distributions. The non-Gaussian distribution of the pericynthion variation results from coupled effects of velocity errors, position errors, and flight path angle errors.

To calculate the probability of having a safe pericynthion, one follows this method extracted from References 3 and 4.

Pericynthion can be written as:

$$P = \frac{1-e}{2-\lambda} R_0$$

where:

$$\lambda = \frac{R_0 V_0^2}{\mu}$$

with R_0 and V_0 the nominal position and velocity magnitudes. The error in pericynthion caused by errors in λ, e, and R_0 is:

$$\delta P = \frac{1-e}{2-\lambda} \delta R_0 + R_0 \frac{1-e}{(2-\lambda)^2} \delta\lambda - \frac{\delta e}{2-\lambda} R_0$$

which becomes $\delta P = \delta R_0 + R_0 \delta\lambda - R_0 \delta e$ after inserting the nominal conditions $e = 0$ and $\lambda = 1$. The error in λ is:

$$\delta\lambda = \frac{\delta R_0}{R_0} + 2 \frac{\delta V_0}{V_0}$$

The eccentricity can be written as:

$$e^2 = 1-\lambda (2-\lambda)\sin^2\beta_0$$

By replacing λ by $(1 + \delta\lambda)$, β_0 by $(90 + \delta \beta_0)$ and e by δe; and neglecting all terms above the second order, the error in eccentricity becomes:

$$\delta e = \sqrt{(\delta\lambda)^2 + (\delta\beta_0)^2}$$

The error in pericynthion can now be written as:

$$\delta P = \delta R_0 + R_0 \delta\lambda_0 - \sqrt{(R_0 \delta\lambda)^2 + (R_0 \delta\beta_0)^2}$$

Variables X_1, X_2, and X_3 are now defined as:

$$X_1 = R_0 \delta\beta_0$$

$$X_2 = R_0 \delta\lambda = \delta R_0 + 2 \frac{R_0}{V_0} \delta V_0$$

$$X_3 = \delta R_0 + R_0 \delta\lambda = 2\delta R_0 + 2 \frac{R_0}{V_0} \delta V_0$$

From these definitions the error in pericynthion can be expressed as:

$$\delta P = X_3 - \sqrt{X_1^2 + X_2^2}$$

By a method similar to that above, the error in apocynthion can be expressed as:

$$\delta A = X_3 + \sqrt{X_1^2 + X_2^2}$$

In this study success can be considered to have been attained if

$$-b \leq \delta P \leq \delta A \leq a \qquad b \cong 15,000 \text{ ft}$$

a is unrestricted

An equivalent statement in terms of X_1, X_2, and X_3 is:

$$-b \leq X_3 - \sqrt{X_1^2 + X_2^2} \leq X_3 + \sqrt{X_1^2 + X_2^2} \leq a$$

If the substitutions

$$U_1 = X_1$$

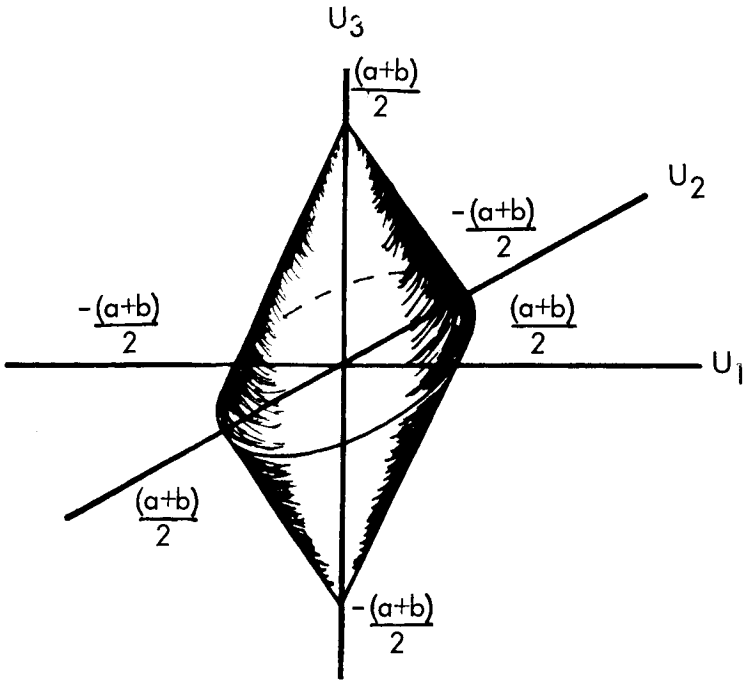
$$U_2 = X_2$$

$$U_3 = X_3 - \frac{(a-b)}{2}$$

are made, the statement of success becomes

$$-\frac{(a+b)}{2} \leq U_3 - \sqrt{U_1^2 + U_2^2} \leq U_3 + \sqrt{U_1^2 + U_3^2} \leq \frac{(a+b)}{2}$$

The region of success in (U_1, U_2, U_3) space is shown below and consists of two intersecting cones.



Since (δR_0, $\delta\beta$, δV_0) are assumed to have a trivariate normal density function, (U_1, U_2, U_3) also have a trivariate normal density function. The covariance matrix in (U_1, U_2, U_3) can be calculated from the covariance matrix of actual dispersions at insertion. A machine program was used which computes the probability of success by integrating the trivariate normal density function of (U_1, U_2, U_3) within the region of success described above.

The matrix used in the transforming of the covariance matrix of actual errors in selenocentric coordinate into a covariance matrix of errors in the R, V, β directions is presented in Appendix B.

5. DISCUSSION OF RESULTS

5.1 COVARIANCE MATRICES

The covariance matrices generated in this study for the direct ascent and parking orbit cases in several coordinate systems are presented in Appendix D. The covariance matrices have seven rows and seven columns and describe the state vector consisting of the three components of position, the three components of velocity, and weight.

Since the elements of a covariance matrix do not have the dimensions most easily understood, a "normalized" form of the covariance matrices is presented in this section. This normalized form consists of the standard deviations along the diagonal, the covariances above the diagonal, and the correlation coefficients below the diagonal.

The following tables are normalized covariance matrices of the actual errors from the reference trajectory and of the estimated errors from the actual trajectory. They are presented in orbit plane coordinates.

Table 5-1. 140° in-plane direct ascent transfer

Table 5-2. 180° in-plane direct ascent transfer

Table 5-3. 180° out-of-plane direct ascent transfer

Table 5-4. 220° in-plane direct ascent transfer

Table 5-5. In-plane ascent into a parking orbit

Table 5-6. Out-of-plane ascent into a parking orbit

By noting the similarity of the matrices of one type (either actual errors or errors in the estimate) it can be concluded that, to a large degree, they are trajectory independent. The covariance matrices for only the second 140° transfer (See Section 2.2.1) are presented so that each direct ascent trajectory will have the property of being injected into the trajectory at pericynthion.

This independence is not as evident when the matrices corresponding to in-plane and out-of-plane trajectories are compared. The difference is most apparent in the correlation terms of the crossrange position and velocity (w and $\dot{w}$). This is expected since the out-of-plane trajectories had greater initial "crossrange" errors because of the out-of-planeness.

Table 5-1. 140° In-Plane Direct Ascent Transfer

COVARIANCE MATRIX OF THE ACTUAL DISPERSIONS (NORMALIZED)

	u	v	w	$\dot{u}$	$\dot{v}$	$\dot{w}$
1	.16530203 04	-.68675321 06	-.58189941 03	.84946290 04	-.23625047 04	-.16095667 02
2	-.91992481-01	.45161689 04	-.21138281 04	-.15321724 05	-.56800306 03	.37267459 01
3	-.22285407-03	-.29630903-03	.15796257 04	-.43437901 01	-.73406247 01	.80254561 04
4	.72717768 00	-.48007797 00	-.38912326-03	.70668467 01	-.11032882 02	-.12561284 00
5	-.40267437 00	-.35435623-01	-.13092963-02	-.43986846 00	.35492818 01	-.64405378-01
6	-.14626087-02	.12395248-03	.76315492 00	-.26699684-02	-.27257074-02	.66573717 01
7	-.36100518 00	.68705405-01	.28545599-06	-.41250002 00	.13351742 00	-.67597045-06

	wt
1	-.27441277 11
2	.14268351 11
3	.20682723 05
4	-.13404862 09
5	.21791700 08
6	-.20693942 03
7	.45984628 08

COVARIANCE MATRIX OF THE ERRORS IN THE ESTIMATE (NORMALIZED)

	u	v	w	$\dot{u}$	$\dot{v}$	$\dot{w}$
1	.16578644 04	-.70076819 06	-.66271390 03	.86827485 04	-.23789116 04	-.16464622 02
2	-.33551734 00	.12598254 04	-.12510807 04	-.38293152 04	.26604480 04	.77613213 01
3	-.25314580-03	-.62888028-03	.15790840 04	-.21686163 01	-.72299151 01	.79499732 04
4	.78640745 00	-.45640476 00	-.20621367-03	.66597906 01	-.13184088 02	-.11435554 00
5	-.40524376 00	.59639151 00	-.12930525-02	-.55908338 00	.35408940 01	-.62822416-01
6	-.15068273-02	.93472978-03	.76387232 00	-.26053000-02	-.26919234-02	.65908229 01
7	-.36141372 00	.85864779-01	-.16909831-05	-.43016783 00	.14148590 00	.16620576-06

	wt
1	-.27552839 11
2	.49743705 10
3	-.12272916 06
4	-.13173804 09
5	.23037683 08
6	.50373068 02
7	.45984628 08

Table 5-2. 180° In-Plane Direct Ascent Transfer

COVARIANCE MATRIX OF THE ACTUAL DISPERSIONS (NORMALIZED)

	u	v	w	$\dot{u}$	$\dot{v}$	$\dot{w}$
1	.16538910 04	-.72293154 06	-.36123285 03	.85302795 04	-.23699662 04	-.12075779 01
2	-.98117979-01	.44549383 04	-.19947590 04	-.18686853 05	.12121491 04	-.10935799 02
3	-.13819638-03	-.28331016-03	.15804631 04	-.12785258 01	-.70478178 01	.80356696 04
4	.69523008 00	-.56541412 00	-.10904261-03	.74186999 01	-.11888308 02	-.31512489-02
5	-.41040279 00	.77927260-01	-.12771634-02	-.45895202 00	.34916038 01	-.40637785-01
6	-.10990031-03	-.36950108-03	.76531922 00	-.63937527-04	-.17519017-02	.66434712 01
7	-.13907710-01	.44655275 00	-.17268963-03	-.23341872 00	-.54994568-01	-.21621473-03

	wt
1	-.40279479 03
2	.34836606 05
3	-.47793524 01
4	-.30323886 02
5	-.33625298 01
6	-.25153671-01
7	.17511420 02

COVARIANCE MATRIX OF THE ERRORS IN THE ESTIMATE (NORMALIZED)

	u	v	w	$\dot{u}$	$\dot{v}$	$\dot{w}$
1	.16586200 04	-.70189537 06	-.38960511 03	.86848234 04	-.23878355 04	-.13306808 01
2	-.33586125 00	.12599855 04	-.11883213 04	-.38255167 04	.26665184 04	-.68618630 01
3	-.14867684-03	-.59695416-03	.15798879 04	-.19799115 01	-.68632463 01	.79565575 04
4	.78674970 00	-.45619137 00	-.18829586-03	.66554508 01	-.13211744 02	-.79762311-02
5	-.40635833 00	.59735254 00	-.12261825-02	-.56031770 00	.35428136 01	-.38954607-01
6	-.12204595-03	-.82846771-03	.76612037 00	-.18231211-03	-.16726629-02	.65735795 01
7	-.13900881-01	-.42055991-01	-.17611355-03	-.15907379-01	-.68377210-01	-.21715419-03

	wt
1	-.40374820 03
2	-.92792908 03
3	-.48723724 01
4	-.18539476 01
5	-.42421015 01
6	-.24997208-01
7	.17511420 02

Table 5-3. 180° Out-of-Plane Direct Ascent Transfer

COVARIANCE MATRIX OF THE ACTUAL DISPERSIONS (NORMALIZED)

	u	v	w	$\dot{u}$	$\dot{v}$	$\dot{w}$
1	.16486229 04	-.81272611 06	-.63265610 05	.84833726 04	-.23070041 04	-.21881617 03
2	-.11092389 00	.44442428 04	-.46084483 05	-.14600562 05	.87634201 03	-.45595054 03
3	-.24435156-01	-.66027622-02	.15704762 04	.29138422 01	.81861844 02	.78609213 04
4	.73366446 00	-.46840558 00	.26453338-03	.70137408 01	-.11617502 02	.64775200-01
5	-.39880778 00	.56196914-01	.14855477-01	-.47206264 00	.35088386 01	.47195601 00
6	-.20185148-01	-.15602483-01	.76122996 00	.14045378-02	.20455588-01	.65754607 01
7	-.18182815-01	.44188219 00	-.83997277-03	-.21178214 00	-.69476854-01	-.17892321-02

	wt
1	-.52547602 03
2	.34425063 05
3	-.23124128 02
4	-.26038113 02
5	-.42734046 01
6	-.20623544 00
7	.17529537 02

COVARIANCE MATRIX OF THE ERRORS IN THE ESTIMATE (NORMALIZED)

	u	v	w	$\dot{u}$	$\dot{v}$	$\dot{w}$
1	.16522457 04	-.68964942 06	-.62400811 05	.85845696 04	-.23235543 04	-.20537779 03
2	-.33079429 00	.12618151 04	-.81204510 05	-.38064832 04	.26352694 04	-.47893750 03
3	-.24049635-01	-.40980507-01	.15703885 04	.10178423 02	.86489527 02	.78537164 04
4	.78150716 00	-.45375067 00	.97490558-03	.66483047 01	-.13018537 02	.84416399-01
5	-.39887250 00	.59235930 00	.15621126-01	-.55540164 00	.35256897 01	.49681636 00
6	-.18939054-01	-.57831250-01	.76198699 00	.19346179-02	.21469960-01	.65632740 01
7	-.13292290-01	-.41788764-01	-.71477603-03	-.15190391-01	-.68077447-01	-.38132904-03

	wt
1	-.38498597 03
2	-.92432712 03
3	-.19676487 02
4	-.17703141 01
5	-.42074389 01
6	-.43872359-01
7	.17529537 02

Table 5-4. 220° In-Plane Direct Ascent Transfer

COVARIANCE MATRIX OF THE ACTUAL DISPERSIONS (NORMALIZED)

	u	v	w	$\dot{u}$	$\dot{v}$	$\dot{w}$
1	.16525072 04	-.70220644 06	-.33214354 03	.85008176 04	-.23704095 04	-.38978535 00
2	-.95267426-01	.44604330 04	-.40430403 04	-.17658750 05	.71984230 03	-.14622336 02
3	-.12727356-03	-.57396160-03	.15792314 04	.22933155 02	-.75844033 01	.80049492 04
4	.70405128 00	-.54183852 00	.19874973-02	.73065613 01	-.11708616 02	.11689104 00
5	-.40957918 00	.46080605-01	-.13712953-02	-.45756245 00	.35022095 01	-.43965124-01
6	-.35596003-04	-.49476210-03	.76501288 00	.24144808-02	-.18946235-02	.66258873 01
7	-.12086246-01	.44929172 00	-.26596941-03	-.22297874 00	-.70727287-01	-.35604312-03

	wt
1	-.35013030 03
2	.35131806 05
3	-.73632730 01
4	-.28560877 02
5	-.43423437 01
6	-.41356299-01
7	.17530529 02

COVARIANCE MATRIX OF THE ERRORS IN THE ESTIMATE (NORMALIZED)

	u	v	w	$\dot{u}$	$\dot{v}$	$\dot{w}$
1	.16571859 04	-.70094117 06	-.71936689 03	.86582632 04	-.23826390 04	-.30166627 01
2	-.33567868 00	.12600465 04	-.11309555 04	-.38181356 04	.26661911 04	-.65799723 01
3	-.27497117-03	-.56854238-03	.15786813 04	-.26412885 01	-.75442896 01	.79318625 04
4	.10285034 00	-.59650071-01	-.32935903-04	.50798840 02	.21528650 04	-.48757832 02
5	-.33316539-01	.49031771-01	-.11073818-03	.98205514 00	.43154602 02	-.41670423 02
6	-.27446835-03	-.78735371-03	.75755250 00	-.14471802 00	-.14559042 00	.66323578 01
7	-.13457310-01	-.42773140-01	-.25281967-03	-.24182316 00	-.24677583 00	.34994971-01

	wt
1	-.39095300 03
2	-.94482799 03
3	-.69968155 01
4	-.21535093 03
5	-.18669161 03
6	.40688210 01
7	.17530529 02

Table 5-5. In-Plane Ascent Into a Parking Orbit

COVARIANCE MATRIX OF THE ACTUAL DISPERSIONS (NORMALIZED)

	u	v	w	$\dot{u}$	$\dot{v}$	$\dot{w}$
1	.16526695 04	-.74260762 06	-.49707048 03	.83931069 04	-.23683967 04	-.19572121 01
2	-.10475226 00	.42895331 04	-.19704064 04	-.20157432 05	.83396799 03	-.10498313 02
3	-.19040142-03	-.29080271-03	.15796219 04	-.10658135 01	-.65025274 01	.78439485 04
4	.67099687 00	-.62088180 00	-.89149427-04	.75686116 01	-.11058353 02	-.41017706-02
5	-.41207900 00	.55905095-01	-.11836982-02	-.42013253 00	.34776663 01	-.36708828-01
6	-.18259785-03	-.37736063-03	.76564805 00	-.83559151-04	-.16275311-02	.64856334 01
7	-.16026681-01	.44882614 00	-.18027732-03	-.26353567 00	-.68347112-01	-.22277235-03

	wt
1	-.46189726 03
2	.33574078 05
3	-.49659478 01
4	-.34783361 02
5	-.41449949 01
6	-.25195975-01
7	.17438772 02

COVARIANCE MATRIX OF THE ERRORS IN THE ESTIMATE (NORMALIZED)

	u	v	w	$\dot{u}$	v	$\dot{w}$
1	.16577746 04	-.70147758 06	-.57656379 03	.85450124 04	-.23876569 04	-.23532009 01
2	-.33578965 00	.12601463 04	-.11455539 04	-.37474318 04	.26678087 04	-.64736929 01
3	-.22022944-03	-.57564089-03	.15792183 04	-.19905660 01	-.63688733 01	.78243567 04
4	.78831471 00	-.45480493 00	-.19277359-03	.65386422 01	-.12938012 02	-.83741342-02
5	-.40653019 00	.59755801 00	-.11383261-02	-.55850405 00	.35428570 01	-.35479665-01
6	-.21963581-03	-.79487841-03	.76661133 00	-.19816248-03	-.15495140-02	.64629565 01
7	-.14393448-01	-.42066421-01	-.17946658-03	-.17139622-01	-.68291373-01	-.22495372-03

	wt
1	-.41610817 03
2	-.92442667 03
3	-.49424428 01
4	-.19543607 01
5	-.42192512 01
6	-.25353641-01
7	.17438772 02

Table 5-6. Out-of-Plane Ascent Into a Parking Orbit

COVARIANCE MATRIX OF THE ACTUAL DISPERSIONS (NORMALIZED)

	u	v	w	$\dot{u}$	$\dot{v}$	$\dot{w}$
1	.16472597 04	-.73493440 06	.62459519 05	.83385767 04	-.23429405 04	.20362930 03
2	-.10502303 00	.42481701 04	.37249627 05	-.19815302 05	.91515291 03	.14084848 03
3	.24142270-01	.55829184-02	.15705747 04	.35309651 02	-.93107473 02	.77488521 04
4	.66935729 00	-.61677524 00	.29727822-02	.75626124 01	-.11177474 02	.20712391 00
5	-.40580969 00	.61463176-01	-.16914105-01	-.42169168 00	.35049092 01	-.54677851 00
6	.19085340-01	.51188446-02	.76172905 00	.42284435-02	-.24085537-01	.64770647 01
7	-.15282390-01	.43926409 00	.29774751-03	-.25505386 00	-.68197586-01	.77411260-03

	wt
1	-.43843091 03
2	.32499406 05
3	.81443151 01
4	-.33593215 02
5	-.41628771 01
6	.87323309-01
7	.17415976 02

COVARIANCE MATRIX OF THE ERRORS IN THE ESTIMATE (NORMALIZED)

	u	v	w	$\dot{u}$	$\dot{v}$	$\dot{w}$
1	.16517866 04	-.68992069 06	.61861366 05	.84658912 04	-.23546409 04	.20655664 03
2	-.33098235 00	.12619448 04	.78440341 05	-.37399046 04	.26552579 04	.45340702 03
3	.23846207-01	.39577905-01	.15705302 04	-.14059034 02	-.99900389 02	.77626510 04
4	.78304203 00	-.45277921 00	-.13676516-02	.65453618 01	-.12957366 02	-.10126763 00
5	-.40208442 00	.59348924 00	-.17941857-01	-.55837963 00	.35453040 01	-.56206366 00
6	.19311590-01	.55485650-01	.76330236 00	-.23892953-02	-.24483015-01	.64754081 01
7	-.13815732-01	-.41631390-01	.22038517-03	-.15889329-01	-.67408335-01	-.21044357-03

	wt
1	-.39744375 03
2	-.91497475 03
3	.60280413 01
4	-.18112860 01
5	-.41621230 01
6	-.23732877-01
7	.17415976 02

As with the sensitivity matrices, the covariance matrices for all cases could be summarized into one or two (one for in-plane cases and one for out-of-plane cases) matrices for use in analyses not requiring extreme accuracy.

The differences between the covariance matrix of the actual errors from the reference trajectory and the covariance matrix of the errors in the estimate from the actual trajectory for each case appear mostly in the diagonal terms, especially in the downrange terms (v).

The standard deviation of weight (wt) appears to be also trajectory independent. Using the largest value of the weight standard deviation of approximately 17.55 pounds, it can be stated that for perturbations of 3 sigma in the initial LEM state vector and in the system parameters the weight variation will be 52.65 pounds from the nominal. Using the same value of the standard deviation of the weight, it can also be stated that there is a 99 per cent probability that the weight variation will not be more than 44 pounds for any trajectory studied in this analysis.

Tables 5-7 and 5-8 are normalized covariance matrices presented in the special parking orbit system described in Appendix B. The matrix used in the transformation of the covariance matrices in selenocentric coordinates to the special elements is also presented in that appendix. That set of elements was chosen because of its ability to separate the errors associated with the guidance system's ability to achieve a circular orbit (R, λ, β) from the errors associated with the ability to match an injection point (θ, w, $\dot{w}$). In this set of elements R (feet) represents the radial position, λ represents the ratio of the velocity achieved to the circular velocity at the burnout altitude, β (radians) represents the flight path angle, θ (radians) represents the downrange angle measured from the launch vector projected into the plane of the CSM, w (feet) represents the crossrange position, and $\dot{w}$ (feet/second) represents the crossrange velocity.

Since the covariance matrices for all the direct ascent cases were quite similar, a "miss" distance at the nominal time of interception was calculated to serve as a basis for comparing the various direct ascent trajectories. This miss distance is the radius of 95% sphere, that is, 95% of the dispersed trajectories will be within that distance from the

Table 5-7. In-Plane Ascent Into a Parking Orbit (Special Elements)

COVARIANCE MATRIX OF THE ACTUAL DISPERSIONS (NORMALIZED)

	R	λ	β	θ	w	ẇ
1	.16526695 04	-.38911743 00	-.14008137 01	-.12907765 00	-.49707048 03	-.19572121 01
2	-.19969794 00	.11790121-02	.43889249-06	.30583234-07	-.24570101-02	-.13723144-04
3	-.77964217 00	.34240343 00	.10871515-02	.82767592-07	.53676723-03	.25724269-05
4	-.10475226 00	.34790500-01	.10210796 00	.74557039-03	-.34249475-03	-.18247796-05
5	-.19040142-03	-.13192671-02	.31256038-03	-.29080312-03	.15796219 04	.78439485 04
6	-.18259785-03	-.17946479-02	.36483017-03	-.37736095-03	.76564805 00	.64856334 01
7	-.16026681-01	-.77319504-01	.26626401-01	.44882614 00	-.18027732-03	-.22277235-03

	wt
1	-.46189726 03
2	-.15897396-02
3	.50480937-03
4	.58357372-02
5	-.49659478 01
6	-.25195975-01
7	.17438772 02

COVARIANCE MATRIX OF THE ERRORS IN THE ESTIMATE (NORMALIZED)

	R	λ	β	θ	w	ẇ
1	.16577746 04	-.39320913 00	-.14356528 01	-.12192856 00	-.57656379 03	-.23532009 01
2	-.19704076 00	.12037435-02	.44155458-06	.14789500-06	-.24220554-02	-.13343645-04
3	-.78051184 00	.33059626 00	.11095363-02	.70756712-07	.56195775-03	.26516811-05
4	-.33578966 00	.56091728 00	.29114583 00	.21900475-03	-.19911717-03	-.11252381-05
5	-.22022944-03	-.12740896-02	.32071341-03	-.57564227-03	.15792183 04	.78243567 04
6	-.21963581-03	-.17151499-02	.36978216-03	-.79487948-03	.76661133 00	.64629565 01
7	-.14393448-01	-.76716980-01	.26715784-01	-.42066420-01	-.17946658-03	-.22495372-03

	wt
1	-.41610817 03
2	-.16104581-02
3	.51692587-03
4	-.16068084-03
5	-.49424428 01
6	-.25353641-01
7	.17438772 02

Table 5-8. Out-of-Plane Ascent Into a Parking Orbit (Special Elements)

COVARIANCE MATRIX OF THE ACTUAL DISPERSIONS (NORMALIZED)

	R	λ	β	θ	w	$\dot{w}$
1	.16472597 04	-.38292994 00	-.13922462 01	-.12774359 00	.62459519 05	.20362930 03
2	-.19521777 00	.11907900-02	.44316157-06	.35951745-07	-.23089491-01	-.16395413-03
3	-.77478192 00	.34115343 00	.10908662-02	.82613017-07	-.12909825-01	-.62234076-04
4	-.10502304 00	.40887409-01	.10256084 00	.73839382-03	.64745998-02	.24481761-04
5	.24142270-01	-.12345764-01	-.75350691-02	.55829182-02	.15705747 04	.77488521 04
6	.19085340-01	-.21257203-01	-.88079678-02	.51188444-02	.76172905 00	.64770647 01
7	-.15282390-01	-.76775945-01	.24992278-01	.43926409 00	.29774751-03	.77411260-03

	wt
1	-.43843091 03
2	-.15922485-02
3	.47481908-03
4	.56489269-02
5	.81443151 01
6	.87323309-01
7	.17415976 02

COVARIANCE MATRIX OF THE ERRORS IN THE ESTIMATE (NORMALIZED)

	R	λ	β	θ	w	$\dot{w}$
1	.16517866 04	-.38460579 00	-.14232783 01	-.11991947 00	.61861366 05	.20655664 03
2	-.19304059 00	.12061682-02	.44579691-06	.14744489-06	-.25667581-01	-.16900311-03
3	-.77545614 00	.33261756 00	.11111354-02	.70384080-07	-.11069969-01	-.60344648-04
4	-.33098235 00	.55729556 00	.28877852 00	.21931680-03	.13634210-01	.78809536-04
5	.23846207-01	-.13549567-01	-.63433906-02	.39577904-01	.15705302 04	.77626510 04
6	.19311590-01	-.21637862-01	-.83867341-02	.55485649-01	.76330236 00	.64754081 01
7	-.13815732-01	-.75516308-01	.25279548-01	-.41631390-01	.22038517-03	-.21044357-03

	wt
1	-.39744375 03
2	-.15863602-02
3	.48921049-03
4	-.15903754-03
5	.60280413 01
6	-.23732877-01
7	.17415976 02

nominal intercept point at the nominal intercept time. This distance is not the distance of closest approach and should only be used as a basis for making a comparison. The calculated miss distances are as follows:

Trajectory	Miss Distance at CSM
140° in-plane transfer	57,250 ft
180° in-plane transfer	78,920 ft
180° out-of-plane transfer	79,390 ft
220° in-plane transfer	104,240 ft

5.2 SAFE PERICYNTHION ANALYSIS

5.2.1 Direct Ascent Cases

The standard deviation of pericynthion for each direct ascent case studied was calculated for use in the formulas developed in Section 4.2. The standard deviations, the nominal pericynthion altitude, and the resulting probability that pericynthion will be greater than 35,000 feet are given in Table 5-9.

It is immediately obvious that the 140° transfer case as originally considered will not be satisfactory. Therefore, the trajectory was changed so that injection occurred at pericynthion at an altitude of approximately 50,000 feet. This was accomplished by changing the target velocity vector and the time of flight. The weight penalty associated with this new trajectory is approximately 16 pounds. The new trajectory, however, did improve the probability of having a pericynthion of greater than 35,000 feet, as shown in Table 5-9.

In can be concluded that for all trajectories which inject into the nominal transfer trajectory at pericynthion there is no danger of having a pericynthion of less than 35,000 feet. For the cases of 140° and 220° injection can occur easily at a point not at pericynthion, and for these cases the savings in weight must be traded against increased probability of having a pericynthion less than 35,000 feet. This trade off was not considered as a part of this study.

Table 5-9. Probability of Pericynthion Being Greater Than 35,000 Feet

Trajectory	Standard Deviation	Nominal Pericynthion	Probability
140° in-plane intercept at apocynthion	3617 feet	528 feet	0.0
180° in-plane	1657 feet	49,749 feet	0.999999
180° out-of-plane	2333 feet	47,466 feet	0.999999
220° in-plane injection at pericynthion	1617 feet	49,792 feet	0.999999
140° in-plane injection at pericynthion	1687 feet	49,716 feet	0.999999

5.2.2 Parking Orbit

The probability of having a pericynthion altitude greater than a given value after injecting into a parking orbit was calculated by using the equations developed in Section 4.3.

The limits for the integration were calculated within a machine program from the covariance matrix of R, V, β (radial position, velocity, flight path angle) as developed from the covariance matrix of actual dispersions.

The integration of the probability density function over the region which requires the pericynthion altitude to be greater than 35,000 feet gave the following results:

Case	Probability
In-plane ascent	.81433
Out-of-plane ascent	.81709

If the pericynthion altitude restriction is relaxed, the following probabilities result:

Case	Probability $R_P > 25,000$ ft	Probability $R_P > 20,000$ ft	Probability $R_P > 10,000$ ft
In-plane	.95594	.98166	.99775
Out-of-plane	.95764	.98265	.99795

These probabilities are reasonable as shown by the following approximate analysis. The variation is pericynthion can be written as:

$$\delta P = \delta R_0 + R_0 \delta\lambda - \sqrt{(R_0 \delta\lambda)^2 + (R_0 \delta \beta_0)^2}$$

If δR_0 and $\delta\lambda$ are assumed to be 0, then

$$\delta P = - \left| R_0 \delta \beta_0 \right|$$

The probability that pericynthion is greater than 35,000 feet, assuming an error in flight path angle only, is:

$$\Pr \left\{ \delta P \leq 15,000 \right\} =$$

$$\Pr \left\{ -15,000 \leq - \left| R_0 \delta \beta_0 \right| \right\} =$$

$$\Pr\left\{-15,000 \le -R_0 \delta\beta_0 \le 15,000\right\} =$$

$$\Pr\left\{\frac{-15,000}{R_0} \le \delta\beta_0 \le \frac{15,000}{R_0}\right\} =$$

$$\Pr\left\{\frac{-15,000}{R_0\sigma_\beta} \le \frac{\delta\beta_0}{\sigma_\beta} \le \frac{15,000}{R_0\sigma_\beta}\right\}$$

Using the nominal orbit radius as 5,753,380 feet and the standard deviation flight path angle of approximately 0.0011 radians (from Table 5-5) the probability is 0.9822.

An alternate statement can be made that a small 3 sigma variation of $\pm$ 0.0033 radians or $\pm$ 0.19 degrees in only flight path angle can cause a variation in pericynthion altitude of -17,260 feet.

If each error source is perturbed independently and the variation in pericynthion is calculated, the relatively large uncertainty in pericynthion altitude can be attributed to the following specific error sources:

- Platform misalignment about the platform Y-axis
- Platform drift about the platform Y-axis
- Accelerometer bias along the platform X-axis

Each of these errors do result in a flight path angle error at insertion.

6. SUMMARY OF TECHNICAL ACHIEVEMENT

This report contains no innovations or improvements involving new technology, approaches, methods, or patentable ideas as defined in the contract's "New Technology and Property Rights in Inventions" clause.

APPENDIX A

BASIC HARDWARE SPECIFICATIONS AND NATURAL CONSTANTS

This appendix contains the orientation of the IMU assumed in this study (Figure A-1), a table of the standard Apollo natural constants which were used in this study (Table A-1), and a table of LEM weight and propulsion data (Table A-2).

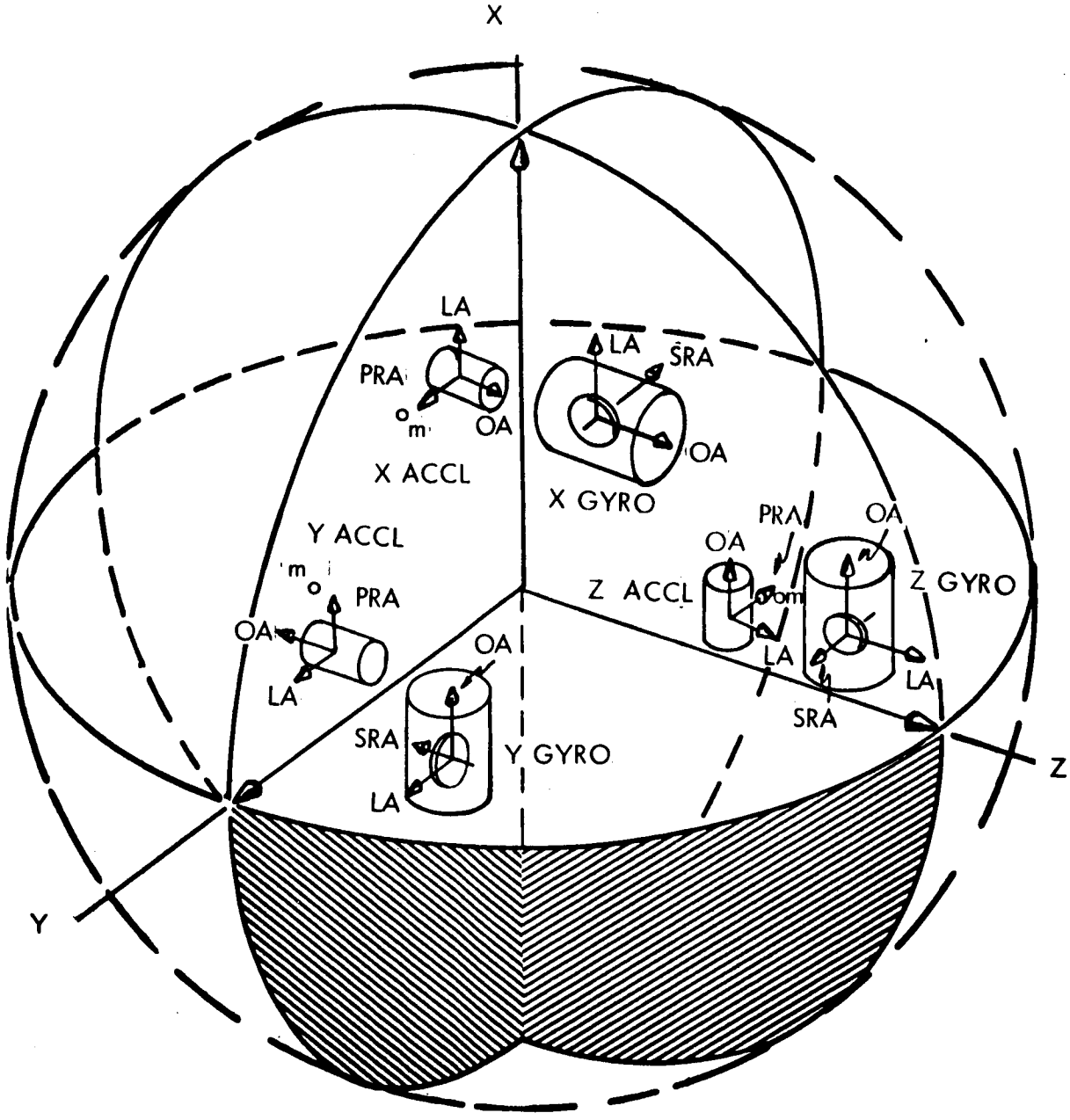


Figure A-1. IMU Orientation

Table A-1. Natural Constants

Earth Constants		
Rotational rate	$4.37526902 \times 10^{-3}$	rad/min
	$0.417807416 \times 10^{-2}$	deg/sec
	$0.729211504 \times 10^{-4}$	rad/sec
Equatorial radius	$2.092573819 \times 10^{7}$	ft
Average radius	2.0909841×10^{7}	ft
Gravitational parameter ($\mu_{\oplus}$)	$5.53039344 \times 10^{-3}$	er^3/min^2
	$11.46782384 \times 10^{3}$	er^3/day^2
	3.986032×10^{5}	km^3/sec^2
	$1.407653916 \times 10^{16}$	ft^3/sec^2
Coefficients of potential harmonics		
J term (second harmonic)	1.62345×10^{-3}	nd
H term (third harmonic)	-0.575×10^{-5}	nd
D term (fourth harmonic)	0.7875×10^{-5}	nd
Earth flattening (f)	1/298.3	nd
Sun Constants		
Radius	109.2	er
Gravitational parameter ($\mu_{\odot}$)	3.81822686×10^{9}	er^3/day^2
Mass of Sun/Mass of Earth	3.329513×10^{5}	nd
Moon Constants		
Radius		
a (along mean earth/moon line)	1.73856×10^{3}	km
b (orthogonal to a and c)	1.73821×10^{3}	km
c (spin axis)	1.73749×10^{3}	km

Table A-1. Natural Constants (Continued)

Average radius [(a + b + c)/3]	1.73809×10^3	km
	0.27250628	er
	5.70239502×10^6	ft
Average equatorial radius [(a + b)/2]	1.73839×10^3	km
	0.27255331	er
	5.70337927×10^6	ft
Gravitational parameter ($\mu_{☾}$)	$\mu_{\oplus}/81.3015$	appropriate units
Principal moments of inertia		
A	2.1823953×10^{21}	kg-er^2
	0.88782×10^{29}	kg-km^2
B	2.1828378×10^{21}	kg-er^2
	0.88800×10^{29}	kg-km^2
C	2.1837473×10^{21}	kg-er^2
	0.88837×10^{29}	kg-km^2
Rotational rate	$0.26616995 \times 10^{-5}$	rad/sec
	$0.1525041477 \times 10^{-3}$	deg/sec
	13.17635836	deg/day
Moon flattening*	$0.5177204194 \times 10^{-3}$	nd
Venus Constants		
Radius	0.97206642	er
Gravitational parameter ($\mu_{♀}$)	$\mu_{\oplus}/1.22734166$	appropriate units
Mass of Venus/Mass of Earth	0.814769052	nd

*Calculations of altitude above the lunar surface are referenced to an approximate lunar figure described by the given flattening which is computed from the average equatorial radius and the spin axis radius.

Table A-1. Natural Constants (Continued)

Mars Constants		
Radius	0.53306868	er
Gravitational parameter ($\mu_{♂}$)	$\mu_{\oplus}$/9.27463015	appropriate units
Mass of Mars/Mass of Earth	0.10782102	nd
Miscellaneous Constants and Conversion Factors		
Velocity of light in a vacuum	9.83571194×10^{8}	ft/sec
Astronominal unit of length	$4.90810367 \times 10^{11}$	ft
Kilometers per foot	0.3048×10^{-3}	km/ft
Kilometers per nautical mile	1.852	km/nm
Feet per nautical mile	6076.115486	ft/nm
Weight to mass ratio	32.17404856	lb/slug
Mass to weight ratio	0.031080950	slug/lb
Feet per earth equatorial radius	$2.092573819 \times 10^{7}$	ft/er
Nautical mile per earth equatorial radius	3443.93358	nm/er

Table A-2. LEM Weight and Propulsion Data

WEIGHT DATA

Ascent stage structure weight	5045 lb
Ascent useful propellant weight	+5015 lb
Total ascent stage weight	10060 lb

ASCENT ENGINE DATA

Thrust	3500(lbf)
Specific Impulse	303 (lbf-sec/lbm)
Flow Rate*	11.551155 (lbm/sec)

* Flow rate calculated from given thrust and specific impulse and used as input to the reference trajectory computer program.

APPENDIX B

COORDINATE SYSTEM DESCRIPTIONS

1. SELENOCENTRIC, X, Y, Z

Inertial, right-handed, orthogonal system with the origin at the center of the moon and oriented such that the X-Y plane is parallel to the earth's mean equator of 1950, the positive X-axis points in the direction of the mean vernal equinox of 1950, the Z-axis is parallel to the earth's spin axis, and the Y-axis completes the right-handed system.

2. SELENOGRAPHIC, X, Y, Z

Right-handed, orthogonal system in which the origin coincides with the center of the moon and the coordinate axes are fixed in the moon such that the X-Y plane contain the moon's equator, the positive X-axis passes through the Sinus Medii(Central Bay) on the lunar surface, the Z-axis coincides with the moon's spin axis, and the Y-axis completes the right-handed system.

3. ORBIT PLANE, U, V, W

A right-handed system in which the origin coincides with the center of the moon and the positive directions of the coordinate axes are defined by the following set of equations:

$$\underline{i}_U = \frac{\underline{R}}{|\underline{R}|}$$

$$\underline{i}_W = \frac{\underline{V} \times \underline{R}}{|\underline{V} \times \underline{R}|}$$

$$\underline{i}_V = \underline{i}_W \times \underline{i}_U$$

where $\underline{R}$ is the position vector and $\underline{V}$ is the velocity vector.

4. SPECIAL PARKING ORBIT ELEMENTS, R, λ, β, θ, w, $\dot{w}$

A set of elements designed to separate guidance errors from position errors in the achievement of a circular parking orbit. The elements and their deviations are defined below:

$$R^2 = \underline{R} \cdot \underline{R}$$

$$2R\delta R = 2\underline{R} \cdot \delta\underline{R}$$

$$\delta R = \frac{\underline{R} \cdot \delta\underline{R}}{|\underline{R}|}$$

$$\lambda = \frac{RV^2}{\mu}$$

$$\delta\lambda = \frac{V^2}{\mu}\,\delta R + \frac{2RV}{\mu}\,\delta V = \frac{V^2}{\mu R}\,\underline{R} \cdot \delta\underline{R} + \frac{2R}{\mu}\,\underline{V} \cdot \delta\underline{V}$$

$$\cos\beta = \frac{\underline{R} \cdot \underline{V}}{RV}$$

$$-\sin\beta\,\delta\beta = \frac{\underline{V} \cdot \delta\underline{R}}{RV} + \frac{\underline{R} \cdot \delta\underline{V}}{RV} - \frac{\underline{R} \cdot \underline{V}}{RV^2}\,\delta V$$

with nominal $= 90^{\circ}$

$$\delta\beta = -\frac{\underline{V} \cdot \delta\underline{R}}{RV} - \frac{\underline{R} \cdot \delta\underline{V}}{RV}$$

θ = transfer angle

$$\delta\theta = \frac{\text{downrange error}}{R} = \frac{\left[\underline{R} \times [\underline{V} \times \underline{R}]\right] \cdot \delta R}{R\,\left|\underline{R} \times [\underline{V} \times \underline{R}]\right|}$$

$$\left.\begin{matrix} w, & \delta w \\ \dot{w}, & \delta\dot{w} \end{matrix}\right\} \text{ in the direction of } \frac{\underline{V} \times \underline{R}}{|\underline{V} \times \underline{R}|}$$

The transformation matrix A used in the following expression,

$$\Sigma \begin{bmatrix} R \\ \lambda \\ \beta \\ \theta \\ w \\ \dot{w} \\ wt \end{bmatrix} = A\,\Sigma \begin{bmatrix} x \\ y \\ z \\ \dot{x} \\ \dot{y} \\ \dot{z} \\ wt \end{bmatrix} A^T$$

is:

$$\left[\begin{array}{c|c|c}
\frac{\underline{R}^T}{|R|} & 0 & 0 \\ \hline
\frac{V^2}{\mu R}\underline{R}^T & \frac{2R}{\mu}\underline{V}^T & 0 \\ \hline
-\frac{1}{RV}\underline{V}^T & -\frac{1}{RV}\underline{R}^T & 0 \\ \hline
\frac{[\underline{R} \times [\underline{V} \times \underline{R}]]^T}{|\underline{R} \times [\underline{V} \times \underline{R}]||\underline{R}|} & 0 & 0 \\ \hline
\frac{[\underline{V} \times \underline{R}]^T}{|\underline{V} \times \underline{R}|} & 0 & 0 \\ \hline
0 & \frac{[\underline{V} \times \underline{R}]^T}{|\underline{V} \times \underline{R}|} & 0 \\ \hline
0 & 0 & 1
\end{array}\right]$$

5. PERICYNTHION ANALYSIS ELEMENTS, R, V, β

A set of elements required in the pericynthion analysis as described in Section 4. 3 are those which describe deviations in the direction of the radius vector, R ; the deviations in velocity, V ; and the deviations in the flight path angle, β .

The following expression is the one used in the transformation of matrices in selenocentric coordinates to ones in β, V, R:

$$\Sigma \begin{bmatrix} \beta \\ V \\ R \end{bmatrix} = A \, \Sigma \begin{bmatrix} x \\ y \\ z \\ \dot{x} \\ \dot{y} \\ \dot{z} \\ wt \end{bmatrix} A^T$$

where:

$$A = \left[\begin{array}{c|c|c} -\dfrac{\underline{V}^T}{RV} & -\dfrac{\underline{R}^T}{RV} & 0 \\ \hline 0 & \dfrac{\underline{V}^T}{V} & 0 \\ \hline \dfrac{\underline{R}^T}{R} & 0 & 0 \end{array}\right]$$

6. LEM PLATFORM X, Y, Z

Inertial, right-handed, orthogonal system with the origin at the center of the moon, the X-axis along the radius vector through the landing site, the Z-axis in the direction opposite the launch azimuth (backrange), and the Y-axis completing the coordinate system.

7. GUIDANCE COMPUTATION REFERENCE X, Y, Z

Inertial, right-handed, orthogonal system based on the target state vector. The origin is at the center of the moon, the Y-axis is in the direction of the cross product of the target velocity vector and the target position vector, the Z-axis in the direction of the cross product of the burnout position vector and the Y-axis, and the X-axis completing the coordinate system.

$$\underline{i}_Y = \frac{\underline{V}_T \times \underline{R}_T}{|\underline{V}_T \times \underline{R}_T|}$$

$$\underline{i}_Z = \frac{\underline{R}_T \times \underline{i}_Y}{|\underline{R}_T \times \underline{i}_Y|}$$

$$\underline{i}_X = \underline{i}_Y \times \underline{i}_Z$$

APPENDIX C

TRANSFORMATION SENSITIVITY MATRICES

This appendix contains all the transformation sensitivity matrices generated in this study.

The first six rows of the sensitivity matrices correspond to the estimated state vector, the next six rows correspond to the actual state vector, and the last row relates to weight.

The columns of the matrices are the independent parameters which are perturbed at lift-off. These columns are identified in each table by the same symbols that were used in Table 2-1.

It should be noted that Tables C-1 and C-15 have two parts, a and b. The "a" parts are the sensitivity matrices for the 140° transfer case in which interception occurs at apocynthion. The "b" parts are the sensitivity matrices for the 140° transfer case in which injection occurs at pericynthion. The perturbations made had + 3 sigma magnitudes. Tables C-2 and C-16 are matrices for the first case described above except the perturbations had - 3 sigma magnitudes.

It should be further noted that the "b" parts are more nearly similar to the other matrices presented in this appendix than are the "a" parts.

Table C-1a. Sensitivity Matrix for 140° Direct, In-Plane Transfer, Selenocentric Coordinates, + 3 Sigma Perturbations

	x_e	y_e	z_e	$\dot{x}_e$	$\dot{y}_e$	$\dot{z}_e$
1	.77843750-01	-.64635416 00	-.34382291 00	.73854165 02	-.32947916 03	-.13406250 03
2	-.43041666-01	.68562499 00	.27935417 00	-.59374999 02	.27729166 03	.11187500 03
3	-.16421875-01	.26795312 00	.10919792 00	-.23177083 02	.10859375 03	.43854166 02
4	.23531087-03	-.61041259-03	-.23529053-03	-.49845377-01	-.38248698-01	-.14383952 00
5	.18870036-03	-.66257731-03	-.25593058-03	.65917968-01	-.12084961 00	-.10416667 00
6	.11197101-04	-.28176880-03	-.10865275-03	.26295980-01	-.50303141-01	-.45013427-01
7	-.[illegible]2291 00	-.96425000 00	-.39451041 00	-.36458333 03	-.34666666 03	-.13958333 03
8	-.16141667 00	-.32315625 00	.23931250 00	-.76458332 02	-.15468750 03	.10729167 03
9	-.67416665-01	.22783854 00	-.82366665 00	-.30572916 02	.10250000 03	-.37609375 03
10	-.49458821-04	-.11624349-02	-.47245280-03	-.10978190 01	-.15523275 00	-.19287109 00
11	-.37202962-03	-.74473063-03	-.45669555-03	-.54524739-01	-.11428833 01	-.14882405 00
12	-.15964254-03	-.48244222-03	.19045003-03	-.25227864-01	-.95570882-01	-.98042805 00
13	.10352987-02	.75181071-03	.31612142-03	-.98063149-01	.71879069 00	.25817871 00

	x_a	y_a	z_a	$\dot{x}_a$	$\dot{y}_a$	$\dot{z}_a$
1						
2						
3						
4						
5						
6						
7	.10659479 01	.11769792 00	.50760416-01	.43843750 03	.16875000 02	.72916666 01
8	.11822917 00	.10086250 01	.40114583-01	.16875000 02	.43177083 03	.60416666 01
9	.50921875-01	.40057291-01	.93282811 00	.72395832 01	.59374999 01	.42041666 03
10	.28497314-03	.55230712-03	.23765055-03	.10504150 01	.11759440 00	.50455728-01
11	.56044514-03	.81787108-04	.20080566-03	.11830648 00	.10213216 01	.44962565-01
12	.24073283-03	.20047506-03	-.29915873-03	.50710041-01	.44962565-01	.93556721 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	-.19188596 01	-.20879934 04	-.27412280 00	.30000000 04	-.20570000 07	.84999999 04
2	-.49342105 01	.15646930 04	-.35635965 01	.74999998 03	.15137500 07	.25000000 04
3	-.13432017 02	.60910088 03	.13706140 00	-.15750000 05	.58849998 06	.31250000 04
4	-.82129761 00	-.22267124 01	-.33729954 00	-.29199218 03	-.18876953 04	.17041015 03
5	-.27519360 00	-.23734109 01	-.27867367 00	.35083007 03	-.18234863 04	.12548828 03
6	-.12103967 01	-.10097571 01	.33194558-01	-.13739013 04	-.77880859 03	.24401855 03
7	.27275219 03	.17250822 05	.10471491 03	.30300000 06	.18327250 08	.11075000 06
8	.68607455 04	.69295504 04	.28867873 04	.73657499 07	.76432499 07	.28945000 07
9	-.16783717 05	.31191064 04	-.70593475 04	-.18013000 08	.34291250 07	-.70628749 07
10	.65371863 00	.91059097 02	-.13920299-01	.14165039 04	.10255224 06	.49316406 03
11	.36031355 02	.40375291 02	.84686277 01	.41921142 05	.48909179 05	.89736327 04
12	-.89869449 02	.18023441 02	-.21326968 02	-.10294568 06	.21709228 05	-.21361328 05
13	-.12795967 00	.13620477 01	-.54075006-01	-.12060547 03	.11308594 04	-.16113281 02

Table C-1a Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	.36337209 01	.38971656 04	-.54505812 01	.30886628 02	-.59792877 04	.90843022 01
2	.14534884 02	-.34375000 04	-.36337209 01	.41787790 02	.50272529 04	.72674417 01
3	.63590115 01	-.13472020 04	.90843023 00	.54505812 01	.19667514 04	.27252907 01
4	.93327010 00	.13484511 00	-.25088288 01	.37259833 00	-.49608806 01	-.21894588 01
5	.22018787 01	.21273591 01	-.53583188 00	.18470232 01	-.33941934 01	-.13484511 01
6	.91907588 00	.87560607 00	-.80729638-01	-.26081883 00	-.14744248 01	-.58994736 00
7	-.90843022 01	.18462936 05	.92659882 02	.27797965 03	-.11900436 04	-.10901163 02
8	.72674417 01	.74763807 04	.28797238 04	.69004360 04	-.49600290 03	-.72674417 01
9	.18168605 01	.33621002 04	-.70630450 04	-.16766896 05	-.22256540 03	-.36337209 01
10	.95456143 00	.79097302 02	-.21433276 01	.18133119 01	.93610896 01	-.21752645 01
11	.21823617 01	.61835355 02	.81900661 01	.38184232 02	-.20283544 02	-.13715167 01
12	.91020450 00	.26642555 02	-.21448357 02	-.88908173 02	-.81794206 01	-.59970589 00
13	-.46840933 00	-.14052280 02	-.85165332 00	-.46131222 00	.13800333 02	-.38679256 00

	DBX	DBY	DBZ	KS1	KS2	KS3
1	-.22673251 05	.11172280 03	.69353949 05	-.13229167 06	-.20833333 03	-.77062500 06
2	.19923899 05	-.97150258 01	-.58863342 05	.11416667 06	.52083333 03	.66729165 06
3	.78165478 04	.25097150 02	-.23056185 05	.44791665 05	.26041666 03	.26156250 06
4	.50978585 01	.17709683 01	.41133900 02	-.51269531 02	-.97656250 02	-.36499023 03
5	-.36051854 00	.77005494 00	.39963796 02	-.92264811 02	-.13122559 02	-.35807291 03
6	-.70364362-01	.85868242 01	.17059010 02	-.38655599 02	-.69173177 01	-.15294393 03
7	-.96296954 05	.14345855 04	.12091969 05	-.48885416 06	-.83333333 03	-.12010417 06
8	-.35307642 05	.34583873 05	.70887305 04	-.15312500 06	-.20833333 03	-.85416665 05
9	-.16027364 05	-.84293230 05	.31015220 04	-.70677082 05	-.15625000 03	-.37031250 05
10	-.34499726 03	.79472200 01	-.21979613 03	-.12202962 04	-.97249349 02	.30686442 04
11	-.26608956 03	.15944565 03	.34404379 03	-.98876952 03	-.13732910 02	-.43466186 04
12	-.11472237 03	-.37803847 03	.13772203 03	-.42526245 03	-.71207682 01	-.17354329 04
13	.74339555 02	-.10657434 01	-.25342556 03	.42867025 03	-.36214192 02	.33005778 04

	ISP	WTFLO	WT	DTGO
1	-.88578437 06	-.19193750 06	.10364250 03	-.15000000 03
2	.76240312 06	.17411250 06	-.90081248 02	.13229167 03
3	.29884375 06	.68414060 05	-.35325625 02	.52083333 02
4	-.47516479 03	-.94061277 02	.51469725-01	-.14796956 02
5	-.62281493 03	-.13013611 03	.70721434-01	.12414551 02
6	-.26322021 03	-.54916381 02	.29847412-01	.48604329 01
7	-.88579687 06	-.19193125 06	.10365000 03	-.15416667 03
8	.76237812 06	.17411875 06	-.90075000 02	.13020833 03
9	.29882968 06	.68414060 05	-.35323125 02	.50520833 02
10	-.47501831 03	-.94018554 02	.51481933-01	-.14796956 02
11	-.62290037 03	-.13015747 03	.70712889-01	.12413533 02
12	-.26325073 03	-.54924011 02	.29844971-01	.48599243 01
13	.37481750 04	-.34381164 04	.50604247 00	-.11551921 02

Table C-1b. Sensitivity Matrix for 140° Direct, In-Plane Transfer, Selenocentric Coordinates, + 3 Sigma Perturbations

	x_e	y_e	z_e	$\dot{x}_e$	$\dot{y}_e$	$\dot{z}_e$
1	.25572916-01	-.88421874 00	-.36043750 00	.61979166 02	-.35052083 03	-.14416667 03
2	-.18989583-01	.70480207 00	.28740625 00	-.51562499 02	.27843750 03	.11385417 03
3	-.73906248-02	.27521354 00	.11223958 00	-.20208333 02	.10864583 03	.44375000 02
4	.18070475-03	-.61964925-03	-.25089518-03	-.91756184-01	-.17395019 00	-.66935221-01
5	.14512126-03	-.70380655-03	-.28610230-03	-.91247558-01	-.20182292 00	-.87178548-01
6	.62444050-04	-.29907226-03	-.12062581-03	-.38960774-01	-.85652669-01	-.36824544-01
7	-.10403542 01	-.10016250 01	-.41067708 00	-.37760416 03	-.36572916 03	-.15208333 03
8	-.13698958 00	-.30372916 00	.24768750 00	-.69583332 02	-.15260417 03	.10697917 03
9	-.58213541-01	.23527083 00	-.82061458 00	-.27916666 02	.10307292 03	-.37640625 03
10	-.10443115-03	-.11707357-02	-.48756917-03	-.11431885 01	-.29215495 00	-.11922200 00
11	-.41413371-03	-.78498331-03	-.48602295-03	-.21077474 00	-.12234497 01	-.13275146 00
12	-.17779032-03	-.49901326-03	.17803955-03	-.90128579-01	-.13066610 00	-.97295125 00
13	.12165324-02	.88779703-03	.37522379-03	-.25431315-01	.71919759 00	.30131022 00

	x_a	y_a	z_a	$\dot{x}_a$	$\dot{y}_a$	$\dot{z}_a$
1						
2						
3						
4						
5						
6						
7	.10659375 01	.11748958 00	.50677083-01	.43843750 03	.16770833 02	.71874999 01
8	.11801042 00	.10085104 01	.40010416-01	.16770833 02	.43177083 03	.59374999 01
9	.50838541-01	.39958333-01	.93291666 00	.72395832 01	.59374999 01	.42046875 03
10	.28515625-03	.55114746-03	.23714193-03	.10502116 01	.11718750 00	.50252278-01
11	.55920410-03	.80891926-04	.20010376-03	.11800130 00	.10210164 01	.44759114-01
12	.24020894-03	.19976806-03	-.29868062-03	.50608317-01	.44809977-01	.93571979 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	.46600876 01	-.23788377 04	.16447368 01	.64999999 04	-.23542500 07	.30000000 04
2	.16447368 01	.17743969 04	-.38377193 01	.37500000 04	.17230000 07	-.25000000 04
3	-.14117324 02	.69037829 03	.15076754 01	-.17500000 05	.66962498 06	.32500000 04
4	.48185648-02	-.20784077 01	-.44437876-01	.37597656 02	-.21645507 04	.97656248 00
5	.52120811 00	-.24424770 01	-.15071400 00	.70019530 03	-.25095215 04	-.14843750 03
6	-.13192160 01	-.10358576 01	.27024118 00	-.16972656 04	-.10640869 04	.38281250 03
7	.28125000 03	.16846765 05	.10882675 03	.30500000 06	.17874250 08	.10650000 06
8	.68220942 04	.70731907 04	.28813048 04	.73249999 07	.78344999 07	.28582500 07
9	-.16667900 05	.31717379 04	-.70415295 04	-.17908750 08	.35006250 07	-.69854999 07
10	.14814410 01	.89604961 02	.24414062 00	.17475586 04	.10026611 06	.27734375 03
11	.36849172 02	.42090433 02	.76406378 01	.42344238 05	.50678710 05	.74411620 04
12	-.90031004 02	.18704197 02	-.18760146 02	-.10344751 06	.22399780 05	-.18143554 05
13	-.43367085-01	.15756707 01	-.91017338-02	-.56152343 02	.14150390 04	-.78124999 01

Table C-1b Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1		.38372093 04	.36337209 01	-.18168604 02	-.62699853 04	.18168605 01
2		-.32031250 04	.90843022 01	-.23619186 02	.49763807 04	
3	-.90843023 00	-.12536337 04	.63590115 01	-.24527616 02	.19422238 04	-.90843023 00
4	-.14194222 00	.87294467 00	-.60325445-01	-.19942882 01	-.30872433 01	-.15968500 00
5	-.30162722-01	.15329760 01	.15968500 00	-.16518526 01	-.40347077 01	.92262443-01
6	-.15081361-01	.64406282 00	.41163244 00	-.21956688 01	-.17033067 01	.34598417-01
7	.72674417 01	.18263081 05	.10719477 03	.25254360 03	-.14752907 04	.36337209 01
8	-.18168605 01	.76144621 04	.28888081 04	.68095930 04	-.52507267 03	-.18168605 01
9		.34166061 04	-.70385173 04	-.16673328 05	-.23891715 03	
10	-.11000522 00	.79767981 02	.24130178 00	-.57841454 00	.96272311 01	-.15968500 00
11	-.60325445-01	.61210809 02	.79558616 01	.34738584 02	-.19103649 02	.88713888-01
12	-.27501306-01	.26397705 02	-.18616610 02	-.90883829 02	-.76870584 01	.32824139-01
13	-.31937000-01	-.11937341 02	-.12065089 00	-.10645667 00	.13534191 02	-.10645667 00

	DBX	DBY	DBZ	KS1	KS2	KS3
1	-.23745142 05	.76101035 02	.72527524 05	-.15135417 06	-.14583333 04	-.80937500 06
2	.19371761 05	-.50194300 02	-.58073185 05	.12000000 06	-.15625000 04	.64427083 06
3	.75728627 04	-.12953368 02	-.22682156 05	.46822915 05	-.67708333 03	.25156250 06
4	-.18816538 01	-.18974660-01	.36975287 02	-.83211263 02	-.12878418 03	-.40588379 03
5	-.80515807 01	-.19891768 01	.36524639 02	-.10386149 03	-.13804118 03	-.50689697 03
6	-.33340059 01	.50069383 01	.15583730 02	-.43894450 02	-.58644612 02	-.21448771 03
7	-.97378560 05	.14135363 04	.15254210 05	-.50802083 06	-.17708333 04	-.15885417 06
8	-.35866256 05	.34543394 05	.78643133 04	-.14781250 06	-.20833333 04	-.99791665 05
9	-.16273478 05	-.84333711 05	.34715026 04	-.68750000 05	-.88541666 03	-.43489582 05
10	-.35201789 03	.61477898 01	-.22403381 03	-.11442057 04	-.12817383 03	.30303955 04
11	-.27369366 03	.15670381 03	.34056984 03	-.92142741 03	-.13916016 03	-.44959513 04
12	-.11795123 03	-.38164366 03	.13623094 03	-.39647420 03	-.59153239 02	-.17971802 04
13	.71815925 02	-.31624433 00	-.25354257 03	.46203613 03	-.46793619 01	.33374023 04

	ISP	WTFLO	WT	DTGO
1	-.93748748 06	-.20886562 06	.11019750 03	-.14166667 03
2	.74935937 06	.16657187 06	-.88099998 02	.10312500 03
3	.29266250 06	.65046873 05	-.34408125 02	.39583333 02
4	-.42415771 03	-.96801757 02	.46835937-01	-.15883382 02
5	-.57324522 03	-.12846985 03	.65020750-01	.11292521 02
6	-.24206085 03	-.54273986 02	.27432861-01	.43823242 01
7	-.93751248 06	-.20890625 06	.11018000 03	-.14270833 03
8	.74932187 06	.16653125 06	-.88118750 02	.10104167 03
9	.29264843 06	.65031248 05	-.34415625 02	.39583333 02
10	-.42410278 03	-.96789550 02	.46809082-01	-.15883382 02
11	-.57332152 03	-.12853699 03	.64997557-01	.11291504 02
12	-.24208984 03	-.54301452 02	.27423706-01	.43818155 01
13	.37845764 04	-.34419861 04	.50159424 00	-.11549886 02

Table C-2. Sensitivity Matrix for 140° Direct, In-Plane Transfer, Selenocentric Coordinates, - 3 Sigma Perturbations

	x_e	y_e	z_e	$\dot{x}_e$	$\dot{y}_e$	$\dot{z}_e$
1	.71322915-01	-.85109375 00	-.35028125 00	.73645832 02	-.33437500 03	-.13645833 03
2	-.39385416-01	.68936457 00	.28387500 00	-.58854166 02	.27416666 03	.11020833 03
3	-.15036458-01	.26940104 00	.11094271 00	-.22968750 02	.10723958 03	.42968750 02
4	.19604492-03	-.60949707-03	-.25343831-03	.20650228 00	-.99080402-01	-.12268066 00
5	.13251750-03	-.67482502-03	-.28328450-03	.22430420 00	-.25563558 00	-.22003174 00
6	.57515461-04	-.28675333-03	-.12008158-03	.95570882-01	-.10635376 00	-.92213947-01
7	-.99438541 00	-.96863540 00	-.40109375 00	-.36447916 03	-.34843750 03	-.14322917 03
8	-.15752083 00	-.31907291 00	.24372916 00	-.75520832 02	-.15531250 03	.10458333 03
9	-.65911458-01	.22942187 00	-.82191665 00	-.30104166 02	.10223958 03	-.37718750 03
10	-.88887531-04	-.11617025-02	-.49086507-03	-.84513345 00	-.21748861 00	-.17415364 00
11	-.42783610-03	-.75604248-03	-.48377482-03	.10721842 00	-.12758382 01	-.26326497 00
12	-.18317668-03	-.48704020-03	.17911784-03	.45318603-01	-.15085856 00	-.10271199 01
13	.10599162-02	.77097575-03	.34230550-03	-.53304036-01	.74808755 00	.31962077 00

	x_a	y_a	z_a	$\dot{x}_a$	$\dot{y}_a$	$\dot{z}_a$
1						
2						
3						
4						
5						
6						
7	.10662083 01	.11795833 00	.50687500-01	.43833333 03	.16770833 02	.71874999 01
8	.11846875 00	.10085937 01	.40052083-01	.16770833 02	.43177083 03	.59374999 01
9	.51041666-01	.40119791-01	.93273958 00	.72916666 01	.59895833 01	.42046875 03
10	.28564453-03	.55322265-03	.23734538-03	.10502116 01	.11739095 00	.50252278-01
11	.56147258-03	.81614175-04	.20057169-03	.11840820 00	.10213216 01	.45064290-01
12	.24118551-03	.20073446-03	-.29959106-03	.50710041-01	.45013427-01	.93556721 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	-.82236842 01	-.20995066 04	.82236840 00	-.42499999 04	-.20795000 07	-.17500000 04
2	.30153508 01	.15773026 04	.16447368 01	.87499999 04	.15175000 07	-.25000000 03
3	-.98684210 01	.61376096 03	.24671052 01	-.12500000 05	.58949998 06	.25000000 04
4	-.97977486-01	-.13550875 01	.32391464 00	.20166015 03	-.22197265 04	.24072265 03
5	.51130328-01	-.18730833 01	.74955455-02	.54394530 03	-.23159179 04	-.78857421 02
6	-.10141741 01	-.79024465 00	.17413758 00	-.12811279 04	-.98583984 03	.21423340 03
7	.24972588 03	.17224780 05	.12033991 03	.26900000 06	.18273750 08	.11875000 06
8	.68988486 04	.69714911 04	.29040570 04	.74129999 07	.76819999 07	.29050000 07
9	-.16767544 05	.31361020 04	-.70516721 04	-.17994125 08	.34443750 07	-.70576249 07
10	.12506853 01	.91851484 02	.68102384 00	.17270508 04	.10209375 06	.60498045 03
11	.36504912 02	.41036505 02	.87901331 01	.42324951 05	.48657226 05	.88041991 04
12	-.89615270 02	.18307870 02	-.21171168 02	-.10276953 06	.21598877 05	-.21374389 05
13	.12688888 00	.16286750 01	.11618095 00	.13232422 03	.13344726 04	.11132812 03

Table C-2 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	.18168605 01	.39262354 04	.10901163 02	.72674417 01	-.59538517 04	
2	-.18168604 02	-.34120639 04	.10901163 02	.54505812 01	.50436045 04	.18168605 01
3	-.72674417 01	-.13372093 04	.63590115 01	-.90843022 01	.19731104 04	.90843023 00
4	.13732910 01	.44569858 01	.21681674 01	.21717160 01	-.39034111-01	.57131743 00
5	-.93149582 00	.45261826 01	.23260782 01	.10006927 01	-.89778455 00	-.10290811 00
6	-.35751697 00	.19313014 01	.11594905 01	-.58462453 00	-.36816264 00	-.31049861-01
7	.14534884 02	.18472020 05	.13808139 03	.28706395 03	-.11555232 04	.10901163 02
8	-.10901163 02	.74945493 04	.29196947 04	.68949853 04	-.47601744 03	.90843022 01
9	-.36337209 01	.33711845 04	-.70439680 04	-.16767805 05	-.21257267 03	.45421511 01
10	.13626453 01	.83369763 02	.24839889 01	.35840411 01	.14279388 02	.57131743 00
11	-.92262445 00	.64262567 02	.11130044 02	.37385807 02	-.17780038 02	-.95810999-01
12	-.35396841 00	.27708896 02	-.20177974 02	-.89215121 02	-.70704969 01	-.28388445-01
13	.97585277 00	-.13154495 02	-.81616778-01	.67422555 00	.14900385 02	.27323878 00

	DBX	DBY	DBZ	KS1	KS2	KS3
1	-.22979274 05	-.10848445 03	.69060880 05	-.13270833 06	.10416667 03	-.77614583 06
2	.19959520 05	.11334197 02	-.58800194 05	.11791667 06	-.72916666 03	.66468750 06
3	.78246437 04	.19430052 02	-.23035136 05	.46302082 05	-.36458333 03	.26036458 06
4	.60086422 00	-.11764289 01	.40479274 02	.26428223 03	.51472981 02	-.44616699 03
5	-.59706929 01	-.50646530 01	.35397228 02	.18188477 03	-.99690753 01	-.48756917 03
6	-.24437781 01	.52907677 01	.15177356 02	.78989663 02	-.33060710 01	-.20736694 03
7	-.96607836 05	.12564767 04	.11755181 05	-.49187500 06	.41666666 03	-.12552083 06
8	-.35281735 05	.34634067 05	.71097797 04	-.15166667 06	-.20833333 03	-.87708332 05
9	-.16020887 05	-.84284325 05	.31063795 04	-.70052082 05	-.52083333 02	-.37968750 05
10	-.34954802 03	.49745232 01	-.22047922 03	-.90840656 03	.50048828 02	.29870605 04
11	-.27163649 03	.15364098 03	.33944876 03	-.71512858 03	-.82397461 01	-.44770304 04
12	-.11706970 03	-.38132267 03	.13582773 03	-.30792236 03	-.26448567 01	-.17902120 04
13	.75576070 02	.91078366 00	-.25168621 03	.45572916 03	.25634766 02	.33249918 04

	ISP	WTFLO	WT	DTGO
1	-.90446248 06	-.19290937 06	.10340250 03	-.15729167 03
2	.77926873 06	.17464375 06	-.90021250 02	.13020833 03
3	.30546718 06	.68615623 05	-.35305625 02	.50520833 02
4	-.44562988 03	-.96038816 02	.49255371-01	-.14798991 02
5	-.60106506 03	-.13673095 03	.67912596-01	.12413533 02
6	-.25381164 03	-.57652282 02	.28660889-01	.48599243 01
7	-.90439687 06	-.19300000 06	.10340500 03	-.15520833 03
8	.77929687 06	.17457187 06	-.90021250 02	.13020833 03
9	.30547968 06	.68584373 05	-.35304375 02	.51041666 02
10	-.44554443 03	-.96069335 02	.49235839-01	-.14796956 02
11	-.60105285 03	-.13677673 03	.67924803-01	.12413533 02
12	-.25380554 03	-.57672119 02	.28665771-01	.48599243 01
13	.38136108 04	-.34575012 04	.50673827 00	-.11551921 02

Table C-3. Sensitivity Matrix for 180° Direct, In-Plane Transfer, Selenocentric Coordinates, + 3 Sigma Perturbations

	x_e	y_e	z_e	$\dot{x}_e$	$\dot{y}_e$	$\dot{z}_e$
1	.39750000-01	-.87383333 00	-.35591666 00	.67499998 02	-.34114583 03	-.13906250 03
2	-.30937500-01	.69565625 00	.28347916 00	-.52916666 02	.27291666 03	.11145833 03
3	-.12072917-01	.27162500 00	.11069792 00	-.20677083 02	.10651042 03	.43489583 02
4	.72285969-04	-.69828286-03	-.28446452-03	.52490234-01	-.24963379 00	-.10498047 00
5	.10726929-03	-.73119100-03	-.29748535-03	.54524739-01	-.24556478 00	-.10182699 00
6	.45166014-04	-.31170654-03	-.12551880-03	.23091634-01	-.10503133 00	-.43487548-01
7	-.10259479 01	-.99135415 00	-.40633333 00	-.37031250 03	-.35708333 03	-.14708333 03
8	-.14877083 00	-.31289583 00	.24365625 00	-.69270832 02	-.15729167 03	.10479167 03
9	-.62822916-01	.23166146 00	-.82216667 00	-.27656250 02	.10130208 03	-.37718750 03
10	-.21262614-03	-.12494914-02	-.52130126-03	-.99690755 00	-.36763509 00	-.15421549 00
11	-.45211792-03	-.81242879-03	-.49743652-03	-.63069660-01	-.12647502 01	-.14760335 00
12	-.19511414-03	-.51171365-03	.17326355-03	-.27262370-01	-.14897664 00	-.97951253 00
13	.11710612-02	.85516357-03	.36108398-03	-.21158854-01	.69539387 00	.28808593 00

	x_a	y_a	z_a	$\dot{x}_a$	$\dot{y}_a$	$\dot{z}_a$
1						
2						
3						
4						
5						
6						
7	.10659271 01	.11753125 00	.50687500-01	.43833333 03	.16770833 02	.71874999 01
8	.11805208 00	.10085312 01	.40020833-01	.16770833 02	.43166666 03	.59374999 01
9	.50854166-01	.39979166-01	.93290104 00	.72395832 01	.59374999 01	.42046875 03
10	.28509521-03	.55135091-03	.23722331-03	.10502116 01	.11718750 00	.50252278-01
11	.55941771-03	.81064859-04	.20023600-03	.11810303 00	.10211181 01	.44860839-01
12	.24029541-03	.19989522-03	-.29876200-03	.50557454-01	.44809977-01	.93566894 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	.49342105 01	-.22952303 04	.30153508 01	.52499999 04	-.22737500 07	.27500000 04
2	.24671052 01	.17097039 04	-.38377193 01	.35000000 04	.16580000 07	-.42499999 04
3	-.14254386 02	.66515899 03	.19188596 01	-.18750000 05	.64424998 06	.32500000 04
4	.25163617-01	-.24783486 01	-.11243318-01	.43457031 02	-.27143554 04	-.27343750 02
5	.54744252 00	-.24601451 01	-.13518752 00	.74169920 03	-.26894531 04	-.20288086 03
6	-.13313963 01	-.10492425 01	.31909608 00	-.17722168 04	-.11470947 04	.43811035 03
7	.28125000 03	.16947368 05	.10992325 03	.30675000 06	.17978000 08	.10700000 06
8	.68314144 04	.70227521 04	.28826754 04	.73342499 07	.77769999 07	.28620000 07
9	-.16688185 05	.31526864 04	-.70396107 04	-.17925500 08	.34786250 07	-.69931249 07
10	.14964321 01	.89236609 02	.27572899 00	.17534180 04	.99741697 05	.25292969 03
11	.36875139 02	.42038767 02	.76842726 01	.42372070 05	.50435302 05	.74143066 04
12	-.90024043 02	.18677561 02	-.18760949 02	-.10347998 06	.22291382 05	-.18157226 05
13	-.45508669-01	.10793585 01	-.11778714-01	-.62011718 02	.90136718 03	-.97656249 01

Table C-3 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1		.38590116 04	.72674417 01	.12718023 02	-.61246365 04	.54505812 01
2		-.31740552 04	-.36337209 01	.18168605 01	.48928052 04	-.18168605 01
3		-.12418241 04	.18168605 01	-.16351744 02	.19086119 04	-.27252907 01
4	.21291333-01	.22178472 01	.49679778-01	.10290811 00	-.45173112 01	.14194222-01
5	.51454056-01	.22675270 01	-.90488166-01	.64406282 00	-.45119883 01	-.17742778-02
6	.21291333-01	.96431997 00	.32203142 00	-.13697424 01	-.19268657 01	-.17742778-02
7	.72674417 01	.18306686 05	.11809593 03	.27797965 03	-.13426599 04	
8	.54505812 01	.76544330 04	.28888081 04	.68495638 04	-.59956393 03	.18168605 01
9	.27252907 01	.34338662 04	-.70367004 04	-.16681504 05	-.26707848 03	.90843023 00
10	.39034111-01	.81130626 02	.34066133 00	.15045876 01	.82220031 01	.10645667-01
11	.44356944-01	.61959554 02	.77535939 01	.37059340 02	-.19580929 02	.53228332-02
12	.19517055-01	.26725059 02	-.18747019 02	-.90029515 02	-.79070688 01	.88713889-03
13	-.14194222-01	-.11933792 02	-.35485556-02	-.28388445-01	.12973519 02	

	DBX	DBY	DBZ	KS1	KS2	KS3
1	-.23371114 05	.74481865 02	.71648314 05	-.14614583 06	.31250000 03	-.79916665 06
2	.19044689 05	-.61528497 02	-.57202072 05	-.11531250 06		.63770833 06
3	.74457577 04	-.22668394 02	-.22339702 05	.45000000 05	-.10416667 03	.24890625 06
4	-.82982513 01	-.94873297-02	.55089762 02	-.11881510 03	.14241536 01	-.60892741 03
5	-.10121400 02	-.18816538 01	.43812489 02	-.11576335 03	.16276042 01	-.58827718 03
6	-.42859012 01	.47373401 01	.18860021 02	-.49489339 02	.61035155 00	-.25141398 03
7	-.96985101 05	.14232513 04	.14347474 05	-.50135416 06	.10416667 03	-.14822917 06
8	-.36167422 05	.34554728 05	.87224740 04	-.15125000 06	.10416667 03	-.10739583 06
9	-.16390868 05	-.84332091 05	.38090997 04	-.70104165 05	.52083333 02	-.46458332 05
10	-.35842184 03	.61414649 01	-.20590668 03	-.11824544 04	.12207031 01	.28265381 04
11	-.27573817 03	.15684770 03	.34788141 03	-.93088785 03	.19327799 01	-.45748901 04
12	-.11889206 03	-.38189428 03	.13951751 03	-.40100098 03	.71207681 00	-.18330892 04
13	.70709069 02	-.35735609 00	-.24739794 03	.45104980 03	-.20345052 00	.32631429 04

	ISP	WTFLO	WT	DTGO
1	-.92507498 06	-.20655625 06	.10872250 03	-.14479167 03
2	.73700312 06	.16454375 06	-.86729999 02	.10208333 03
3	.28778593 06	.64248436 05	-.33870000 02	.39062500 02
4	-.65597533 03	-.14920654 03	.77282715-01	-.16005452 02
5	-.66387633 03	-.14940796 03	.77972411-01	.11146037 02
6	-.28295745 03	-.63708496 02	.33234863-01	.43202718 01
7	-.92509373 06	-.20648750 06	.10874250 03	-.14583333 03
8	.73699687 06	.16458437 06	-.86714998 02	.10104167 03
9	.28778593 06	.64270311 05	-.33862500 02	.39062500 02
10	-.65588988 03	-.14915771 03	.77277832-01	-.16001383 02
11	-.66387328 03	-.14938354 03	.77993164-01	.11144002 02
12	-.28295593 03	-.63697814 02	.33242797-01	.43192545 01
13	.37130493 04	-.34573059 04	.51054686 00	-.11549886 02

Table C-4. Sensitivity Matrix for 180° Direct, In-Plane Transfer, Selenocentric Coordinates, - 3 Sigma Perturbations

	x_e	y_e	z_e	$\dot{x}_e$	$\dot{y}_e$	$\dot{z}_e$
1	.33520833-01	-.87824999 00	-.36213541 00	.65312498 02	-.34375000 03	-.14062500 03
2	-.25531250-01	.70053124 00	.28856250 00	-.52187499 02	.27385416 03	.11187500 03
3	-.99427081-02	.27356250 00	.11269792 00	-.20364583 02	.10703125 03	.43802083 02
4	.95235187-04	-.67447915-03	-.28965250-03	.44148763-01	-.25492350 00	-.10640462 00
5	.11869303-03	-.71851603-03	-.30245971-03	.42317707-01	-.25278727 00	-.10538737 00
6	.50221760-04	-.30614726-03	-.12760925-03	.18107096-01	-.10777791 00	-.44860839-01
7	-.10325312 01	-.99564583 00	-.41297916 00	-.37416666 03	-.36052083 03	-.15031250 03
8	-.14376042 00	-.30780208 00	.24842708 00	-.70104165 02	-.15812500 03	.10395833 03
9	-.60869791-01	.23364583 00	-.82028124 00	-.28125000 02	.10088542 03	-.37765625 03
10	-.18971761-03	-.12257283-02	-.52655028-03	-.10064697 01	-.37231445 00	-.15726725 00
11	-.44097900-03	-.79899089-03	-.50252277-03	-.76904296-01	-.12748210 01	-.15167236 00
12	-.19017537-03	-.50584411-03	.17112223-03	-.32958984-01	-.15299479 00	-.98108926 00
13	.11951701-02	.87402343-03	.38321940-03	-.16276041-01	.70088704 00	.29235839 00

	x_a	y_a	z_a	$\dot{x}_a$	$\dot{y}_a$	$\dot{z}_a$
1						
2						
3						
4						
5						
6						
7	.10662187 01	.11781250 00	.50625000-01	.43843750 03	.16770833 02	.72916666 01
8	.11831250 00	.10085104 01	.39979166-01	.16875000 02	.43177083 03	.60416666 01
9	.50968750-01	.40041665-01	.93280729 00	.72395832 01	.59895833 01	.42046875 03
10	.28578694-03	.55228678-03	.23695882-03	.10504150 01	.11739095 00	.50252278-01
11	.56043497-03	.80881753-04	.19999186-03	.11810303 00	.10211181 01	.44860839-01
12	.24075317-03	.20015971-03	-.29918416-03	.50659179-01	.44860839-01	.93571979 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	-.43859649 01	-.23111294 04	-.32894737 01	-.42499999 04	-.22897500 07	-.32500000 04
2	.84978068 01	.17184759 04	.54824561 00	.97499999 04	.16690000 07	.25000000 03
3	-.11513158 02	.66885963 03	.43859649 01	-.15750000 05	.64887498 06	.52499999 04
4	.21415844-01	-.24751362 01	-.37477727-02	.18066406 02	-.26992187 04	-.34179687 01
5	.54369473 00	-.24523818 01	-.14536004 00	.70996093 03	-.26765136 04	-.17993164 03
6	-.13284516 01	-.10453609 01	.35175524 00	-.17578125 04	-.11413574 04	.45092773 03
7	.25000000 03	.16910088 05	.11458333 03	.26450000 06	.17932750 08	.11600000 06
8	.68637609 04	.70550986 04	.28941886 04	.73759999 07	.78217499 07	.28765000 07
9	-.16675301 05	.31652960 04	-.70344023 04	-.17908875 08	.34962500 07	-.69869999 07
10	.13727556 01	.89162724 02	.31534830 00	.15434570 04	.99634765 05	.30957031 03
11	.37008185 02	.42198583 02	.76979251 01	.42548828 05	.50672119 05	.74631346 04
12	-.89966889 02	.18742210 02	-.18718251 02	-.10338306 06	.22387085 05	-.18133301 05
13	.46579461-01	.11912563 01	.96371297-02	.58593749 02	.10493164 04	.87890624 01

Table C-4 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	-.72674417 01	.38444767 04	-.54505812 01	-.14534884 02	-.61573400 04	-.90843022 01
2	.36337209 01	-.31831395 04	.18168605 01	.72674417 01	.49018895 04	.54505812 01
3	.90843023 00	-.12454578 04	.45421511 01	-.99927323 01	.19149709 04	.18168605 01
4	.35485556-02	.21078420 01	-.49679778-01	.70971110-02	-.46131222 01	-.70971110-02
5	-.30162722-01	.21291333 01	-.17742778 00	.47728072 00	-.46982875 01	-.62099722-01
6	-.10645667-01	.90931736 00	.29630439 00	-.12348973 01	-.20004982 01	-.25727028-01
7	-.72674417 01	.18308503 05	.10537791 03	.25436046 03	-.13680959 04	-.72674417 01
8	-.18168605 01	.76598837 04	.28833575 04	.68459302 04	-.61046510 03	-.36337209 01
9	-.90843023 00	.34356831 04	-.70403342 04	-.16681504 05	-.27252906 03	-.18168605 01
10	-.70971110-02	.81006426 02	.24839889 00	.14087765 01	.81652262 01	.24839889-01
11	-.30162722-01	.61828258 02	.76489115 01	.36869492 02	-.19836426 02	-.10645667 00
12	-.12419944-01	.26670943 02	-.18779843 02	-.89900881 02	-.80117513 01	-.43469806-01
13	.17742778-01	-.11919598 02	.10645667-01	.28388445-01	.13076427 02	.63874000-01

	DBX	DBY	DBZ	KS1	KS2	KS3
1	-.23550842 05	-.77720205 02	.71475063 05	-.14812500 06		-.80229165 06
2	.19200129 05	.59909326 02	-.57070919 05	.11635417 06		.63781250 06
3	.75064766 04	.25906736 02	-.22286269 05	.45416665 05	.10416667 03	.24906250 06
4	-.72008834 01	-.15812216 00	.55440793 02	-.13020833 03	.34586588 01	-.61055501 03
5	-.10845599 02	-.19812707 01	.42898543 02	-.12583415 03	.37638346 01	-.58837891 03
6	-.45649869 01	.45665681 01	.18493178 02	-.53660075 02	.16784668 01	-.25126139 03
7	-.97195595 05	.12580958 04	.14183938 05	-.50625000 06	.20833333 03	-.15218750 06
8	-.36047602 05	.34658353 05	.88536267 04	-.15270833 06	.10416667 03	-.10875000 06
9	-.16345531 05	-.84294040 05	.38601036 04	-.70729165 05	.52083333 02	-.47031250 05
10	-.35732131 03	.59959925 01	-.20555565 03	-.11946615 04	.34586588 01	.28271484 04
11	-.27647660 03	.15671804 03	.34695798 03	-.94492593 03	.35603841 01	-.45799764 04
12	-.11917826 03	-.38207849 03	.13914513 03	-.40685018 03	.16276042 01	-.18349202 04
13	.72290292 02	.35735609 00	-.24697417 03	.45674642 03		.32704671 04

	ISP	WTFLO	WT	DTGO
1	-.94321562 06	-.20718437 06	.10860000 03	-.14895833 03
2	.75337187 06	.16529687 06	-.86588750 02	.99999998 02
3	.29421875 06	.64549998 05	-.33813125 02	.39062500 02
4	-.66417235 03	-.14156494 03	.77045898-01	-.15999349 02
5	-.67153930 03	-.14510803 03	.77832030-01	.11144002 02
6	-.28623199 03	-.61816406 02	.33176269-01	.43202718 01
7	-.94322812 06	-.20715000 06	.10860000 03	-.14479167 03
8	.75334373 06	.16531562 06	-.86591248 02	.10104167 03
9	.29420625 06	.64559373 05	-.33813750 02	.39062500 02
10	-.66405028 03	-.14152832 03	.77036131-01	-.15999349 02
11	-.67160644 03	-.14512634 03	.77817381-01	.11144002 02
12	-.28625640 03	-.61824035 02	.33170166-01	.43197631 01
13	.37748718 04	-.34770813 04	.51090576 00	-.11551921 02

Table C-5. Sensitivity Matrix for 180° Direct, In-Plane Transfer, Selenocentric Coordinates, - 5 Sigma Perturbations

	x_e	y_e	z_e	$\dot{x}_e$	$\dot{y}_e$	$\dot{z}_e$
1	.25681250-01	-.88396250 00	-.36589375 00	.64187500 02	-.34387500 03	-.14043750 03
2	-.19231250-01	.70550000 00	.29173125 00	-.52000000 02	.27506250 03	.11168750 03
3	-.74874998-02	.27550625 00	.11392812 00	-.20343750 02	.10740625 03	.43656250 02
4	.11606445-03	-.65842285-03	-.27789307-03	-.98876951-02	-.17761230 00	-.94970702-01
5	.12488403-03	-.71132813-03	-.29710693-03	-.10742187-01	-.18762207 00	-.10107422 00
6	.53106688-04	-.30293274-03	-.12533874-03	-.44555663-02	-.79772948-01	-.42785644-01
7	-.10400937 01	-.10014437 01	-.41622500 00	-.37400000 03	-.35962500 03	-.14612500 03
8	-.13721875 00	-.30282500 00	.25200625 00	-.68437500 02	-.15550000 03	.10693750 03
9	-.58309375-01	.23559687 00	-.81886562 00	-.27375000 02	.10200000 03	-.37631250 03
10	-.16896973-03	-.12096313-02	-.51470946-03	-.10612793 01	-.29516602 00	-.14526367 00
11	-.43444214-03	-.79147339-03	-.49672241-03	-.12829590 00	-.12079468 01	-.14514160 00
12	-.18715515-03	-.50246887-03	.17352600-03	-.54840088-01	-.12423706 00	-.97824097 00
13	.12138306-02	.88785400-03	.39497070-03	-.24169922-01	.71057129 00	.28833008 00

	x_a	y_a	z_a	$\dot{x}_a$	$\dot{y}_a$	$\dot{z}_a$
1						
2						
3						
4						
5						
6						
7	.10662187 01	.11784375 00	.50637500-01	.43843750 03	.16750000 02	.72500000 01
8	.11834375 00	.10084750 01	.39962500-01	.16812500 02	.43175000 03	.60000000 01
9	.50984375-01	.40043750-01	.93279374 00	.72500000 01	.59687500 01	.42046875 03
10	.28581543-03	.55241698-03	.23691406-03	.10504150 01	.11730957 00	.50292969-01
11	.56060180-03	.80712889-04	.19989624-03	.11804199 00	.10210571 01	.44799805-01
12	.24082336-03	.20017090-03	-.29927978-03	.50598144-01	.44799805-01	.93569945 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	-.98684211 01	-.23310855 04	-.50986842 01	-.10651704 05	-.23127700 07	-.51008160 04
2	.50986842 01	.17437500 04	.82236841 00	.84013440 04	.16900204 07	.90014401 03
3	-.66611842 01	.67861842 03	.31250000 01	-.12001920 05	.65688008 06	.39006241 04
4	-.18374794 00	-.22223222 01	-.18953022-01	-.16350272 03	-.26333315 04	-.10548563 02
5	.10649028 00	-.23018285 01	-.11516370 00	.34487940 03	-.27108341 04	-.13200354 03
6	-.83794845 00	-.98001581 00	.23851897 00	-.13825943 04	-.11544816 04	.30656760 03
7	.23717105 03	.16879605 05	.11743421 03	.24903985 06	.17895613 08	.11896903 06
8	.68656250 04	.70873354 04	.28991776 04	.73826812 07	.78563070 07	.28804608 07
9	-.16655674 05	.31780428 04	-.70342104 04	-.17890062 08	.35098866 07	-.69829422 07
10	.11220832 01	.89215088 02	.31288549 00	.13012824 04	.99444523 05	.31352673 03
11	.36532432 02	.42258815 02	.77431127 01	.42137113 05	.50523953 05	.75302087 04
12	-.89245204 02	.18767668 02	-.18843239 02	-.10271033 06	.22323176 05	-.18293845 05
13	.65853720-01	.13867830 01	.11885794-01	.94351032 02	.12508837 04	.12892688 02

Table C-5 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	-.14174808 02	.38381019 04	-.54518492 01	-.54518492 01	-.61834874 04	-.76325889 01
2	-.20717027 02	-.31707955 04	-.10903698 02	.10903698 01	.48957606 04	-.76325889 01
3	-.92681435 01	-.12397505 04	-.10903698 01	-.10358513 02	.19114183 04	-.38162945 01
4	-.14737030 01	.27110172 01	-.65379598 00	-.10861106 00	-.50280530 01	-.88166623 00
5	-.15663418 01	.20623134 01	-.79967554 00	.27152765 00	-.53602751 01	-.95726806 00
6	-.66550893 00	.12618050 01	-.56435157-01	-.10014579 01	-.22802998 01	-.40569425 00
7	-.15265178 02	.18293135 05	.10358514 03	.25841765 03	-.13684142 04	-.10903698 01
8	-.17445918 02	.76663904 04	.28818475 04	.68431611 04	-.58443822 03	-.43614793 01
9	-.70874039 01	.34384813 04	-.70416085 04	-.16666848 05	-.26168876 03	-.16355548 01
10	-.14992585 01	.81430609 02	-.37268500 00	.12926846 01	.77646258 01	-.87101810 00
11	-.15493048 01	.62507794 02	.70607836 01	.36584890 02	-.20485962 02	-.96791620 00
12	-.65858763 00	.26956839 02	-.19138972 02	-.89452920 02	-.82853199 01	-.41048591 00
13	-.10648143 00	-.11842865 02	-.51111087-01	.10648143-01	.13124901 02	-.53240715-01

	DBX	DBY	DBZ	KS1	KS2	KS3
1	-.23700832 05	-.13506685 03	.71555309 05	-.14843750 06	-.31250000 03	-.80212498 06
2	.19333022 05	.64132462 02	-.57199353 05	.11687500 06	-.62499998 03	.63731248 06
3	.75579134 04	.45670087 02	-.22339474 05	.45593748 05	-.25000000 03	.24881250 06
4	-.58681810 01	-.13379908 01	.49820705 02	-.94360351 02	-.41015625 02	-.60485838 03
5	-.87728547 01	-.39503942 01	.38838742 02	-.97595214 02	-.44433593 02	-.62396239 03
6	-.36937087 01	.59051893 01	.16735798 02	-.41473388 02	-.18859863 02	-.26574707 03
7	-.97281172 05	.12107431 04	.14288907 05	-.50412500 06	-.43750000 03	-.15262500 06
8	-.35854905 05	.34681086 05	.87569961 04	-.14987500 06	-.43750000 03	-.10793750 06
9	-.16267296 05	-.84265196 05	.38221976 04	-.69531248 05	-.18750000 03	-.46749998 05
10	-.35597009 03	.48015841 01	-.21117860 03	-.11597900 04	-.41992187 02	.28239746 04
11	-.27436973 03	.15477138 03	.34292136 03	-.91558836 03	-.43334960 02	-.46048583 04
12	-.11829262 03	-.38073146 03	.13739790 03	-.39425659 03	-.18432617 02	-.18452148 04
13	.71847259 02	.48585199 00	-.24868789 03	.45581054 03	-.30517578 01	.32843017 04

	ISP	WTFLO	WT	DTGO
1	-.95205458 06	-.20729042 06	.10869555 03	-.15562500 03
2	.76109776 06	.16525570 06	-.86799556 02	.11000000 03
3	.29725086 06	.64531156 05	-.33898413 02	.42500000 02
4	-.59125748 03	-.12946629 03	.65678338-01	-.15931396 02
5	-.63628692 03	-.13962478 03	.71573864-01	.11184692 02
6	-.27059407 03	-.59375637 02	.30424934-01	.43371581 01
7	-.95197397 06	-.20728479 06	.10871505 03	-.15625000 03
8	.76115213 06	.16526132 06	-.86777806 02	.11000000 03
9	.29727429 06	.64534905 05	-.33888664 02	.42812500 02
10	-.59112933 03	-.12946263 03	.65662227-01	-.15931396 02
11	-.63628509 03	-.13962295 03	.71584849-01	.11184082 02
12	-.27059133 03	-.59373806 02	.30428962-01	.43371581 01
13	.38134268 04	-.34781801 04	.50892655 00	-.11551514 02

Table C-6. Sensitivity Matrix for 180° Direct, Out-of-Plane Transfer, Selenocentric Coordinates, + 3 Sigma Perturbations

	x_e	y_e	z_e	$\dot{x}_e$	$\dot{y}_e$	$\dot{z}_e$
1	.17822917-01	-.96843748 00	-.15970833 00	.57499999 02	-.37135416 03	-.79270832 02
2	-.16593750-01	.77251041 00	.12845833 00	-.47083333 02	.29583333 03	.63854166 02
3	-.62812500-02	.30182812 00	.50239582-01	-.18854166 02	.11536458 03	.24322916 02
4	.14615885-03	-.67325846-03	-.13382975-03	.31127929-01	-.20019531 00	-.69173177-01
5	.11604818-03	-.76880900-03	-.16739909-03	.54219562-01	-.16957601 00	-.43029785-01
6	.72387695-04	-.31560770-03	-.60043334-04	-.33060709-01	-.88857015-01	-.91145832-01
7	-.10479896 01	-.10845000 01	-.21246875 00	-.37510416 03	-.38572916 03	-.85520832 02
8	-.13348958 00	-.23412500 00	.87208331-01	-.59166666 02	-.13416667 03	.58645833 02
9	-.59390625-01	.26060937 00	-.88421354 00	-.24166666 02	.11005208 03	-.39588541 03
10	-.13964844-03	-.12208862-02	-.37894694-03	-.10190836 01	-.31738281 00	-.12044271 00
11	-.44001261-03	-.84354654-03	-.37246704-03	-.61950683-01	-.11894735 01	-.89619953-01
12	-.17548625-03	-.51973470-03	.23325602-03	-.83872476-01	-.13397217 00	-.10281881 01
13	.12203369-02	.11753743-02	-.32120768-03	-.93587237-02	.75520833 00	.10945638 00

	x_a	y_a	z_a	$\dot{x}_a$	$\dot{y}_a$	$\dot{z}_a$
1						
2						
3						
4						
5						
6						
7	.10659792 01	.11645833 00	.53062500-01	.43843750 03	.16666666 02	.73958332 01
8	.11700000 00	.10068854 01	.41468750-01	.16666666 02	.43156250 03	.60416666 01
9	.53161458-01	.41359375-01	.93450519 00	.74479166 01	.60937499 01	.42062500 03
10	.28605143-03	.54762777-03	.24550374-03	.10508219 01	.11678060 00	.51472981-01
11	.55581665-03	.74686684-04	.20519002-03	.11759440 00	.10199992 01	.45369466-01
12	.24779765-03	.20407613-03	-.29332987-03	.51574706-01	.45267741-01	.93633015 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	-.86047149 03	-.23237390 04	-.35635965 01	-.88799998 06	-.23042500 07	-.30500000 05
2	.68064693 03	.17475329 04	-.16173245 02	.69924998 06	.16997500 07	.25000000 03
3	.26233553 03	.68146928 03	-.49342105 01	.26837500 06	.66062498 06	.11250000 04
4	-.47275476 00	-.24167780 01	.73884661-01	-.42871093 03	-.27465820 04	-.59082031 02
5	-.39057146 00	-.25235895 01	-.20077354-01	-.29809570 03	-.27788086 04	-.15209961 03
6	-.67687453 00	-.88139584 00	.27452435 00	-.80798338 03	-.12144775 04	.21740722 03
7	.74808114 03	.16716831 05	-.12042215 04	.68399998 06	.17738500 08	-.11405000 07
8	.63448464 04	.67554824 04	.19070724 04	.69687499 07	.75022499 07	.19712500 07
9	-.16566612 05	.33797971 04	-.75259045 04	-.17755000 08	.37257500 07	-.74401249 07
10	.20917926 01	.88872539 02	.22486636 00	.14619140 04	.99361814 05	.14580078 04
11	.37026388 02	.41205423 02	.75306139 01	.43909179 05	.49647216 05	.81804199 04
12	-.88605109 02	.20347595 02	-.18729093 02	-.10134924 06	.24024902 05	-.17754150 05
13	.41064881 00	.11500308 01	-.42885228 00	.47412109 03	.99414062 03	-.37500000 03

Table C-6 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	-.78488370 03	.38517441 04	.79578487 03	.60319767 03	-.61646075 04	-.14498546 04
2	.62681685 03	-.31486191 04	-.61773254 03	-.48328488 03	.49146075 04	.11882267 04
3	.24164244 03	-.12172965 04	-.23346657 03	-.20530523 03	.19267805 04	.45784883 03
4	.10184354 01	.36372694 01	.17600836 01	.64938567 00	-.30765977 01	.39388967 00
5	.13537739 01	.26543196 01	.13076427 01	.13892595 01	-.29985294 01	.69196833 00
6	.26259311 00	.32895110 01	.17875849 01	-.14939419 01	-.37792117 00	-.48437783 00
7	-.21620639 04	.18106831 05	.10592296 04	.11282703 04	-.13299418 04	-.35973837 03
8	-.39970930 03	.74218749 04	.23946221 04	.64534883 04	-.58684592 03	-.58139534 02
9	-.23437500 03	.36900436 04	-.72501816 04	-.16527071 05	-.25436046 03	-.35428779 02
10	.57131743 00	.82230678 02	.23917264 01	.34066133 01	.95775515 01	.13484511 00
11	.93681867 00	.61446788 02	.93078611 01	.38728935 02	-.17973434 02	.85520188 00
12	.84278193-01	.30501609 02	-.17022421 02	-.89455537 02	-.63244131 01	-.42316525 00
13	.25301201 01	-.11362475 02	-.29736896 01	.37259833 00	.12384459 02	.32646711 00

	DBX	DBY	DBZ	KS1	KS2	KS3
1	-.23988018 05	.55488989 04	.72064441 05	-.15156250 06	-.15833333 05	-.79572915 06
2	.19405764 05	-.44381476 04	-.57261981 05	.12031250 06	.13229167 05	.63208333 06
3	.75704339 04	-.17171308 04	-.22371276 05	.46770832 05	.52604166 04	.24630208 06
4	-.87504805 01	.56702608 01	.43088290 02	-.30517578 02	.62866211 02	-.45511881 03
5	-.69605377 01	.32130424 01	.40578891 02	.40690104 00	.63273112 02	-.29164632 03
6	-.50401440 01	.76072574 01	.17678849 02	-.22379557 02	.45522054 02	-.20263672 03
7	-.97514571 05	.82140542 04	.14820272 05	-.50656250 06	-.18125000 05	-.15343750 06
8	-.35145725 05	.31149611 05	.87030438 04	-.14312500 06	-.24791666 05	-.10093750 06
9	-.17739637 05	-.85590996 05	.37961464 04	-.75416665 05	.96458332 05	-.44270832 05
10	-.35875389 03	.17864642 02	-.21794294 03	-.10874430 04	.63069661 02	.29724121 04
11	-.26966470 03	.16643148 03	.34460512 03	-.80200194 03	.69478353 02	-.42686971 04
12	-.12648429 03	-.37701937 03	.13832132 03	-.39164225 03	.28177897 02	-.17806498 04
13	.68745192 02	-.10439225 02	-.24458653 03	.45023600 03	.80566405 02	.31351725 04

	ISP	WTFLO	WT	DTGO
1	-.92530312 06	-.20527500 06	.10873000 03	-.10208333 03
2	.73313437 06	.16162187 06	-.86016250 02	.58333333 02
3	.28656718 06	.63237498 05	-.33609375 02	.46874999 02
4	-.48284912 03	-.66369628 02	.53466797-01	-.16082763 02
5	-.51030578 03	-.60250854 02	.55667724-01	.93536376 01
6	-.20196380 03	-.15547180 02	.22872314-01	.75744628 01
7	-.92529687 06	-.20523437 06	.10874250 03	-.10104167 03
8	.73312187 06	.16163750 06	-.86002500 02	.58333333 02
9	.28656718 06	.63246873 05	-.33603125 02	.47395833 02
10	-.48275148 03	-.66333007 02	.53452148-01	-.16082763 02
11	-.51041870 03	-.60293579 02	.55670166-01	.93536376 01
12	-.20197906 03	-.15560913 02	.22870483-01	.75744628 01
13	.36889282 04	-.34903564 04	.51243164 00	-.11551921 02

Table C-7. Sensitivity Matrix for 180° Direct, Out-of-Plane Transfer, Selenocentric Coordinates, - 3 Sigma Perturbations

	x_e	y_e	z_e	$\dot{x}_e$	$\dot{y}_e$	$\dot{z}_e$
1	.11416667-01	-.97308332 00	-.16620833 00	.58437499 02	-.36927083 03	-.76145832 02
2	-.12062500-01	.77697916 00	.13335417 00	-.48645833 02	.29291666 03	.60729166 02
3	-.49375000-02	.30317187 00	.52119791-01	-.18177083 02	.11333333 03	.23750000 02
4	.10664876-03	-.71419271-03	-.15629069-03	-.30314127-01	-.35888671 00	-.12430827 00
5	.94228107-04	-.79200236-03	-.18761190-03	-.68155924-01	-.29337565 00	-.13010661 00
6	.60526530-05	-.38396708-03	-.74345905-04	.73293050-01	-.26824951 00	-.53049723-01
7	-.10548542 01	-.10895729 01	-.21926041 00	-.38093750 03	-.38697916 03	-.86874998 02
8	-.12931250 00	-.22983333 00	.91958333-01	-.65833332 02	-.13916667 03	.52499999 02
9	-.58218750-01	.26182812 00	-.88238540 00	-.25937500 02	.10692708 03	-.39791666 03
10	-.17940267-03	-.12616373-02	-.40155029-03	-.10805257 01	-.47546386 00	-.17679850 00
11	-.46160889-03	-.86601765-03	-.39236450-03	-.18463135 00	-.13125610 01	-.17364502 00
12	-.24176534-03	-.58778890-03	.21909078-03	.22176107-01	-.31316121 00	-.98882039 00
13	.12406413-02	.11907552-02	-.30122884-03	-.14241536-01	.76070148 00	.10701497 00

	x_a	y_a	z_a	$\dot{x}_a$	$\dot{y}_a$	$\dot{z}_a$
1						
2						
3						
4						
5						
6						
7	.10662500 01	.11671875 00	.53000000-01	.43843750 03	.16666666 02	.74999999 01
8	.11723958 00	.10068542 01	.41427083-01	.16666666 02	.43156250 03	.61458332 01
9	.53276041-01	.41416665-01	.93441144 00	.74479166 01	.60937499 01	.42062500 03
10	.28670247-03	.54852295-03	.24519857-03	.10506185 01	.11678060 00	.51269531-01
11	.55683390-03	.74493407-04	.20496623-03	.11759440 00	.10201009 01	.45369466-01
12	.24825541-03	.20433044-03	-.29376221-03	.51625569-01	.45318603-01	.93638102 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	-.87225877 03	-.23366228 04	-.60307017 01	-.90199998 06	-.23172500 07	-.35749998 05
2	.68421052 03	.17546601 04	-.15625000 02	.70549998 06	.17057500 07	.22500000 04
3	.26411732 03	.68311403 03	-.38377193 01	.26687500 06	.66312498 06	.20000000 04
4	-.95246967 00	-.28327808 01	-.36781712 00	-.10717773 04	-.29926757 04	-.39355468 03
5	-.90428401 00	-.28887297 01	-.52736515 00	-.77685545 03	-.30324707 04	-.50000000 03
6	-.87925424 00	-.12579131 01	.14710008 00	-.15927734 04	-.13266601 04	.41625976 02
7	.69627193 03	.16670778 05	-.12129934 04	.62424998 06	.17686750 08	-.11437500 07
8	.63610196 04	.67796052 04	.19057017 04	.69979999 07	.75359999 07	.19767500 07
9	-.16559622 05	.33871985 04	-.75298793 04	-.17746625 08	.37388750 07	-.74421249 07
10	.14846534 01	.88373015 02	-.18524705 00	.63818359 03	.98993650 05	.11523437 04
11	.36651076 02	.40998492 02	.70466158 01	.43629150 05	.49619872 05	.78581542 04
12	-.88752746 02	.20035727 02	-.18846880 02	-.10205188 06	.24005371 05	-.17910522 05
13	.48613966 00	.12533623 01	-.42135673 00	.61767577 03	.11259765 04	-.35986328 03

Table C-7 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	-.77579941 03	.38335755 04	.78306685 03	.59229649 03	-.61864098 04	-.14716570 04
2	.62863370 03	-.31613372 04	-.63408430 03	-.49055232 03	.49073400 04	.11591570 04
3	.24164244 03	-.12272892 04	-.25436046 03	-.19258721 03	.19140625 04	.45694040 03
4	-.47550644 00	.75584233 00	-.10503724 01	.29098155 00	-.48189384 01	-.27927132 01
5	-.13839367 00	-.97585278-01	-.95988428 00	.32646711 00	-.43700461 01	-.31972485 01
6	-.72213106 00	.11701362 01	-.13271598 01	-.20404194-01	-.23118839 01	-.87738036 00
7	-.22692587 04	.18028706 05	.97747092 03	.10973837 04	-.14516715 04	-.42332848 03
8	-.48510174 03	.73619185 04	.23273982 04	.64335027 04	-.67042149 03	-.11991279 03
9	-.27434593 03	.36573401 04	-.72965115 04	-.16520712 05	-.30250726 03	-.52688953 02
10	-.92262445 00	.79324409 02	-.44356944 00	.30375636 01	.78316621 01	-.30659520 01
11	-.59970589 00	.58700206 02	.70350113 01	.37660820 02	-.19378662 02	-.30322407 01
12	-.91818874 00	.28384896 02	-.20142488 02	-.87977564 02	-.82725700 01	-.81261922 00
13	.26720623 01	-.11366023 02	-.28565872 01	.25194744 00	.12586727 02	.63874000-01

	DBX	DBY	DBZ	KS1	KS2	KS3
1	-.24179080 05	.54080311 04	.71897668 05	-.15187500 06	-.16458333 05	-.79687500 06
2	.19533679 05	-.43393782 04	-.57129209 05	.11822917 06	.12708333 05	.63125000 06
3	.76181995 04	-.16790803 04	-.22332416 05	.45937500 05	.55208332 04	.24604167 06
4	-.11315222 02	.31814180 01	.41677840 02	-.19673665 03	-.71207682 01	-.62418619 03
5	-.93576696 01	.80484182 00	.38687750 02	-.17425537 03	-.30008952 02	-.47342936 03
6	-.66514088 01	.60877033 01	.14689549 02	-.10625203 03	.59661865 02	-.27582804 03
7	-.97793068 05	.80003238 04	.14556347 05	-.51145833 06	-.19687500 05	-.15916667 06
8	-.35079339 05	.31199805 05	.87629531 04	-.14854167 06	-.26145833 05	-.10500000 06
9	-.17722636 05	-.85577232 05	.38001943 04	-.77864582 05	.96302082 05	-.46041665 05
10	-.36131863 03	.15344175 02	-.21936604 03	-.12540690 04	-.79345702 01	.28031413 04
11	-.27207765 03	.16403910 03	.34269817 03	-.97747803 03	-.23295084 02	-.44513956 04
12	-.12810346 03	-.37853339 03	.13532806 03	-.47587077 03	.42572021 02	-.18542480 04
13	.69447254 02	-.98320363 01	-.24395088 03	.44840494 03	.71818032 02	.31304932 04

	ISP	WTFLO	WT	DTGO
1	-.94510312 06	-.20638125 06	.10856750 03	-.10104167 03
2	.74869998 06	.16211875 06	-.85923750 02	.58333333 02
3	.29246250 06	.63292186 05	-.33571250 02	.48437499 02
4	-.50692749 03	-.75738523 02	.52878417-01	-.16084798 02
5	-.52117918 03	-.63183593 02	.55145264-01	.93546548 01
6	-.22685852 03	-.34349060 02	.22944336-01	.75739542 01
7	-.94515312 06	-.20649062 06	.10854250 03	-.10104167 03
8	.74866248 06	.16203750 06	-.85936250 02	.59374999 02
9	.29244687 06	.63254686 05	-.33578125 02	.47916666 02
10	-.50682373 03	-.75744628 02	.52858886-01	-.16084798 02
11	-.52120361 03	-.63223266 02	.55150146-01	.93536376 01
12	-.22685241 03	-.34355163 02	.22945557-01	.75739542 01
13	.37500671 04	-.35110412 04	.51277588 00	-.11551921 02

Table C-8. Sensitivity Matrix for 220° Direct, In-Plane Transfer, Selenocentric Coordinates, + 3 Sigma Perturbations

	x_e	y_e	z_e	$\dot{x}_e$	$\dot{y}_e$	$\dot{z}_e$
1	.35270833-01	-.87801041 00	-.35486458 00	.63229166 02	-.34322916 03	-.13833333 03
2	-.27093750-01	.69997916 00	.28314583 00	-.49687499 02	.27802083 03	.11406250 03
3	-.10578125-01	.27333854 00	.11058333 00	-.19166666 02	.10880208 03	.44791666 02
4	.10664876-03	-.65989175-03	-.26615397-03	.59204101-01	-.12349447 00	.74666341-01
5	.12151082-03	-.70668538-03	-.28533935-03	.58695475-01	-.13631185 00	.76293943-01
6	.49677531-04	-.30147807-03	-.12058004-03	.37790934-01	-.49692789-01	.43538411-01
7	-.10308958 01	-.99553125 00	-.40563542 00	-.37572916 03	-.36312500 03	-.14666667 03
8	-.14529167 00	-.30859375 00	.24310417 00	-.66874998 02	-.15583333 03	.10697917 03
9	-.61500000-01	.23335417 00	-.82240625 00	-.26666666 02	.10182292 03	-.37625000 03
10	-.17844645-03	-.12109782-02	-.50317383-03	-.99100748 00	-.24047851 00	.25227864-01
11	-.43820190-03	-.78785197-03	-.48532105-03	-.59204101-01	-.11606852 01	.28991699-01
12	-.19077047-03	-.50145467-03	.17810567-03	-.12715657-01	-.95926920-01	-.89324950 00
13	.11844075-02	.86840820-03	.35878499-03	-.12817383-01	.72163898 00	.30131022 00

	x_a	y_a	z_a	$\dot{x}_a$	$\dot{y}_a$	$\dot{z}_a$
1						
2						
3						
4						
5						
6						
7	.10659479 01	.11750000 00	.50687500-01	.43843750 03	.16770833 02	.71874999 01
8	.11803125 00	.10085104 01	.40020833-01	.16875000 02	.43177083 03	.60416666 01
9	.50848958-01	.39963542-01	.93291145 00	.71874999 01	.59374999 01	.42046875 03
10	.28525797-03	.55122883-03	.23720296-03	.10504150 01	.11718750 00	.50252278-01
11	.55927531-03	.80841063-04	.20013428-03	.11810303 00	.10210164 01	.44759114-01
12	.24026998-03	.19979858-03	-.29871623-03	.50608317-01	.44809977-01	.93566894 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	.24396930 02	-.23374452 04	.84978068 01	.23000000 05	-.23122500 07	.12250000 05
2	-.98684210 01	.17494518 04	-.10142544 02	-.54999999 04	.16952500 07	-.49999999 04
3	-.17817982 02	.68092104 03	-.41118421 00	-.22250000 05	.65912498 06	.22500000 04
4	.23075572 00	-.20403945 01	-.78167830-01	.23144531 03	-.22060547 04	.20019531 03
5	.71823388 00	-.21099960 01	-.19889965 00	.91577148 03	-.22590332 04	.78124998 02
6	-.11101438 01	-.90080395 00	.24588066 00	-.16329346 04	-.96667480 03	.43103027 03
7	.29851973 03	.16877193 05	.11622807 03	.32200000 06	.17910000 08	.11350000 06
8	.68061951 04	.70367324 04	.28788377 04	.73099999 07	.77934999 07	.28587500 07
9	-.16659265 05	.31572094 04	-.70464637 04	-.17901250 08	.34842500 07	-.69952499 07
10	.16993472 01	.89505915 02	.21415844 00	.19360351 04	.10005224 06	.48291015 03
11	.36958661 02	.42216518 02	.76318037 01	.42443602 05	.50666992 05	.77116699 04
12	-.89594656 02	.18752516 02	-.18865351 02	-.10309436 06	.22387207 05	-.18202514 05
13	-.70672286-01	.13320655 01	-.33194558-01	-.78613279 02	.11557617 04	-.15136719 02

Table C-8 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	.14534884 02	.38390261 04	.39970930 02	.29069767 02	-.61518895 04	.90843022 01
2	.16351744 02	-.31704215 04	.54505812 01	-.18168605 01	.49509446 04	.72674417 01
3	.99927323 01	-.12409157 04	.81758720 01	-.11809593 02	.19349564 04	.63590115 01
4	.53583188 00	.15968500 01	.14300679 01	.10965037 01	-.32966081 01	.30162722 00
5	.47373217 00	.17955691 01	.13732910 01	.15897529 01	-.35556527 01	.23065611 00
6	.40897103 00	.60059302 00	.10148869 01	-.57752742 00	-.15587030 01	.37437261 00
7	.12718023 02	.18228561 05	.14534883 03	.29796511 03	-.13953488 04	.54505812 01
8	.90843022 01	.76180958 04	.28978924 04	.68332122 04	-.57412790 03	.72674417 01
9	.54505812 01	.34156976 04	-.70376089 04	-.16646984 05	-.25890261 03	.54505812 01
10	.56776889 00	.80328651 02	.17316951 01	.25088288 01	.94746432 01	.28743300 00
11	.44534372 00	.61315492 02	.92191472 01	.37895025 02	-.18686693 02	.24130178 00
12	.39832536 00	.26286812 02	-.18091423 02	-.89036806 02	-.75664076 01	.37703403 00
13	.53228333-01	-.11816690 02	.35485555-01	.70971110-02	.13285792 02	

	DBX	DBY	DBZ	KS1	KS2	KS3
1	-.23406736 05	.19591969 03	.71740607 05	-.14729167 06		-.79875000 06
2	.19120790 05	-.13601036 03	-.57375323 05	.11708333 06		.63927083 06
3	.74789507 04	-.46146373 02	-.22407707 05	.45677082 05		.24968750 06
4	-.50124726 01	.27829501 00	.47272202 02	-.11840820 03	-.31738281 02	-.49947103 03
5	-.79535449 01	-.17630621 01	.38146972 02	-.12461344 03	-.35400391 02	-.51493327 03
6	-.32225297 01	.53129048 01	.16404384 02	-.55135091 02	-.17038981 02	-.22440592 03
7	-.97038534 05	.15171632 04	.14391192 05	-.50468750 06	-.62500000 03	-.15145833 06
8	-.36107513 05	.34462435 05	.85055050 04	-.15135417 06	-.62500000 03	-.10593750 06
9	-.16365771 05	-.84366902 05	.37192357 04	-.70208332 05	-.31250000 03	-.45989582 05
10	-.35512657 03	.64418970 01	-.21372741 03	-.11830648 04	-.31738281 02	.29276530 04
11	-.27360669 03	.15692676 03	.34214474 03	-.94380695 03	-.35909017 02	-.44942220 04
12	-.11784529 03	-.38133690 03	.13703183 03	-.40842692 03	-.17293294 02	-.18032837 04
13	.70917790 02	-.56923979 00	-.24922899 03	.45633952 03	-.20345052 00	.32893880 04

	ISP	WTFLO	WT	DTGO
1	-.92590937 06	-.20661250 06	.10883750 03	-.15312500 03
2	.73857187 06	.16468750 06	-.86881248 02	.10833333 03
3	.28842656 06	.64310936 05	-.33927500 02	.42187500 02
4	-.58892210 03	-.13281250 03	.68625486-01	-.15911865 02
5	-.63681029 03	-.14197387 03	.73841551-01	.11208089 02
6	-.27109222 03	-.60711669 02	.31578979-01	.43701171 01
7	-.92593123 06	-.20660937 06	.10882875 03	-.15312500 03
8	.73854373 06	.16469687 06	-.86884998 02	.10833333 03
9	.28840937 06	.64312498 05	-.33930625 02	.41666666 02
10	-.58881225 03	-.13280029 03	.68625486-01	-.15915934 02
11	-.63687132 03	-.14200744 03	.73814697-01	.11209106 02
12	-.27111663 03	-.60725402 02	.31568603-01	.43701171 01
13	.37282043 04	-.34505554 04	.50903808 00	-.11549886 02

Table C-9. Sensitivity Matrix for 220° Direct, In-Plane Transfer, Selenocentric Coordinates, - 3 Sigma Perturbations

	x_e	y_e	z_e	$\dot{x}_e$	$\dot{y}_e$	$\dot{z}_e$
1	.30145833-01	-.88041665 00	-.35991666 00	.65937498 02	-.34312500 03	-.14156250 03
2	-.22916666-01	.70329165 00	.28677083 00	-.52499999 02	.27562500 03	.10864583 03
3	-.89270831-02	.27465625 00	.11196354 00	-.20572916 02	.10781250 03	.42187500 02
4	.11549886-03	-.63659668-03	-.28680420-03	.81990559-01	-.10131836 00	-.23539225 00
5	.11937459-03	-.69287109-03	-.30617269-03	.90942382-01	-.10681152 00	-.24617513 00
6	.51228841-04	-.29468791-03	-.13093058-03	.37027995-01	-.34790039-01	-.11383057 00
7	-.10356250 01	-.99771874 00	-.41065625 00	-.37093750 03	-.35781250 03	-.14739583 03
8	-.14088542 00	-.30500000 00	.24672916 00	-.68541665 02	-.15489583 03	.10354167 03
9	-.59739583-01	.23478125 00	-.82096875 00	-.27343750 02	.10239583 03	-.37781250 03
10	-.16959635-03	-.11875000-02	-.52374267-03	-.96862791 00	-.21830241 00	-.28666178 00
11	-.43991089-03	-.77314249-03	-.50597126-03	-.25533040-01	-.11259969 01	-.28900146 00
12	-.18904622-03	-.49429321-03	.16783651-03	-.12868245-01	-.78735351-01	-.10486857 01
13	.12047119-02	.88391113-03	.37768555-03	-.21769206-01	.71289062 00	.27791341 00

	x_a	y_a	z_a	$\dot{x}_a$	$\dot{y}_a$	$\dot{z}_a$
1						
2						
3						
4						
5						
6						
7	.10662292 01	.11778125 00	.50625000-01	.43843750 03	.16770833 02	.71874999 01
8	.11827083 00	.10084687 01	.39958333-01	.16770833 02	.49166666 03	.59374999 01
9	.50963540-01	.40026041-01	.93282290 00	.72395832 01	.59895833 01	.42046875 03
10	.28592936-03	.55216470-03	.23693848-03	.10504150 01	.11739095 00	.50252278-01
11	.56029256-03	.80668130-04	.19990031-03	.11810303 00	.10210164 01	.44759114-01
12	.24071757-03	.20005798-03	-.29914856-03	.50608317-01	.44809977-01	.93566894 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	.13157895 02	-.23525219 04	.98684210 01	.67499999 04	-.23270000 07	.74999999 04
2	-.35635965 01	.17532895 04	-.14254386 02	-.44999999 04	.17070000 07	-.14500000 05
3	-.16995614 02	.68119517 03	-.24671052 01	-.18750000 05	.66299998 06	-.13750000 04
4	.54610403-01	-.23262961 01	-.26876884 00	-.15820312 03	-.22822265 04	-.19873047 03
5	.58224326 00	-.23851896 01	-.39565772 00	.40209961 03	-.23237304 04	-.35449218 03
6	-.12941862 01	-.10952866 01	.15365868 00	-.15068359 04	-.10281982 04	.29150390 03
7	.26562500 03	.16846491 05	.12938596 03	.27775000 06	.17873250 08	.12700000 06
8	.68377192 04	.70696271 04	.28818531 04	.73474999 07	.78419999 07	.28620000 07
9	-.16648026 05	.31695449 04	-.70449561 04	-.17882750 08	.35033750 07	-.69929999 07
10	.14005362 01	.89140239 02	.56751987-01	.13671875 04	.99858396 05	.11914062 03
11	.36965085 02	.42104620 02	.74620832 01	.42136718 05	.50830322 05	.73071288 04
12	-.89721947 02	.18623887 02	-.18946999 02	-.10288599 06	.22417480 05	-.18329834 05
13	.48185648-02	.14070210 01	-.46579461-01	.18066406 02	.12797851 04	-.40039062 02

Table C-9 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	-.18168604 02	.38081395 04	-.36337209 01	-.18168605 01	-.61864098 04	-.19985465 02
2	-.18168604 02	-.31740552 04	-.21802325 02	-.25436046 02	.49073400 04	-.90843022 01
3	-.10901163 02	-.12454578 04	-.81758720 01	-.29978197 02	.19167878 04	-.63590115 01
4	-.13200627 01	.13094170 01	-.11994118 01	-.12313488 01	-.46308650 01	-.10823094 01
5	-.13449026 01	.15436217 01	-.13395797 01	-.69729116 00	-.49395893 01	-.11195693 01
6	-.71592107 00	.49679778 00	-.41606814 00	-.20803407 01	-.20386451 01	-.57575314 00
7	-.19985465 02	.18223110 05	.10174418 03	.25799418 03	-.13917151 04	-.23619186 02
8	-.18168604 02	.76271802 04	.28615552 04	.67986918 04	-.59956393 03	-.16351744 02
9	-.90843022 01	.34202398 04	-.70548691 04	-.16666061 05	-.26707848 03	-.81758720 01
10	-.13236112 01	.80016378 02	-.89423600 00	.16678211 00	.81723235 01	-.10823094 01
11	-.13395797 01	.61088384 02	.65045024 01	.35622175 02	-.20081276 02	-.11195693 01
12	-.71325967 00	.26193663 02	-.19523266 02	-.90533410 02	-.80498983 01	-.57575314 00
13	-.74519667-01	-.11859273 02	-.88713888-01	-.88713888-01	.13197078 02	-.46131222-01

	DBX	DBY	DBZ	KS1	KS2	KS3
1	-.23588083 05	.24287564 02	.71609454 05	-.14864583 06	-.72916666 03	-.80031250 06
2	.19260039 05	-.46955958 02	-.57273316 05	.11760417 06	-.10416667 04	.63854166 06
3	.75291450 04	-.17001295 02	-.22372085 05	.45677082 05	-.67708333 03	.24916667 06
4	-.53635039 01	-.56607734 00	.51538339 02	-.11271159 03	-.76090493 02	-.52124023 03
5	-.82239337 01	-.24935865 01	.41579804 02	-.10996501 03	-.76293944 02	-.52744546 03
6	-.34573411 01	.47523617 01	.17689917 02	-.60679118 02	-.47861735 02	-.23579915 03
7	-.97223120 05	.13779145 04	.14319948 05	-.50645833 06	-.93750000 03	-.15166667 06
8	-.35968264 05	.34567681 05	.86609456 04	-.15114583 06	-.93750000 03	-.10656250 06
9	-.16312338 05	-.84327232 05	.37807642 04	-.70208332 05	-.52083333 03	-.46250000 05
10	-.35550606 03	.55943622 01	-.20945811 03	-.11785889 04	-.77311196 02	.29091390 04
11	-.27381699 03	.15621205 03	.34564556 03	-.92905679 03	-.74768065 02	-.45087687 04
12	-.11805480 03	-.38189033 03	.13834662 03	-.41386922 03	-.47302246 02	-.18154398 04
13	.71572416 02	.12649773-01	-.24866608 03	.44962565 03	-.50862629 01	.32875569 04

	ISP	WTFLO	WT	DTGO
1	-.94460312 06	-.20722187 06	.10869625 03	-.15312500 03
2	.75501562 06	.16535312 06	-.86782498 02	.10729167 03
3	.29487968 06	.64579686 05	-.33893125 02	.41666666 02
4	-.58130492 03	-.12185669 03	.67858886-01	-.15915934 02
5	-.62815246 03	-.13377075 03	.73271483-01	.11210124 02
6	-.26686706 03	-.56277465 02	.31166382-01	.43701171 01
7	-.94456562 06	-.20715625 06	.10867250 03	-.15312500 03
8	.75503437 06	.16540625 06	-.86799998 02	.10729167 03
9	.29489062 06	.64606248 05	-.33898750 02	.42187500 02
10	-.58118896 03	-.12183227 03	.67844237-01	-.15913900 02
11	-.62814329 03	-.13370971 03	.73271483-01	.11209106 02
12	-.26685943 03	-.56254577 02	.31166992-01	.43701171 01
13	.37914123 04	-.34704834 04	.50935546 00	-.11551921 02

Table C-10. Sensitivity Matrix for Parking Orbit, In-Plane Transfer, Selenocentric Coordinates, + 3 Sigma Perturbations

	x_e	y_e	z_e	$\dot{x}_e$	$\dot{y}_e$	$\dot{z}_e$
1	-.95333332-01	-.72310416 00	-.29095833 09	.22916667 01	-.28437500 03	-.11395833 03
2	.10793750 00	.81440625 00	.32785416 00	-.14583333 01	.32062500 03	.12916667 03
3	.42796875-01	.32286458 00	.13000000 00	-.57291666 00	.12718750 03	.51249999 02
4	-.10118612-03	-.84530639-03	-.34035237-03		-.34027099 00	-.13936361 00
5	-.79447427-04	-.63985188-03	-.25796509-03	.81380208-03	-.25512695 00	-.10335286 00
6	-.33014933-04	-.26625569-03	-.10598246-03	.20345052-03	-.10620117 00	-.43029785-01
7	-.12038333 01	-.82749998 00	-.33485416 00	-.44375000 03	-.29833333 03	-.12000000 03
8	.28229166-02	-.15857292 00	.30380208 00	-.17395833 02	-.10500000 03	.12604167 03
9	-.13385416-02	.29881771 00	-.79580729 00	-.72916666 01	.12385417 03	-.36802083 03
10	-.58885701-03	-.13469238-02	-.55056762-03	-.10939534 01	-.45033773 00	-.18513997 00
11	-.58904012-03	-.55205281-03	-.38217163-03	-.10945638 00	-.12375895 01	-.13071696 00
12	-.24640401-03	-.39052327-03	.22673035-03	-.45827229-01	-.13376872 00	-.97091673 00
13	.13417969-02	.66951497-03	.27284749-03	.11393229 00	.70332844 00	.28381347 00

	x_a	y_a	z_a	$\dot{x}_a$	$\dot{y}_a$	$\dot{z}_a$
1						
2						
3						
4						
5						
6						
7	.11084583 01	.10462500 00	.43979166-01	.44437500 03	.15208333 02	.62499999 01
8	.10511458 00	.97309375 00	.24125000-01	.15208333 02	.42666666 03	.36458333 01
9	.44124999-01	.24093750-01	.92576040 00	.63541666 01	.36458333 01	.41942708 03
10	.48768107-03	.50168864-03	.21042887-03	.10936483 01	.10904948 00	.45572916-01
11	.50957235-03	-.87738036-04	.12449137-03	.10986328 00	.98500568 00	.28584798-01
12	.21338908-03	.12428284-03	-.33272807-03	.45928955-01	.28635661-01	.92844645 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	.43859649 01	-.18448465 04	.27412280 01	.54999999 04	-.18340000 07	.20000000 04
2	.16447368 01	.19259868 04	-.32894737 01	.27500000 04	.18725000 07	-.42499999 04
3	-.16036184 02	.76247258 03	.27412280 01	-.18375000 05	.74099998 06	.40000000 04
4	.16597279-01	-.30252557 01	.10707922-02	.15625000 02	-.32795410 04	.24414062 01
5	.39431923 00	-.22374203 01	-.86734168-01	.45507812 03	-.24157715 04	-.12500000 03
6	-.96371298 00	-.92998303 00	.22245708 00	-.11253662 04	-.10045166 04	.32128906 03
7	.15625000 03	.18111842 05	.54824561 02	.16900000 06	.19258000 08	.53499998 05
8	.67324561 04	.41195175 04	.28453947 04	.72222499 07	.46909999 07	.28277500 07
9	-.16715460 05	.18200384 04	-.70598957 04	-.17945375 08	.20607500 07	-.70176249 07
10	.80764501 00	.94241760 02	.14696623 00	.93432616 03	.10570190 06	.14404297 03
11	.35509344 02	.26015164 02	.77734160 01	.40557626 05	.32279052 05	.75834960 04
12	-.88078950 02	.11320817 02	-.19254986 02	-.10071142 06	.13950073 05	-.18781494 05
13	-.48185649-01	.93854937 00	-.74955455-02	-.63964843 02	.76416015 03	-.87890624 01

Table C-10 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1		.31613372 04	.36337209 01	.10901163 02	-.49745638 04	
2	-.18168605 01	-.36954941 04	-.18168605 01	.54505812 01	.56177325 04	-.18168605 01
3		-.14643895 04	.45421511 01	-.13626453 02	.22283793 04	
4	.88713887-02	.30375636 01	.88713887-02	.19517055-01	-.59810904 01	-.15968500-01
5	.88713887-02	.23243039 01	-.83391054-01	.41163244 00	-.45013427 01	-.35485556-02
6		.96343283 00	.25815742 00	-.97141708 00	-.18718631 01	-.53228332-02
7	.36337209 01	.19436773 05	.61773255 02	.13808139 03	-.12972384 04	-.36337209 01
8		.47165696 04	.28488372 04	.67441860 04	-.57594475 03	-.18168605 01
9	-.90843023 00	.20721293 04	-.70585027 04	-.16711482 05	-.24436773 03	-.90843023 00
10	.88713887-02	.90330255 02	.16500783 00	.74164811 00	.39548652 01	-.39034111-01
11	.19517055-01	.47905500 02	.77926280 01	.35620400 02	-.21706514 02	.28388445-01
12	.35485556-02	.20131843 02	-.19213654 02	-.88049420 02	-.87374308 01	.79842498-02
13	-.70971110-02	-.12537047 02	-.14194222-01	-.24839889-01	.13441928 02	-.24839889-01

	DBX	DBY	DBZ	KS1	KS2	KS3
1	-.19009067 05	.64766838 02	.57794689 05	-.11895833 06		-.64291666 06
2	.22032059 05	-.97150257 02	-.65200777 05	.13239583 06	-.10416667 03	.72416665 06
3	.87402848 04	.39669689 02	-.25849255 05	.52500000 05		.28713541 06
4	-.77922603 01	-.15812217-01	.72472132 02	-.15787760 03	-.61035155 00	-.78257243 03
5	-.89275775 01	-.45191315 01	.38412618 02	-.11596680 03	.40690104 00	-.57250977 03
6	-.36787122 01	.11372146 02	.16141111 02	-.48370361 02	-.10172526 00	-.23808797 03
7	-.10194624 06	.78691708 03	.13620466 05	-.51770833 06	.20833333 03	-.14250000 06
8	-.20822539 05	.34054404 05	.88827720 04	-.73854165 05		-.11375000 06
9	-.92891837 04	-.84458910 05	.37054728 04	-.34322915 05	-.52083333 02	-.47239582 05
10	-.40272925 03	.32936847 01	-.12800147 03	-.13772583 04	-.91552734 00	.18039958 04
11	-.21568654 03	.15209138 03	.37961021 03	-.76171875 03	.71207681 00	-.49579874 04
12	-.90613487 02	-.37615445 03	.15228509 03	-.31977335 03	.10172526 00	-.19879150 04
13	.73251675 02	-.36368098 00	-.24774581 03	.45776367 03	-.81380208 00	.32476807 04

	ISP	WTFLO	WT	DTGO
1	-.74541873 06	-.16373125 06	.87257500 02	-.20000000 03
2	.83846562 06	.18443750 06	-.98412498 02	.19583333 03
3	.33239531 06	.73120310 05	-.39015625 02	.78124998 02
4	-.86347044 03	-.19203796 03	.10126953 00	-.13480631 02
5	-.65769652 03	-.14516601 03	.76968994-01	.13410441 02
6	-.27317047 03	-.60308837 02	.31967773-01	.53029377 01
7	-.74536248 06	-.16375000 06	.87259998 02	-.20000000 03
8	.83849062 06	.18443125 06	-.99411248 02	.19791667 03
9	.33240312 06	.73115623 05	-.39015000 02	.78124998 02
10	-.86337279 03	-.19202270 03	.10125732 00	-.13482666 02
11	-.65774229 03	-.14517822 03	.76992187-01	.13411458 02
12	-.27318725 03	-.60313415 02	.31976927-01	.53034463 01
13	.37054260 04	-.34281616 04	.51469237 00	-.11549886 02

Table C-11. Sensitivity Matrix for Parking Orbit, In-Plane Transfer, Selenocentric Coordinates, - 3 Sigma Perturbations

	x_e	y_e	z_e	$\dot{x}_e$	$\dot{y}_e$	$\dot{z}_e$
1	-.10154167 00	-.72531249 00	-.29597916 00	.62499998 00	-.28666666 03	-.11687500 03
2	.11476042 00	.81779165 00	.33348958 00	-.83333333 00	.32114583 03	.13010417 03
3	.45489583-01	.32419791 00	.13222396 00	-.41666666 00	.12723958 03	.51562499 02
4	-.10839844-03	-.84957886-03	-.34680176-03		-.34250895 00	-.13956706 00
5	-.85754393-04	-.64171346-03	-.26250203-03	.81380208-03	-.25604248 00	-.10467529 00
6	-.35578410-04	-.26710002-03	-.10781860-03	.55948893-03	-.10630290 00	-.43233235-01
7	-.12100417 01	-.83000000 00	-.33970833 00	-.44541666 03	-.30125000 03	-.12291667 03
8	.95312498-02	-.15530208 00	.30950000 00	-.17395833 02	-.10541667 03	.12635417 03
9	.13281250-02	.30010416 00	-.79352082 00	-.72395832 01	.12369792 03	-.36786458 03
10	-.59603882-03	-.13507995-02	-.55677287-03	-.10924276 01	-.45043945 00	-.18524170 00
11	-.59563192-03	-.55375163-03	-.38680013-03	-.11260986 00	-.12434896 01	-.13448079 00
12	-.24909464-03	-.39130656-03	.22484843-03	-.46844482-01	-.13595581 00	-.97218831 00
13	.13639323-02	.67879231-03	.29475911-03	.11820475 00	.70983886 00	.28849284 00

	x_a	y_a	z_a	$\dot{x}_a$	$\dot{y}_a$	$\dot{z}_a$
1						
2						
3						
4						
5						
6						
7	.11088958 01	.10479167 00	.43995833-01	.44458333 03	.15208333 02	.64583332 01
8	.10542708 00	.97303124 00	.24083333-01	.15208333 02	.42666666 03	.36458333 01
9	.44270832-01	.24130208-01	.92569791 00	.64062499 01	.36979167 01	.41947916 03
10	.48898315-03	.50218709-03	.21005249-03	.10937500 01	.10915120 00	.45572916-01
11	.51082356-03	-.88083901-04	.12426758-03	.10996501 00	.98500568 00	.28686523-01
12	.21392822-03	.12439473-03	-.33307393-03	.45928955-01	.28635661-01	.92844645 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	-.32894737 01	-.18580044 04	-.27412280 01	-.35000000 04	-.18485000 07	-.15000000 04
2	.87719296 01	.19388706 04	.54824561 00	.11500000 05	.18855000 07	.74999998 03
3	-.10416667 02	.76740678 03	.38377193 01	-.14500000 05	.74574998 06	.59999999 04
4	.16061883-02	-.30228464 01	-.53539609-02	.19531250 01	-.32834472 04	-.41503906 01
5	.31936378 00	-.22358141 01	-.94229713-01	.43798828 03	-.24174804 04	-.13525390 03
6	-.79332317 00	-.92891224 00	.22339402 00	-.10871582 04	-.10047607 04	.33129882 03
7	.13103070 03	.18087171 05	.66337719 02	.13800000 06	.19232500 08	.66499998 05
8	.67683661 04	.41622806 04	.28574561 04	.72709999 07	.47469999 07	.28412500 07
9	-.16697780 05	.18371710 04	-.70546874 04	-.17925125 08	.20832500 07	-.70117499 07
10	.70297509 00	.94201339 02	.18364086 00	.79174804 03	.10563354 06	.18139648 03
11	.35585102 02	.26174177 02	.77833208 01	.40768066 05	.32504150 05	.75908202 04
12	-.87848461 02	.11385064 02	-.19246954 02	-.10058655 06	.14040649 05	-.18764038 05
13	.45508669-01	.10408100 01	.74955455-02	.65917968 02	.89550780 03	.87890624 01

Table C-11 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1		.31250000 04	-.36337209 01		-.49999999 04	-.36337209 01
2	.18168605 01	-.36773255 04		.72674417 01	.56195494 04	.54505812 01
3		-.14598474 04	.27252907 01	-.13626453 02	.22274709 04	.90843023 00
4	.53228332-02	.29807866 01	-.23065611-01	-.24839889-01	-.60698042 01	-.35485556-02
5	-.17742778-02	.22781727 01	-.12774800 00	.34243561 00	-.45634423 01	-.14194222-01
6	.88713989-03	.95012575 00	.24662461 00	-.93060870 00	-.18949287 01	-.44356943-02
7	-.36337209 01	.19367732 05	.61773255 02	.14171511 03	-.12790697 04	-.36337209 01
8	.18168605 01	.47111191 04	.28524709 04	.67532703 04	-.55959302 03	.18168605 01
9	.90843023 00	.20703125 04	-.70557775 04	-.16706032 05	-.23710029 03	.90843023 00
10	.17742778-02	.90275252 02	.15791072 00	.74342239 00	.39105082 01	.21291333-01
11	-.53228332-02	.47818561 02	.77269797 01	.35510396 02	-.21827165 02	-.46131222-01
12	-.26614166-02	.20099019 02	-.19233171 02	-.88026356 02	-.87853364 01	-.17742778-01
13	.35485556-02	-.12395105 02	.14194222-01	.31937000-01	.13434831 02	.31937000-01

	DBX	DBY	DBZ	KS1	KS2	KS3
1	-.19174223 05	-.61528497 02	.57655440 05	-.12020833 06		-.64416665 06
2	.22213406 05	.45336787 02	-.65053432 05	.13364583 06		.72500000 06
3	.88107189 04	.88244818 02	-.25791774 05	.52916665 05	-.52083333 02	.28739583 06
4	-.80594866 01	-.19449026 00	.72688759 02	-.15960693 03	.20345052 00	-.78867593 03
5	-.91109990 01	-.45128066 01	.37454397 02	-.11810303 03	-.50862630 00	-.57505289 03
6	-.37451235 01	.10965772 02	.15760036 02	-.48980713 02	-.20345052 00	-.23890177 03
7	-.10213083 06	.66386010 03	.13500648 05	-.52208333 06		-.14375000 06
8	-.20660622 05	.34185557 05	.90365930 04	-.74583332 05		-.11312500 06
9	-.92244170 04	-.84423573 05	.37678108 04	-.34583332 05	.52083333 02	-.46927082 05
10	-.40299964 03	.31545372 01	-.12776903 03	-.13795980 04	.91552734 00	.18007406 04
11	-.21588103 03	.15204395 03	.37863459 03	-.76782226 03	-.11189779 01	-.49659220 04
12	-.90684643 02	-.37658296 03	.15189690 03	-.32196045 03	-.50862630 00	-.19908651 04
13	.74026472 02	.36368098 00	-.24729042 03	.46590169 03	.81380208 00	.32503255 04

	ISP	WTFLO	WT	DTGO
1	-.75878123 06	-.16428125 06	.87222500 02	-.19791667 03
2	.85702812 06	.18520937 06	-.98258750 02	.19895833 03
3	.33977812 06	.73424998 05	-.38954375 02	.78645832 02
4	-.88181151 03	-.19303894 03	.10109985 00	-.13482666 02
5	-.67193298 03	-.14582214 03	.76925049-01	.13410441 02
6	-.27907104 03	-.60574340 02	.31954345-01	.53034463 01
7	-.75885623 06	-.16430625 06	.87245000 02	-.19791667 03
8	.85697812 06	.18518750 06	-.98247498 02	.19791667 03
9	.33975937 06	.73417185 05	-.38948750 02	.78645832 02
10	-.88174743 03	-.19303589 03	.10110718 00	-.13481649 02
11	-.67205505 03	-.14587097 03	.76926269-01	.13411458 02
12	-.27912139 03	-.60594177 02	.31954956-01	.53029377 01
13	.37675781 04	-.34493408 04	.51498291 00	-.11551921 02

Table C-12. Sensitivity Matrix for Parking Orbit, In-Plane Transfer, Selenocentric Coordinates, + 5 Sigma Perturbations

	x_e	y_e	z_e	$\dot{x}_e$	$\dot{y}_e$	$\dot{z}_e$
1	-.93612498-01	-.72220000 00	-.28938750 00	.20000000 01	-.28450000 03	-.11400000 03
2	.10562500 00	.81358749 00	.32605625 00	-.17500000 01	.32062500 03	.12950000 03
3	.41878125-01	.32253437 00	.12928437 00	-.68750000 00	.12715625 03	.51375000 02
4	-.11087646-03	-.32642212-03	-.33833008-03	.97656250-03	-.33831787 00	-.13757324 00
5	-.82922362-04	-.63222046-03	-.25646972-03	.17089844-02	-.25292969 00	-.10247803 00
6	-.34469604-04	-.26299438-03	-.10541077-03	.73242188-03	-.10531616 00	-.42510986-01
7	-.12020875 01	-.82691250 00	-.33325000 00	-.44350000 03	-.29825000 03	-.12075000 03
8	.50000000-03	-.15963125 00	.30198125 00	-.17375000 02	-.10518750 03	.12587500 03
9	-.22562500-02	.29840312 00	-.79653437 00	-.72500000 01	.12378125 03	-.36809375 03
10	-.59843750-03	-.13281860-02	-.54853514-03	-.10935059 01	-.44732666 00	-.18347168 00
11	-.59266356-03	-.54485472-03	-.38084106-03	-.10717773 00	-.12368164 01	-.13024902 00
12	-.24792786-03	-.38745117-03	.22724609-03	-.44860840-01	-.13342285 00	-.97061156 00
13	.13325317-02	.67099609-03	.26553955-03	.11279297 00	.70422362 00	.28540039 00

	x_a	y_a	z_a	$\dot{x}_a$	$\dot{y}_a$	$\dot{z}_a$
1						
2						
3						
4						
5						
6						
7	.11084375 01	.10462500 00	.44012500-01	.44450000 03	.15125000 02	.63750000 01
8	.10505625 00	.97313125 00	.24143750-01	.15250000 02	.42662500 03	.36875000 01
9	.44103125-01	.24096875-01	.92579061 00	.63750000 01	.36562500 01	.41943750 03
10	.48753662-03	.50165405-03	.21057739-03	.10936890 01	.10906982 00	.45593262-01
11	.50928345-03	-.87561034-04	.12457275-03	.10992432 00	.98498534 00	.28625488-01
12	.21326599-03	.12427063-03	-.33260803-03	.45928955-01	.28625488-01	.92843628 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	.62500000 01	-.18407895 04	.36184210 01	.66010561 04	-.18329933 07	.39006241 04
2	-.98684209 00	.19226974 04	-.49342105 01	.30004800 03	.18692991 07	-.51008160 04
3	-.15871711 02	.76110197 03	.18092105 01	-.21303408 05	.73961833 06	.29254680 04
4	.17346834-01	-.30164217 01	.14455695-02	.18313477 02	-.32759148 04	.87904689 00
5	.36219547 00	-.22337261 01	-.82879317-01	.49592895 03	-.24102001 04	-.11017388 03
6	-.88926615 00	-.92877839 00	.21442614 00	-.12325702 04	-.10024065 04	.28173453 03
7	.16381579 03	.18122368 05	.52960526 02	.17972876 06	.19268783 08	.49507921 05
8	.67200658 04	.41075658 04	.28421053 04	.72073031 07	.46756481 07	.28231517 07
9	-.16718997 05	.18152960 04	-.70613487 04	-.17953222 08	.20546537 07	-.70201482 07
10	.84083959 00	.94265426 02	.13459858 00	.98350696 03	.10573059 06	.13024545 03
11	.35423520 02	.25965158 02	.77708996 01	.40530948 05	.32201685 05	.75892513 04
12	-.88025704 02	.11300579 02	-.19265827 02	-.10084953 06	.13918975 05	-.18824789 05
13	-.76775800-01	.90107164 00	-.14134457-01	-.10284849 03	.71583719 03	-.12013641 02

Table C-12 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1		.31686148 04	.21807397 01	.10903698 02	-.49829902 04	.21807397 01
2	-.10903698 01	-.37050767 04	-.32711095 01	.21807397 01	.56110431 04	-.43614793 01
3		-.14692734 04	.38162945 01	-.14174808 02	.22254449 04	-.10903698 01
4	-.63888858-02	.30038411 01	-.31944429-02	.15972214-01	-.60023582 01	.21296286-02
5		.22946748 01	-.93703657-01	.36949056 00	-.45126830 01	
6	-.26620357-02	.95194399 00	.24437488 00	-.88965235 00	-.18746056 01	.10648143-02
7	.21807397 01	.19454379 05	.65422191 02	.14392882 03	-.13019016 04	-.43614793 01
8	-.10903698 01	.47093074 04	.28502268 04	.67439375 04	-.57353454 03	-.32711095 01
9	-.54518492 00	.20695220 04	-.70574188 04	-.16709918 05	-.24315248 03	-.16355548 01
10	-.21296286-02	.90309030 02	.15972215 00	.75069407 00	.39163870 01	-.21296286-01
11	.21296286-02	.47891088 02	.77848574 01	.35573316 02	-.21693462 02	.35138872-01
12	-.10648143-02	.20125523 02	-.19225222 02	-.87968569 02	-.87320095 01	.14374993-01
13	-.21296286-02	-.12560549 02	-.17037029-01	-.31944429-01	.13423049 02	-.14907400-01

	DBX	DBY	DBZ	KS1	KS2	KS3
1	-.18973492 05	.97170398 02	.57839706 05	-.11937500 06		-.64324998 06
2	.21983831 05	-.13701026 03	-.65241177 05	.13293750 06		.72412498 06
3	.87205574 04	.17004820 02	-.25864816 05	.52687498 05	.31250000 02	.28709375 06
4	-.77631935 01	.37957186-01	.74377107 02	-.15643310 03	.18310547 00	-.78308105 03
5	-.89218366 01	-.43593829 01	.39174664 02	-.11437988 03	.54931640 00	-.57415771 03
6	-.36733067 01	.11034154 02	.16467725 02	-.47637939 02	.12207031 00	-.23883056 03
7	-.10191620 06	.82206155 03	.13691309 05	-.51900000 06	-.12500000 03	-.14387500 06
8	-.20880947 05	.34011581 05	.88512515 04	-.73687498 05	-.62499999 02	-.11425000 06
9	-.93123251 04	-.84493060 05	.36939327 04	-.34249998 05	-.31250000 02	-.47406248 05
10	-.40270108 03	.33668025 01	-.12608903 03	-.13759765 04	-.54931640 00	.18022461 04
11	-.21569835 03	.15223489 03	.38036137 03	-.76123045 03	.13427734 01	-.49586180 04
12	-.90614716 02	-.37650018 03	.15260782 03	-.31942749 03	.45776367 00	-.19882202 04
13	.73042911 02	-.55986850 00	-.24732713 03	.45935058 03	-.61035155 00	.32495117 04

	ISP	WTFLO	WT	DTGO
1	-.74096430 06	-.16348605 06	.87272016 02	-.19875000 03
2	.83253786 06	.18421753 06	-.98451372 02	.19750000 03
3	.33003618 06	.73031642 05	-.39030627 02	.78437500 02
4	-.85165279 03	-.18822590 03	.10206581 00	-.13482056 02
5	-.65188073 03	-.14375665 03	.77272382-01	.13413086 02
6	-.27071490 03	-.59706991 02	.32098750-01	.53033447 01
7	-.74097180 06	-.16349355 06	.87255519 02	-.19875000 03
8	.83252287 06	.18421566 06	-.98458121 02	.19750000 03
9	.33003055 06	.73030705 05	-.39034377 02	.77812500 02
10	-.85157773 03	-.18821492 03	.10204970 00	-.13482666 02
11	-.65193014 03	-.14374932 03	.77276776-01	.13412476 02
12	-.27073412 03	-.59703330 02	.32100947-01	.53036498 01
13	.36870982 04	-.34203486 04	.51478548 00	-.11550293 02

Table C-13. Sensitivity Matrix for Parking Orbit, Out-of-Plane Transfer, Selenocentric Coordinates, + 3 Sigma Perturbations

	x_e	y_e	z_e	$\dot{x}_e$	$\dot{y}_e$	$\dot{z}_e$
1	-.99666665-01	-.65314583 00	-.46277083 00	-.20833333 01	-.26145833 03	-.16750000 03
2	.11261458 00	.73935416 00	.52306250 00	.28125000 01	.29583333 03	.18875000 03
3	.44364583-01	.29334896 00	.20801562 00	.93749998 00	.11770833 03	.76770832 02
4	-.13666789-03	-.77077230-03	-.57214355-03	-.77311197-02	-.32694498 00	-.21443685 00
5	-.44993083-04	-.57568359-03	-.41058350-03	.50862630-03	-.23447672 00	-.19399007 00
6	-.35644531-04	-.22038778-03	-.11506653-03	-.50862630-03	-.56406657-01	.87941486-01
7	-.12082292 01	-.75870833 00	-.50389583 00	-.45020833 03	-.27812500 03	-.17791667 03
8	.65312498-02	-.23473958 00	.50029165 00	-.14270833 02	-.13114583 03	.18343750 03
9	.29218750-02	.27049479 00	-.71659375 00	-.57812499 01	.11406250 03	-.34317708 03
10	-.62551880-03	-.12758789-02	-.77277628-03	-.11035156 01	-.43741862 00	-.26092529 00
11	-.55779012-03	-.49096678-03	-.53012084-03	-.11016846 00	-.12189738 01	-.22196452 00
12	-.24036662-03	-.34053548-03	.22176107-03	-.45471191-01	-.84177651-01	-.83989461 00
13	.12698771-02	.34541829-03	.97859699-03	.11515299 00	.60506184 00	.47139486 00

	x_a	y_a	z_a	$\dot{x}_a$	$\dot{y}_a$	$\dot{z}_a$
1						
2						
3						
4						
5						
6						
7	.11086250 01	.10566667 00	.41250000-01	.44458333 03	.15208333 02	.60416666 01
8	.10611458 00	.97411457 00	.22864583-01	.15312500 02	.42677083 03	.35416667 01
9	.41463541-01	.22880208-01	.92458854 00	.60937499 01	.35416667 01	.41932291 03
10	.48896280-03	.50516764-03	.20091756-03	.10941569 01	.10945638 00	.44453937-01
11	.51258341-03	-.84798175-04	.11964925-03	.11027018 00	.98520914 00	.27974446-01
12	.20463053-03	.12008667-03	-.33690898-03	.44759114-01	.27974446-01	.92783610 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	.71984649 03	-.18322368 04	.27412281 02	.74299998 06	-.18235000 07	.53499998 05
2	-.80783990 03	.19361294 04	-.90460526 01	-.82824998 06	.18827500 07	-.28500000 05
3	-.32332785 03	.76617323 03	.43859649 01	-.34225000 06	.74987498 06	-.41249999 04
4	.86118463 00	-.30298066 01	.16891747 00	.90844726 03	-.33117675 04	.25781250 03
5	.84458735 00	-.21828099 01	-.82718697-01	.11845703 04	-.25146484 04	-.51269531 01
6	.41894745-01	-.92329057 00	.64716004 00	-.70971679 03	-.63281248 03	.60473631 03
7	-.24671053 03	.17899671 05	.15641447 04	-.16500000 06	.19050500 08	.14685000 07
8	.70816885 04	.40932017 04	.36332237 04	.74337499 07	.46677499 07	.35375000 07
9	-.16280839 05	.14690241 04	-.67937225 04	-.17577625 08	.16916250 07	-.67939999 07
10	.36969101 00	.94307078 02	.49979226 00	.11840820 04	.10599585 06	-.96386718 03
11	.34983049 02	.26424475 02	.80553019 01	.38887939 05	.32699218 05	.71889648 04
12	-.87510092 02	.96815678 01	-.18985547 02	-.10158594 06	.12487182 05	-.19003906 05
13	-.53164832 00	.11029160 01	.40047629 00	-.69433593 03	.98535155 03	.33984375 03

Table C-13 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	.67223836 03	.31286337 04	-.63226742 03	-.47965116 03	-.49745638 04	.11882267 04
2	-.72856103 03	-.36991279 04	.70130813 03	.53234010 03	.56122819 04	-.13517442 04
3	-.27252906 03	-.14325945 04	.32067587 03	.20167151 03	.22601744 04	-.51507992 03
4	.99891838 00	.31298260 01	-.95101289 00	-.56954317 00	-.63590115 01	.13378054 01
5	.21468761 00	.10610181 01	-.17299208 01	-.76293943-01	-.52341194 01	.46663506 00
6	.14522464 01	.33711278 01	.29763510 01	-.82681344 00	.91109163 00	.20013853 01
7	.22565407 04	.19124273 05	-.69404069 03	-.60319767 03	-.13117732 04	.32703488 03
8	.11264535 03	.46874999 04	.35047238 04	.70457848 04	-.61773254 03	.41787790 02
9	.49055232 02	.17578125 04	-.67941497 04	-.16304506 05	-.22347383 03	.42696220 02
10	.15400731 01	.90342675 02	-.11497320 01	-.13378054 01	.36869492 01	.15276532 01
11	.60857727 00	.47208209 02	.60414157 01	.34355340 02	-.22652204 02	.30162722 00
12	.16181413 01	.20977286 02	-.16811282 02	-.88260561 02	-.60405287 01	.19375113 01
13	-.23420466 01	-.11497320 02	.31049861 01	-.43292378 00	.13193530 02	.10645667-01

	DBX	DBY	DBZ	KS1	KS2	KS3
1	-.19355570 05	-.43490931 04	.57681347 05	-.12208333 06	-.13958333 05	-.63645833 06
2	.22412565 05	.48996113 04	-.65508419 05	.13520833 06	.14583333 05	.72010415 06
3	.89248704 04	.20191062 04	-.25922927 05	.55833332 05	.71354166 04	.28661458 06
4	-.12768365 02	-.54520522 01	.69673368 02	-.17344157 03	-.23091634 02	-.84197997 03
5	-.10341190 02	-.77305927 01	.41404289 02	-.16988118 03	-.50557454 02	-.53833008 03
6	-.11835444 01	.95663910 01	.20408828 02	.12166341 03	.99792479 02	-.11617025 03
7	-.10229598 06	-.50680051 04	.13529793 05	-.52895833 06	-.14375000 05	-.14479167 06
8	-.21044365 05	.38298251 05	.85880828 04	-.78125000 05	.51354165 05	-.10635417 06
9	-.76003885 04	-.82789020 05	.36374676 04	-.25260416 05	-.84479165 05	-.43020832 05
10	-.40775121 03	-.89133463 01	-.13084135 03	-.14084879 04	-.24210612 02	.17471313 04
11	-.21981669 03	.14530162 03	.38256077 03	-.83201089 03	-.56660970 02	-.49268595 04
12	-.81204429 02	-.37939595 03	.15653225 03	-.13249715 03	.11637370 03	-.18669128 04
13	.70503509 02	.98035741 01	-.24251513 03	.46407064 03	.88704427 02	.31058756 04

	ISP	WTFLO	WT	DTGO
1	-.73575623 06	-.15977500 06	.85982498 02	-.15000000 03
2	.83219373 06	.18091250 06	-.97517500 02	.16458333 03
3	.32979218 06	.71779685 05	-.38614375 02	.19270833 02
4	-.85996093 03	-.19253845 03	.10052734 00	-.13206990 02
5	-.64677734 03	-.14097900 03	.74796141-01	.14766439 02
6	-.26401062 03	-.48751831 02	.33118286-01	.18122355 01
7	-.73578123 06	-.15966250 06	.85980000 02	-.14791667 03
8	.83217812 06	.18098125 06	-.97518748 02	.16458333 03
9	.32978281 06	.71807810 05	-.38613750 02	.20312500 02
10	-.85988769 03	-.19248657 03	.10051880 00	-.13203939 02
11	-.64685058 03	-.14093323 03	.74802246-01	.14762370 02
12	-.26406555 03	-.48735046 02	.33124390-01	.18102010 01
13	.36515930 04	-.34719177 04	.51990478 00	-.11551921 02

Table C-14. Sensitivity Matrix for Parking Orbit. Out-of-Plane Transfer, Selenocentric Coordinates, - 3 Sigma Perturbations

	x_e	y_e	z_e	$\dot{x}_e$	$\dot{y}_e$	$\dot{z}_e$
1	-.10633333 00	-.65677082 00	-.46856250 00	-.22916667 01	-.26083333 03	-.16687500 03
2	.12067708 00	.74452083 00	.53145833 00	.18750000 01	.29687500 03	.18864583 03
3	.47411458-01	.29511979 00	.21025521 00	.16666667 01	.11458333 03	.74791665 02
4	-.10160319-03	-.77598063-03	-.51330566-03	-.86466471-02	-.31901041 00	-.20823161 00
5	-.92163084-04	-.57120768-03	-.41454061-03	-.23905436-01	-.13956706 00	-.13844808 00
6	-.67443846-04	-.24277751-03	-.20554606-03	.60068766-01	-.31417846 00	-.62815348-01
7	-.12147708 01	-.76247916 00	-.50968750 00	-.44666666 03	-.27437500 03	-.17145833 03
8	.14552083-01	-.22957292 00	.50863542 00	-.13645833 02	-.12927083 03	.18552083 03
9	.59479166-02	.27223437 00	-.71435936 00	-.46354166 01	.11125000 03	-.34442708 03
10	-.59044392-03	-.12807922-02	-.71374510-03	-.11019897 01	-.42714437 00	-.25065104 00
11	-.60492960-03	-.48606364-03	-.53398641-03	-.13529460 00	-.11251831 01	-.16743978 00
12	-.27216593-03	-.36275736-03	.13129679-03	.14648437-01	-.34245809 00	-.99110921 00
13	.13294067-02	.35870361-03	.10342814-02	.11901855 00	.57779948 00	.45166015 00

	x_a	y_a	z_a	$\dot{x}_a$	$\dot{y}_a$	$\dot{z}_a$
1						
2						
3						
4						
5						
6						
7	.11090625 01	.10583333 00	.41166666-01	.44458333 03	.15208333 02	.60416666 01
8	.10643750 00	.97406249 00	.22812500-01	.15312500 02	.42677083 03	.35416667 01
9	.41604166-01	.22911458-01	.92451562 00	.60937499 01	.35416667 01	.41932291 03
10	.49026489-03	.50565592-03	.20050049-03	.10940552 01	.10935465 00	.44352213-01
11	.51382446-03	-.85164386-04	.11940511-03	.11016846 00	.98510741 00	.27872721-01
12	.20516459-03	.12020365-03	-.33724467-03	.44809977-01	.28025309-01	.92783610 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	.71546052 03	-.18404605 04	.20833333 02	.73699998 06	-.18325000 07	.47999998 05
2	-.79961623 03	.19451754 04	-.54824561 00	-.82049998 06	.18962500 07	-.22250000 05
3	-.32716557 03	.76946271 03	.13706140 00	-.33862500 06	.74824998 06	-.51249999 04
4	.86734169 00	-.30627334 01	.18551475 00	.89111327 03	-.33186035 04	.26342773 03
5	.10333145 01	-.21929824 01	.13331363 00	.11606445 04	-.23388672 04	.91796873 02
6	-.47690408 00	-.98539653 00	.69333794-01	-.68688963 03	-.11584472 04	.34106445 03
7	-.25438596 03	.17886513 05	.15751096 04	-.18300000 06	.19031500 08	.14860000 07
8	.71260964 04	.41351425 04	.36480263 04	.74857499 07	.47237499 07	.35532500 07
9	-.16271519 05	.14853344 04	-.67920778 04	-.17558250 08	.17067500 07	-.67872499 07
10	.28857850 00	.94232658 02	.55654424 00	.10371094 04	.10592505 06	-.91259765 03
11	.35327844 02	.26580543 02	.82895378 01	.39089355 05	.33110595 05	.73063964 04
12	-.87965848 02	.96855831 01	-.19555075 02	-.10147644 06	.12054565 05	-.19267212 05
13	-.52522357 00	.11768006 01	.36085697 00,	-.59912109 03	.10502930 04	.32812500 03

Table C-14 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	.65043603 03	.31250000 04	-.64316859 03	-.47601744 03	-.49781976 04	.11736918 04
2	-.70675870 03	-.36646075 04	.70494185 03	.54324126 03	.56377180 04	-.13408430 04
3	-.28706395 03	-.14761991 04	.27616279 03	.20621366 03	.21756904 04	-.54687498 03
4	.10592438 01	.32699939 01	-.83213627 00	-.55712321 00	-.61549696 01	.14673277 01
5	.88891317 00	.26525453 01	-.41340672 00	-.69196832-01	-.25993170 01	.15241046 01
6	-.35574269 00	-.80108642 00	-.51099200 00	-.88004178 00	-.61026283 01	-.70971110 00
7	.22529069 04	.19156977 05	-.66497092 03	-.60319767 03	-.12681686 04	.32703488 03
8	.12718023 03	.47274709 04	.35210755 04	.70476017 04	-.58321220 03	.47238371 02
9	.29069767 02	.17123910 04	-.68359374 04	-.16305414 05	-.30795784 03	.72674417 01
10	.16039471 01	.90513005 02	-.99714410 00	-.12898999 01	.39335738 01	.17033067 01
11	.12544144 01	.48764250 02	.73419614 01	.34316307 02	-.20052887 02	.12934485 01
12	-.20492908 00	.16785555 02	-.20305722 02	-.88334192 02	-.13070217 02	-.80108642 00
13	-.24946345 01	-.11901855 02	.27749704 01	-.36195267 00	.12501561 02	-.19162200 00

	DBX	DBY	DBZ	KS1	KS2	KS3
1	-.19485103 05	-.44689119 04	.57568005 05	-.12083333 06	-.13333333 05	-.63666666 06
2	.22627914 05	.50501943 04	-.65314119 05	.13593750 06	.15416667 05	.72114583 06
3	.89613018 04	.20110103 04	-.25888925 05	.52552082 05	.49479166 04	.28473958 06
4	-.13089353 02	-.54868391 01	.69975383 02	-.16520182 03	-.14953613 02	-.83780923 03
5	-.92422404 01	-.59770178 01	.41728439 02	-.72021483 02	.20955404 02	-.47444661 03
6	-.49911261 01	.46993908 01	.16919072 02	-.13997396 03	-.87992350 02	-.28320312 03
7	-.10240285 06	-.51457253 04	.13409974 05	-.52250000 06	-.13125000 05	-.14083333 06
8	-.20824158 05	.38468264 05	.87645724 04	-.75208332 05	.51875000 05	-.10406250 06
9	-.75631476 04	-.82791449 05	.36633743 04	-.27864583 05	-.86927082 05	-.44531250 05
10	-.40804690 03	-.89386460 01	-.13052352 03	-.13980103 04	-.14750163 02	.17549642 04
11	-.21872248 03	.14705678 03	.38285646 03	-.73476154 03	.14038086 02	-.48661295 04
12	-.85015173 02	-.38426216 03	.15302668 03	-.39469401 03	-.71818032 02	-.20354207 04
13	.70832404 02	.99142598 01	-.24232854 03	.43172200 03	.71411133 02	.30861409 04

	ISP	WTFLO	WT	DTGO
1	-.74928123 06	-.16012500 06	.85934998 02	-.14166667 03
2	.85129373 06	.18166562 06	-.97331248 02	.16666667 03
3	.33720625 06	.71995310 05	-.38599375 02	.20833333 02
4	-.86127318 03	-.18016662 03	.10047485 00	-.13201904 02
5	-.66080015 03	-.15316467 03	.76386717-01	.14758301 02
6	-.28634948 03	-.58956909 02	.28750610-01	.18096924 01
7	-.74926248 06	-.16006875 06	.85940000 02	-.14791667 03
8	.85129998 06	.18167812 06	-.97332499 02	.16562500 03
9	.33720625 06	.71996873 05	-.38600625 02	.20312500 02
10	-.86121214 03	-.18012085 03	.10047607 00	-.13203939 02
11	-.66080627 03	-.15319214 03	.76389159-01	.14760335 02
12	-.28637542 03	-.58979797 02	.28753051-01	.18107096 01
13	.37221923 04	-.34824829 04	.51987547 00	-.11549886 02

Table C-15a. Sensitivity Matrix for 140° Direct, In-Plane Transfer, Orbit Plane Coordinates, + 3 Sigma Perturbations

	u_e	v_e	w_e	$\dot{u}_e$	$\dot{v}_e$	$\dot{w}_e$
1	.19582995-01	-.43513873-03	-.35937898-03	.80674397 01	.10854576 02	.74260814 00
2	.69426747 00	.99607085 00	.25468034-02	.22629976 03	.43332813 03	.64032243 00
3	-.70767962-05	-.27414017-06	.47415742-05	-.39995333-01	-.20981057-01	.50441912-01
4	-.39774413-03	-.98012806-03	-.16933737-04	-.10014724 00	-.15484779 00	.11926918 00
5	-.37370968-04	.26652988-04	-.42746768-06	.41820556-01	-.82961754-01	-.53121178-01
6	.10856695-07	.49924613-08	.15301365-06	.15725991-04	.68131596-04	.61048123-04
7	-.11382287 01	-.17303114 00	-.48625381-03	-.43928800 03	-.66267045 02	-.14828726 01
8	.90093607 00	.96355215-01	.25632115-02	.30697156 03	.22659720 02	.10038577 01
9	-.40780430-05	-.41636153-05	-.91561738 00	.40554723-01	-.47803605-02	-.41790172 03
10	-.12281344-02	-.97267969-03	-.17028000-04	-.12566938 01	-.34208464 00	.11810934 00
11	.43039807-04	.40974427-03	-.38154478-06	.22977273 00	-.98157319 00	-.52792819-01
12	.14124824-07	.80725347-08	.38544489-03	.92135488-05	.80504640-04	-.91624041 00
13	.13177768-02	-.19768803-04	.82974314-05	.40458330 00	.65435343 00	.32658882-01

	u_a	v_a	w_a	$\dot{u}_a$	$\dot{v}_a$	$\dot{w}_a$
1						
2						
3						
4						
5						
6						
7	.11574797 01	.17260468 00	-.54763646-04	.44755476 03	.77618717 02	-.63866092-01
8	-.20660152 00	.89970216 00	.19185684-04	-.80843559 02	.41072350 03	-.88928914-02
9	.14135053-04	.95111581-05	.91556094 00	.41999828-01	.28279649-01	.41784097 03
10	.83031968-03	-.73860895-05	-.26080985-06	.11566103 01	.18753313 00	-.10294987-04
11	-.81054852-04	-.38332215-03	.97898058-07	-.19132057 00	.89977310 00	.53684550-04
12	.38558453-07	.57305984-07	-.38534232-03	.19108699-06	.15588577-04	.91631303 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	-.87004100 01	-.77394752 02	-.26326781 01	-.22188581 04	-.99099359 05	.81957353 04
2	-.46925780 01	.26782446 04	-.19131810 01	-.55462613 04	.26190073 07	-.42186661 04
3	.10522838 02	-.86067267-01	-.14838777 01	.14897673 05	.83893530 02	-.18161495 04
4	-.10859890 01	-.34074161 01	-.40409623 00	-.35288013 03	-.27335816 04	.27110274 03
5	.17289431 00	.21260676-01	.96022665-01	.10999144 03	.15023318 03	.37838590 01
6	.10030239 01	.55255536-04	-.14148408 00	.13997583 04	.22401464 00	-.17555901 03
7	-.16499490 02	.16973118 05	-.12653966 02	-.92902913 04	.18263584 08	-.43878321 04
8	-.21371173 02	-.82007078 04	-.70413010 00	-.29236627 05	-.85151474 07	-.14663671 04
9	.18133853 05	.92195510-01	.76274983 04	.19463127 08	.17030307 03	.76337786 07
10	-.11053983 01	.92716931 02	-.42941691 00	-.37989096 03	.10724710 06	.24298343 03
11	.73282654-01	-.40624353 02	.96456051-01	-.32884460 02	-.43340727 05	.77862132 01
12	.96819297 02	.13398580-03	.22942617 02	.11116230 06	.35988473 00	.23173617 05
13	-.12795967 00	.13620477 01	-.54075006-01	-.12060547 03	.11308594 04	-.16113281 02

C-15a Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	.14430132 02	-.28028836 03	-.58102654 01	.50925498 02	.22736407 03	.11794502 02
2	.75219098 01	-.53610347 04	.21650612 01	.30453819 01	.80524260 04	-.18757831 01
3	-.30979409 00	-.15987556 01	-.23002901 01	.11279682 02	.14493041 01	.37233344 00
4	.24211725 01	.18380672 01	-.20268798 01	.14575572 01	-.60344403 01	-.25404290 01
5	.83778688 00	.13899765 01	.15659319 01	.77142513 00	.13748960 01	.71155196 00
6	-.36263223-03	-.21193359-03	-.16574128 00	.94804049 00	.20049835-02	.14470627-02
7	-.26277885 00	.18214788 05	-.26522410 02	.19697018 02	-.11856728 04	-.13243706 02
8	.11733682 02	-.87350719 04	.33258624 01	.26129635 01	.55311646 03	.30437783 01
9	.94492103 00	.80898552 00	.76280590 04	.18133441 05	.10792512-01	.44119096 00
10	.24186750 01	.10255249 03	-.20420864 01	.14408498 01	-.10567861 02	-.25502799 01
11	.80769589 00	-.16516889 02	.15196167 01	.71920716 00	-.21313736 02	.68450645 00
12	.74670540-03	-.62997559-03	.22917759 02	.96764628 02	.24396754-02	.19250774-02
13	-.46840933 00	-.14052280 02	-.85165332 00	-.46131222 00	.13800333 02	-.38679256 00

	DBX	DBY	DBZ	KS1	KS2	KS3
1	.15717629 04	.73149624 02	-.30964274 04	.74688826 04	.30714721 03	.45273531 05
2	.31139460 05	-.84955485 02	-.93791592 05	.18023768 06	.53480194 03	.10514306 07
3	.51375413 00	-.25257279 02	-.93825964 00	-.33632311 02	-.46199819 02	.63689173 02
4	.30337661 01	.42453318 01	.59752934 02	-.10938726 03	-.74603753 02	-.53309705 03
5	-.41133122 01	.11445115 01	-.31143599 01	-.25885171 02	.64738499 02	.25167912 02
6	.33170574-02	-.76243107 01	.36060509-03	-.31028778-01	-.22917339-01	.13845211 00
7	-.91971546 05	.48071463 02	.13732590 05	-.44542472 06	-.73305012 03	-.14876361 06
8	.48143990 05	-.79820846 02	-.41834467 04	.26271222 06	.47124712 03	.31011569 05
9	.45202798 00	.91123225 05	.78284291 00	.33176306 02	.53150118 02	.52364247 02
10	-.44432661 03	.42394564 01	.13936318 03	-.16107565 04	-.74827807 02	-.15700746 04
11	.74577756 02	.11162574 01	.40770298 03	.23043368 03	.64011947 02	-.53718025 04
12	.32486246-02	.41034124 03	-.15450247-02	-.38716083-01	-.60474048-01	.12366699 00
13	.74339555 02	-.10657434 01	-.25342556 03	.42867025 03	-.36214192 02	.33005778 04

	ISP	WTFLO	WT	DTGO
1	.48275527 05	.17790088 05	-.63683380 01	.10845488 02
2	.12053420 07	.26743066 06	-.14164654 03	.20638825 03
3	-.54403804 01	-.23827382 01	.40031393-03	-.15747074 00
4	-.82281638 03	-.16851258 03	.91806799-01	.54217557 00
5	-.77058883 02	-.20056172 02	.10631715-01	.19909817 02
6	.74892760-03	.32251068-03	.17488247-05	-.24898470-03
7	.48245720 05	.17798519 05	-.63583522 01	.62180735 01
8	.12053331 07	.26742968 06	-.14164788 03	.20793044 03
9	-.21017835 01	.82407372-01	.57074859-03	.43542150 00
10	-.82279028 03	-.16850209 03	.91808007-01	.54131123 00
11	-.77229190 02	-.20103391 02	.10616686-01	.19909082 02
12	-.13046403-02	-.10066515-03	.94221333-06	-.16502106-03
13	.37481750 04	-.34381164 04	.50604247 00	-.11551921 02

Table C-15b. Sensitivity Matrix for 140° Direct, In-Plane Transfer, Orbit Plane Coordinates, + 3 Sigma Perturbations

	u_e	v_e	w_e	$\dot{u}_e$	$\dot{v}_e$	$\dot{w}_e$
1	.12430310-02	-.26391610-03	-.64652536-04	-.19643449 01	.47862746 00	.48946355 00
2	.76701242 00	.99609217 00	.25095690-02	.24944740 03	.43885191 03	-.11312333 01
3	.34090329-05	-.33266666-06	.86978728-05	.69826491-01	.40507357-01	-.31467434-01
4	-.48507737-03	-.97387267-03	-.97492087-06	-.29558273 00	-.14970546 00	-.14106613-02
5	-.44614491-04	.18850615-06	-.11328534-06	-.44408815-02	-.13731324-01	.60103577-02
6	-.20749421-07	-.11546566-07	.79962128-06	.46227838-04	-.71771517-05	.36631365-04
7	-.11560092 01	-.17152380 00	-.45904938-03	-.45021421 03	-.74666088 02	.21896543 01
8	.97220422 00	.95943301-01	.25905077-02	.32934327 03	.27426213 02	-.12950686 01
9	-.67451107-05	-.27816391-05	-.91574581 00	-.42544692-02	.12672763-02	-.41789707 03
10	-.13137404-02	-.96619121-03	-.12013153-05	-.14545131 01	-.33606840 00	-.12710480-04
11	.35849671-04	.38250859-03	-.61846880-07	.18579774 00	-.91323700 00	.52337557-02
12	-.80113512-08	-.69560915-08	.38530276-03	.22969358-04	.29845130-04	-.91654615 00
13	.15519355-02	-.18993074-04	.79308059-05	.47197088 00	.62119810 00	-.60130205-02

	u_a	v_a	w_a	$\dot{u}_c$	$\dot{v}_a$	$\dot{w}_a$
1						
2						
3						
4						
5						
6						
7	.11574190 01	.17142504 00	-.57398760-04	.44752541 03	.77082248 02	.25044872-01
8	-.20526729 00	.90005500 00	.22273676-04	-.80297111 02	.41092229 03	-.61401693-02
9	.47388189-05	.10712412-04	.91569140 00	-.11902741-01	.26562920-01	.41792238 03
10	.82862451-03	-.76925563-05	-.24968483-06	.11561893 01	.18623645 00	-.26504210-05
11	-.80717179-04	-.38254559-03	.78998757-07	-.18989271 00	.90011702 00	.23973999-04
12	.43917640-07	.56514763-07	-.38456679-03	-.63232082-04	-.18238617-04	.91652477 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	-.21947454-01	-.98704299 02	-.11677413 01	.16398060 04	-.12486155 06	.11669396 04
2	-.58832369 01	.30453625 04	-.32168249 01	-.68068899 04	.29906570 07	-.30253616 04
3	.13751635 02	.69281417-01	-.28274991 01	.17707055 05	.11349588 03	-.39112580 04
4	-.24721900-01	-.33671741 01	-.53907250-01	.93162901 01	-.34784402 04	.10680858 02
5	.23298846-04	-.14356820 00	.64206276-02	-.59031921 01	-.12534857 03	-.11230119 00
6	.14182386 01	.15974422-03	-.30785144 00	.18363757 04	-.45354934 00	-.41044605 03
7	-.35358514 01	.16836690 05	-.85161860 01	-.54479883 04	.18134660 08	-.94871293 04
8	-.23871919 02	-.77736292 04	-.29519646 01	-.30794108 05	-.80160252 07	-.18957297 04
9	.18012173 05	-.68336484-02	.76089958 04	.19351253 08	-.26336197 02	.75483806 07
10	-.43674626-01	.93223820 02	-.77470624-01	-.18083837 02	.10725772 06	-.12006781 02
11	-.10033437 00	-.38207590 02	.52884476-02	-.14747668 03	-.40238734 05	.50434678 01
12	.97291448 02	.23026067-03	.20257739 02	.11179201 06	-.21310830 00	.19612144 05
13	-.43367085-01	.15756707 01	-.91017338-02	-.56152343 02	.14150390 04	-.78124999 01

C-15b Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	-.27026917 00	-.12093926 03	.10607847 02	-.35624448 02	-.14137285 02	.91008039 00
2	-.21471843 00	-.51518108 04	.42400383 01	-.62850324 01	.82370572 04	-.15956747 01
3	.84029521 00	-.43041178-01	-.23793183 01	.13452326 02	.53833228 00	.86706597 00
4	-.11780316 00	.18311884 01	.19498804 00	-.31044719 01	-.53350576 01	-.28902556-01
5	.86064404-01	.41666874 00	.23980708 00	-.30591453-02	-.49834494 00	.18539928 00
6	.40630409-03	-.84004234-03	-.32101705 00	.13744122 01	-.18686146-02	.67467463-03
7	.34503453 01	.18208338 05	-.34310450 01	-.32545966 02	-.13968589 04	.10896463 01
8	-.66236093 01	-.84646195 04	.35423444 01	-.10903029 02	.74702785 03	-.38616969 01
9	-.58275831 00	-.12566264 00	.76090344 04	.18012024 05	-.10435875 00	-.63629983 00
10	-.12185138 00	.10249837 03	.18391546 00	-.31121563 01	-.93971982 01	-.31912950-01
11	.40596039-01	-.17338289 02	.23218437 00	-.13842300-01	-.20698225 02	.18283189 00
12	.91285126-03	-.13953935-02	.20244614 02	.97248590 02	-.10795845-02	.96853027-03
13	-.31937000-01	-.11937341 02	-.12065089 00	-.10645667 00	.13534191 02	-.10645667 00

	DBX	DBY	DBZ	KS1	KS2	KS3
1	.37888753 03	.10471044 02	-.25694211 03	-.44852740 03	-.22419732 04	-.25539309 03
2	.31564245 05	-.91288112 02	-.95640737 05	.19874674 06	.25961575 01	.10646391 07
3	.48726794 00	-.59550603 01	-.13902210 00	.21437784 02	.11548493 02	.19427695 01
4	-.78471360 01	.85695499-01	.54210058 02	-.13977873 03	-.19768587 03	-.68211974 03
5	-.42316217 01	-.62187134-02	-.23115692 01	-.99974791 01	.46543323 00	-.49028828 02
6	-.87403129-03	-.53869503 01	-.20947101-02	-.58884049-01	-.64169655-01	-.43098160-01
7	-.[illegible]96525 05	-.58684907 01	.16444707 05	-.65390478 06	-.28713435 04	-.18595358 06
8	.48458291 05	-.97834270 02	-.60134263 04	.28041167 06	-.12439295 03	.50056301 05
9	.70307589-01	.91144990 05	-.37366785 00	-.14685852 02	.18971257 01	-.26887569 01
10	-.45525808 03	.78331930-01	.13324198 03	-.15059247 04	-.19822349 03	-.17112543 04
11	.74009364 02	-.22721015-01	.40863725 03	.21821483 03	-.79604341 00	-.54496183 04
12	-.70151076-03	.41260847 03	-.37531985-02	.22446891-01	-.95614298-02	-.23770844-01
13	.71815925 02	-.31624433 00	-.25354257 03	.46203613 03	-.46793619 01	.33374023 04

	ISP	WTFLO	WT	DTGO
1	.22608663 04	.19127878 03	-.27910236 00	-.81143068 01
2	.12353414 07	.27495834 06	-.14522031 03	.17945752 03
3	-.21950856 01	-.26700593 00	.55938440-03	.45352558 00
4	-.74861140 03	-.16891173 03	.84076955-01	-.11149664 01
5	-.81818477 02	-.17016932 02	.10243554-01	.19944033 02
6	.10322705-02	-.16105088-02	.24387442-05	-.30032405-04
7	.22142041 04	.13181708 03	-.30582075 00	-.10248507 02
8	.12353344 07	.27496094 06	-.14522013 03	.17898818 03
9	-.37867798 01	-.18352361 01	.11912757-03	-.35283972 00
10	-.74863772 03	-.16895894 03	.84040559-01	-.11158292 01
11	-.81913260 02	-.17073344 02	.10247762-01	.19943297 02
12	-.30910089-03	-.15173591-02	.17052909-05	.54303206-04
13	.37845764 04	-.34419861 04	.50159424 00	-.11549886 02

Table C-16. Sensitivity Matrix for 140° Direct, In-Plane Transfer, Orbit Plane Coordinates, - 3 Sigma Perturbations

	u_e	v_e	w_e	$\dot{u}_e$	$\dot{v}_e$	$\dot{w}_e$
1	.18466943-01	.19540538-03	.79091345-04	.42081420 01	.56546118 01	.13181400 01
2	.70569600 00	.99812902 00	-.24394625-02	.22773488 03	.43426652 03	.66282983 00
3	.92476730-05	.28702190-05	.21035706-05	-.42466875-02	.16574412-01	-.91402303-01
4	-.46758805-03	-.95147228-03	.10170660-04	.23485929-01	-.47457411 00	.14185691 00
5	-.51605279-04	.24506357-04	.92496236-06	-.74912365-01	-.93433023-01	.17252526-01
6	-.28691342-07	-.34039542-07	.21861937-06	-.24808856-03	.25664036-05	-.83244325-05
7	-.11386985 01	-.17239136 00	.29461024-03	-.44072803 03	-.69325044 02	.21415651 01
8	.91221942 00	.98512185-01	-.24677991-02	.30818115 03	.23189388 02	.54463302 00
9	-.33884784-05	.15726801-05	-.91557348 00	-.49118901-01	.68311657-02	-.41784634 03
10	-.12974319-02	-.94366678-03	.10281004-04	-.11325557 01	-.66173594 00	.14132701 00
11	.29663697-04	.40804034-03	.91809472-06	.11909203 00	-.99274696 00	.15930702-01
12	-.22364327-07	-.33931784-07	.38549852-03	-.22977663-03	-.25984720-04	-.91635274 00
13	.13545240-02	-.13967698-04	-.82832679-05	.47164270 00	.66485587 00	-.12391611-01

	u_a	v_a	w_a	$\dot{u}_a$	$\dot{v}_a$	$\dot{w}_a$
1						
2						
3						
4						
5						
6						
7	.11578353 01	.17245582 00	.12224374-03	.44739634 03	.77624196 02	.30161306-01
8	-.20673888 00	.89957105 00	-.55041932-04	-.80761225 02	.41077972 03	-.15199299-03
9	-.22140812-04	-.11583826-04	.91548289 00	-.78375931-01	.23140069-01	.41790336 03
10	.83151658-03	-.79427607-05	.42084040-06	.11564803 01	.18746972 00	.63930325-06
11	-.81317585-04	-.38399612-03	-.16942224-06	-.19100210 00	.89981902 00	-.79861779-04
12	-.68451508-07	-.53941836-07	-.38573709-03	.77728746-05	-.32787287-04	.91626160 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	-.61621452 01	-.74645338 02	.24200488 01	-.35183423 03	-.11077207 06	-.56588369 03
2	.57508518 01	.26957265 04	.95072781 00	.55727991 04	.26386295 07	.17703989 04
3	.10151981 02	.22145369 00	-.16454596 01	.14822116 05	.25119998 03	-.24332002 04
4	-.32977413 00	-.24261956 01	.26724449 00	.13024360 03	-.33554980 04	.16474001 03
5	-.13389188 00	-.28768847 00	-.20082778 00	-.12698377 03	.56342820 02	-.18026527 03
6	.95607790 00	-.18130476-03	-.15345800 00	.13945407 04	-.13575215 00	-.22455955 03
7	.62939800-01	.16990656 05	.11862681 02	.73635442 04	.18260555 08	.97189177 04
8	.22997810 02	-.81515302 04	-.34217976 00	.29648662 05	-.84474187 07	.32686589 02
9	.18133021 05	-.87962128-01	.76271860 04	.19463107 08	-.11267316 02	.76330269 07
10	-.31078471 00	.93778751 02	.29297698 00	.15682722 03	.10674035 06	.19297614 03
11	-.34689383-01	-.40760441 02	-.20119226 00	.16494690 02	-.43170221 05	-.18279144 03
12	.96772782 02	-.23110359-03	.22930814 02	.11115725 06	.14654034-01	.23123014 05
13	.12688888 00	.16286750 01	.11618095 00	.13232422 03	.13344726 04	.11132812 03

Table C-16 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	-.13709404 02	-.24064029 03	.16600063 02	.58265624 01	.25721060 03	.15429138 01
2	-.14079943 02	-.53654192 04	-.20411944 00	-.43787203 01	.80444575 04	.13126340 01
3	-.14928066 00	-.75583702 00	-.15823937 01	.10579559 02	.21505792 01	-.15045386 00
4	.13209899 00	.66363546 01	.33808778 01	.19355904 01	-.76369831 00	.28932281 00
5	-.16923277 01	-.19941958 00	.30010102-01	-.11854632 01	-.59987376 00	-.50422846 00
6	-.27413685-02	-.22356713-02	-.15739254 00	.95272701 00	-.90444563-03	-.19338671-02
7	.71297673 00	.18236110 05	.36618007 02	.21502530 02	-.11463059 04	.14786620 02
8	-.18506108 02	-.87288572 04	-.25703073 01	-.78082282 01	.54129007 03	-.17311443 01
9	-.56370117 00	-.56170207 00	.76262585 04	.18132346 05	-.11355530 01	-.59164484 00
10	.13246224 00	.10734159 03	.33970968 01	.19390353 01	-.52936584 01	.29508563 00
11	-.16780278 01	-.18048813 02	.75802806-01	-.11831456 01	-.23280888 02	-.49931035 00
12	-.28122737-02	-.24541840-02	.22927117 02	.96771493 02	-.28929332-03	-.17009766-02
13	.97585277 00	-.13154495 02	-.81616778-01	.67422555 00	.14900385 02	.27323878 00

	DBX	DBY	DBZ	KS1	KS2	KS3
1	.14005896 04	-.56654694 02	-.32360619 04	.10274580 05	-.55164535 03	.39511450 05
2	.31395745 05	.93978762 02	-.93525467 05	.18317793 06	-.60606053 03	.10537743 07
3	.20407832 01	-.15267751 02	-.75006816 00	-.13070250 02	.61917014 02	.10164732 03
4	-.45193458 01	-.27344972 01	.55569836 02	.32235183 03	.25426635 02	-.69265587 03
5	-.46430345 01	-.91771448 00	-.58207180 01	-.72497002 02	-.45970267 02	-.41884314 01
6	.23364203-02	-.68342696 01	-.26349850-02	-.11151345 00	.31395829-01	.11519904 00
7	-.92153156 05	-.29671236 02	.13530289 05	-.44617705 06	.10889905 03	-.15416171 06
8	.48397718 05	.88138694 02	-.39133264 04	.26603970 06	-.45525072 03	.33526413 05
9	-.28334405 C0	.91131422 05	-.68064818 00	-.35746397 02	-.24785452 02	-.30383528 02
10	-.45186254 03	-.27322182 01	.13513791 03	-.11818402 04	.25910719 02	-.17306447 04
11	.74133327 02	-.90576341 00	.40499809 03	.18622876 03	-.43685298 02	-.54014866 04
12	.13607633-02	.41113135 03	-.40693976-02	-.83998767-01	.55396957-01	.76177440-01
13	.75576070 02	.91078366 00	-.25168621 03	.45572916 03	.25634766 02	.33249918 04

	IST	WTFLO	WT	DTGO
1	.49942018 05	.17591665 05	-.64760626 01	.41907523 01
2	.12313115 07	.26853882 06	-.14142294 03	.21030815 03
3	-.36241143 01	-.14379632 01	.11448265-02	.38937580 00
4	-.78562208 03	-.17522874 03	.88049821-01	.53999102 00
5	-.84163318 02	-.23183612 02	.10338653-01	.19910630 02
6	-.87823246-02	-.21021616-02	.16740811-06	-.19500634-03
7	.50008012 05	.17473223 05	-.64740680 01	.56974084 01
8	.12312815 07	.26855695 06	-.14142455 03	.20884592 03
9	-.35380217 01	-.11595675 01	.25177714-04	-.61695901-01
10	-.78555628 03	-.17528651 03	.88047152-01	.54131123 00
11	-.84219514 02	-.23192745 02	.10362045-01	.19909082 02
12	-.85323600-02	-.15849822-02	-.14121003-08	-.16502106-03
13	.38136108 04	-.34575012 04	.50673827 00	-.11551921 02

Table C-17. Sensitivity Matrix for 180° Direct, In-Plane Transfer, Orbit Plane Coordinates, + 3 Sigma Perturbations

	u_e	v_e	w_e	$\dot{u}_e$	$\dot{v}_e$	$\dot{w}_e$
1	.23779510-03	-.65477994-03	-.97134673-04	.12096007 01	.38664225 00	-.14206593 00
2	.74236695 00	.99607272 00	.25210708-02	.23773150 03	.43258191 03	-.24923124 00
3	.94757930-05	.18679657-05	.72480839-05	.77485827-01	.49761242-01	-.10635229-01
4	-.61493694-03	-.97186364-03	-.16906724-05	-.18813936 00	-.35701216 00	.34432754-02
5	.25948514-04	-.86904986-06	-.18989067-06	.10250337-01	.14848804-01	-.11287626-02
6	-.79718437-08	-.85902734-08	.11181913-05	.23164424-03	.10270385-03	.76568896-04
7	-.11569225 01	-.17209582 00	-.34672861-03	-.44493184 03	-.76110691 02	.15772457 01
8	.94741426 00	.96005674-01	.25673899-02	.31815869 03	.22141462 02	-.19153487 00
9	-.30286305-05	-.60970165-05	-.91571354 00	-.31331556-01	-.94884922-02	-.41787108 03
10	-.14436856-02	-.96438797-03	-.18849464-05	-.13431157 01	-.54299809 00	.39730155-02
11	.10615314-03	.38168364-03	-.25153268-06	.20049543 00	-.88412147 00	.93126191-03
12	-.80825977-08	-.84178839-08	.38574803-03	.15250567-03	.51014515-04	-.91641119 00
13	.14942176-02	-.17918874-04	.79495371-05	.45819940 00	.59754458 00	-.27556931-02

	u_a	v_a	w_a	$\dot{u}_c$	$\dot{v}_a$	$\dot{w}_a$
1						
2						
3						
4						
5						
6						
7	.11574981 01	.17132193 00	-.47581258-04	.44744168 03	.77016062 02	-.36352190-02
8	-.20508971 00	.90004353 00	.18603564-04	-.80210890 02	.41083742 03	-.30622877-01
9	.32908741-05	.11175901-04	.91567019 00	-.36304952-01	.67203739-03	.41790734 03
10	.82893946-03	-.74809325-05	-.24927819-06	.11563140 01	.18614521 00	-.26674212-04
11	-.80463202-04	-.38268494-03	.76832412-07	-.18964785 00	.90016989 00	-.15037337-05
12	.47119989-07	.55729833-07	-.38470257-03	.46297388-04	-.16192443-04	.91646145 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	.69145136 00	-.97551239 02	-.15439976 00	.28180080 03	-.12598114 06	-.21922086 03
2	-.56261542 01	.29366800 04	-.41614186 01	-.63036130 04	.28841098 07	-.38946656 04
3	.14194677 02	.77783208-01	-.31876648 01	.18749935 05	.10345681 03	-.45794127 04
4	.32253062-02	-.36433640 01	-.69451421-02	.19859949 02	-.39862249 04	-.29354130 02
5	-.24446906-02	.14606064 00	.21365824-02	-.29543318 01	.16346376 03	.15258935 01
6	.14397660 01	-.60155072-04	-.34665773 00	.19215503 04	-.90232380-01	-.48268521 03
7	-.30481607 01	.16862173 05	-.62740669 01	-.28198426 04	.18156405 08	-.88074379 04
8	-.23098937 02	-.78828206 04	-.25341572 01	-.30563662 05	-.81324026 07	-.18401742 04
9	.18034475 05	-.84442910-01	.76077574 04	.19370284 08	-.12339934 02	.75568649 07
10	-.13689291-01	.92945643 02	-.26663164-01	-.44514298 01	.10671997 06	-.50724351 02
11	-.94764679-01	-.37952454 02	.74155686-02	-.14321537 03	-.39998485 05	.40252699 01
12	.97295089 02	-.32746398-03	.20275515 02	.11183270 06	-.25114061 00	.19614234 05
13	-.45508669-01	.10793585 01	-.11778714-01	-.62011718 02	.90136718 03	-.97656249 01

Table C-17 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1		-.82219605 02	.27208301 01	.46703563 01	.10717361 02	.14599944 01
2		-.51480C57 04	-.72935721 01	-.12431267 02	.80680477 04	-.58866162 01
3		.37079137 00	-.29532198 01	.16002500 02	.20712140 01	.19113326 01
4	.56160526-01	.33140984 01	.64781370-01	.10992037 00	-.66645666 01	.74540306-02
5	.20003311-01	-.84772600-01	-.16408704-01	-.12099511-01	.24595680 00	-.12281084-01
6	.15590714-03	.16401754-02	-.33150347 00	.15130672 01	.26339614-02	.11766250-02
7	.93455802 01	.18270924 05	.41918589 01	.95099441 01	-.13712663 04	.15411419 01
8	-.15790352 01	-.84669855 04	-.43444864 01	-.80461194 01	.59428282 03	.13147145 01
9	-.34428477 00	-.30612856 00	.76075144 04	.18035138 05	-.38205893 00	-.15044844 00
10	.62196950-01	.10400728 03	.68162288-01	.11883129 00	-.10706744 02	.10904471-01
11	.18028345-02	-.17829156 02	.33290227-02	.92615834-02	-.19972517 02	-.46583423-02
12	-.63622507-03	.10232696-03	.20289907 02	.97370211 02	.42406429-03	.13572600-02
13	-.14194222-01	-.11933792 02	-.35485556-02	-.28388445-01	.12973519 02	

	DBX	DBY	DBZ	KS1	KS2	KS3
1	.35099652 03	-.13868859 01	-.10390464 03	-.91274020 03	.17206515 03	.85117161 03
2	.31051976 05	-.99214695 02	-.94364236 05	.19151956 06	-.26212237 03	.10522798 07
3	-.48839654 00	-.12964205 01	.50351988 00	.53645869 01	.10095736 03	.12197818 03
4	-.13746877 02	.86873908-01	.72053102 02	-.17290138 03	.22454540 01	-.88195500 03
5	-.83428554 00	-.12033903-01	-.10884238 02	.85136750 01	.47326427-01	.47190284 02
6	-.81075206-03	-.50966077 01	.13284103-02	.72789004-01	.74394172-01	.22283445 00
7	-.93193092 05	.88638028 01	.16557077 05	-.45241877 06	.15604302 03	-.18525893 06
8	.47936419 05	-.98346214 02	-.47227102 04	.27288165 06	-.37885970 01	.36650433 05
9	.29629841 00	.91147938 05	-.19516111 00	.32062285 02	-.70911736 01	.12879238 02
10	-.46113931 03	.10030407 00	.15105661 03	-.15387716 04	.23569912 01	-.19088682 04
11	.77353747 02	.82734479-02	.40008257 03	.24027952 03	.41075330 00	-.53512030 04
12	-.77485454-03	.41289484 03	.10381223-02	.55024512-01	.93174097-01	.19406397 00
13	.70709069 02	-.35735609 00	-.24739794 03	.45104980 03	-.20345052 00	.32631429 04

	ISP	WTFLO	WT	DTGO
1	.62987298 02	-.20224783 01	-.99218212-01	-.11053003 02
2	.12172748 07	.27178666 06	-.14314273 03	.18107760 03
3	.49607551 01	.33700238 01	.64988404-03	.49447783 00
4	-.97479076 03	-.22041325 03	.11464463 00	-.13179407 01
5	.29720217 02	.78803737 01	-.36713908-02	.19933299 02
6	.29977485-02	.31781557-02	.18147671-05	.32704190-04
7	.46432236 02	.77569752 02	-.73499205-01	-.12458485 02
8	.12172853 07	.27176418 06	-.14314707 03	.18123861 03
9	.23114689 01	-.42874100 00	-.29762327-03	.83623730-01
10	-.97473264 03	-.22036126 03	.11465834 00	-.13170229 01
11	.29657483 02	.78605727 01	-.36532402-02	.19928734 02
12	.40108981-02	.32890097-02	.22835763-05	.26099646-03
13	.37130493 04	-.34573059 04	.51054686 00	-.11549886 02

Table C-18. Sensitivity Matrix for 180° Direct, In-Plane Transfer, Orbit Plane Coordinates, - 3 Sigma Perturbations

	u_e	v_e	w_e	$\dot{u}_e$	$\dot{v}_e$	$\dot{w}_e$
1	.11972834-02	-.49495360-04	.23048287-03	-.93503854-01	.86084448-01	.94745523-01
2	.75495842 00	.99795755-00	-.24402932-02	.24134579 03	.43356849 03	-.60352214 00
3	-.43899843-05	.48765073-07	.15374863-04	-.90509047-01	-.84717076-01	.68708875-01
4	-.58281832-03	-.97063782-03	.15447860-04	-.20646750 00	-.35508635 00	.32198093-02
5	.13546996-04	-.14301608-05	-.41878320-05	.75907654-02	.15131412-01	-.24899556-03
6	-.44850175-08	-.18866933-08	.11552510-05	-.70070861-04	-.35689089-04	.63060649-04
7	-.11563862 01	-.17111033 00	.55729828-03	-.44984356 03	-.77005248 02	.30222753 01
8	.96005130 00	.97964317-01	-.24759008-02	.32157748 03	.22658842 02	-.10953623 01
9	.88503684-05	.11410623-04	-.91567196 00	.43580811-01	-.14404137-01	-.41792761 03
10	-.14114553-02	-.96260337-03	.15600503-04	-.13646188 01	-.54156708 00	.43317563-02
11	.93939740-04	.38162811-03	-.40061529-05	.19643976 00	-.88524019 00	.47829482-04
12	-.28889251-08	.11822024-08	.38578248-03	-.78778356-04	-.35127401-04	-.91635825 00
13	.15293812-02	-.13175828-04	-.50095359-05	.46623731 00	.59965242 00	-.45500594-02

	u_a	v_a	w_a	$\dot{u}_a$	$\dot{v}_a$	$\dot{w}_a$
1						
2						
3						
4						
5						
6						
7	.11578968 01	.17117298 00	.11963995-03	.44763706 03	.77031427 02	-.98020631-01
8	-.20524078 00	.89991414 00	-.62371093-04	-.80183773 02	.41089736 03	.12655169-01
9	-.17042251-04	-.11449099-04	.91558203 00	.86034852-03	-.19697037-01	.41786667 03
10	.83015261-03	-.80296020-05	.41506565-06	.11565291 01	.18615345 00	.17660575-04
11	-.80760655-04	-.38337142-03	-.16554546-06	-.18982871 00	.90015273 00	-.68691082-04
12	-.74262615-07	-.59903831-07	-.38508888-03	-.61666060-04	-.40034710-05	.91648690 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	-.33054143 00	-.10064505 03	-.44915935 00	-.62665659 03	-.12730704 06	-.37510163 03
2	.57562051 01	.29549487 04	.38687525 01	.54093531 04	.29040226 07	.38624539 04
3	.13811555 02	-.24886528 00	-.38972950 01	.18208067 05	-.23375150 03	-.48091836 04
4	-.95547857-03	-.36346915 01	.52494991-03	-.14554155 02	-.39656315 04	.60580852 01
5	-.11692410-02	.14923692 00	-.19977139-02	.53269903 00	.16115016 03	.26648192 00
6	.14355640 01	-.65564418-03	-.38061932 00	.18958016 04	-.26121021 00	-.48547515 03
7	.31058364 01	.16864328 05	.63568203 01	.38773569 04	.18163549 08	.90053588 04
8	.23279674 02	-.78319241 04	.21257901 01	.30752250 05	-.80667541 07	.15464374 04
9	.18034379 05	-.15803370-01	.76073799 04	.19370136 08	.91831416 01	.75568374 07
10	.16018075-01	.93028659 02	.21332015-01	.11597144 02	.10684461 06	.27351612 02
11	.93287879-01	-.37784264 02	-.43351449-02	.14627721 03	-.39751220 05	-.38036904 01
12	.97290916 02	-.53542332-03	.20241787 02	.11180707 06	-.43414689 00	.19611478 05
13	.46579461-01	.11912563 01	.96371297-02	.58593749 02	.10493164 04	.87890624 01

Table C-18 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	-.19101107 01	-.99099408 02	-.91951482 00	-.73333389 01	-.22861622 01	-.15495075 01
2	.79378487 01	-.51433182 04	.63161340 01	.13083832 02	.80999050 04	.10633358 02
3	.43233678 00	.68589223-01	-.35919212 01	.11788500 02	-.84337789 00	.25512310 00
4	-.21960093-01	.31294513 01	-.68247265-01	-.28885713-01	-.68790429 01	-.55703790-01
5	-.23474552-01	-.97958495-01	.38686763-03	-.83783844-02	.18857655 00	-.38284448-01
6	-.15530441-02	-.16500451-02	-.34217999 00	.13235989 01	-.14038749-02	.11413034-03
7	-.62632965 01	.18276458 05	-.89655843 01	-.83788277 01	-.13970406 04	-.78044383 01
8	.42084641 01	-.84646370 04	.11621630 01	.77043360 01	.60572562 03	.28937496 01
9	.43387805-01	.10959696 00	.76086187 04	.18033411 05	.14591386 00	.19383633 00
10	-.29405124-01	.10381864 03	-.74777232-01	-.37957061-01	-.10953498 02	-.71258141-01
11	-.15803409-01	-.17827048 02	.23113318-02	-.24498718-02	-.20108797 02	-.93605126-01
12	-.68672129-04	-.15222272-02	.20279163 02	.97177729 02	-.59145044-03	.15466864-03
13	.17742778-01	-.11919598 02	.10645667-01	.28388445-01	.13076427 02	.63874000-01

	DBX	DBY	DBZ	KS1	KS2	KS3
1	.36100850 03	-.88656124 00	-.10884039 03	-.13461412 04	.30987498 02	-.10600050 04
2	.31297028 05	.10146109 03	-.94140534 05	.19375285 06	.24625686 02	.10547548 07
3	-.28160815 00	-.23615236 01	-.16765708 01	-.13692743 02	-.96353753 02	-.29035377 02
4	-.13623445 02	-.13018804 00	.71532754 02	-.18858962 03	.53794570 01	-.88303833 03
5	-.21726925 01	.24574039-03	-.11791059 02	.10089399 02	.46940703-01	.48401728 02
6	-.14636753-02	-.49786575 01	-.11891735-02	-.60930646-01	-.72528927-01	.19086294-01
7	-.93232562 05	-.14642854 02	.16557731 05	-.45680597 06	.22372724 03	-.18894861 06
8	.48179650 05	.98902451 02	-.45069650 04	.27557179 06	-.82954152 02	.38703444 05
9	.75317618 00	.91149654 05	.14817858-01	-.15652861 02	-.55566380 01	-.29653429 02
10	-.46102590 03	-.13971499 00	.15052798 03	-.15582631 04	.52220119 01	-.19125742 04
11	.76002641 02	-.32150019-02	.39916870 03	.23967513 03	-.88255656-01	-.53551790 04
12	-.20338919-03	.41301386 03	.41722790-04	-.44454591-01	-.10272957 00	-.34494198-01
13	.72290292 02	.35735609 00	-.24697417 03	.45674642 03		.32704671 04

	ISP	WTFLO	WT	DTGO
1	.16394255 04	.20636440 03	-.63091776-01	-.15217666 02
2	.12424922 07	.27279126 06	-.14295067 03	.18298294 03
3	.24580380 01	.11258934 01	-.13320995-03	-.35792591 00
4	-.98645132 03	-.21187730 03	.11437513 00	-.13153987 01
5	.30536461 02	.51233864 01	-.35902534-02	.19927428 02
6	.16167061-02	-.17791528-02	-.77641924-06	-.65007019-03
7	.16079059 04	.24460097 03	-.65025542-01	-.11781648 02
8	.12424817 07	.27277871 06	-.14295233 03	.18044697 03
9	.31545632 01	.79575875-01	-.50367045-03	.98968966-01
10	-.98642622 03	-.21186858 03	.11435672 00	-.13155501 01
11	.30397272 02	.50826657 01	-.35931421-02	.19927308 02
12	.50241086-03	-.11353022-02	-.83709801-06	-.17950101-03
13	.37748718 04	-.34770813 04	.51090576 00	-.11551921 02

Table C-19. Sensitivity Matrix for 180° Direct, In-Plane Transfer, Orbit Plane Coordinates, - 5 Sigma Perturbations

	u_e	v_e	w_e	$\dot{u}_e$	$\dot{v}_e$	$\dot{w}_e$
1	.16491764-02	.45061146-03	.23011628-03	-.20847107-02	.11814185 01	.46720816 00
2	.76878005 00	.99851497 00	-.40083809-02	.24255850 03	.43353178 03	.26900271-01
3	.17996914-05	-.14515476-05	.80622930-05	.16281823-01	-.10324298-01	.49547295-01
4	-.55576782-03	-.96714488-03	.10800548-04	-.20466796 00	-.22700317 00	.31367114-01
5	-.56180122-06	-.60327898-06	-.22781467-05	.17017806-02	.21596224-02	.14969444-03
6	.88741437-08	.29716087-07	.10546550-05	-.16760750-03	-.39264714-04	.15823260-03
7	-.11554484 01	-.17090774 00	-.80116538-04	-.44571064 03	-.74470304 02	-.72573112 00
8	.97413811 00	.98611677-01	-.39311292-02	.32292037 03	.22550652 02	.34523086 00
9	.82649493-05	.86933015-05	-.91567361 00	-.27843344-01	-.71937025-02	-.41789013 03
10	-.13839295-02	-.95882675-03	.10697134-04	-.13608017 01	-.41268399 00	.31000540-01
11	.80445427-04	.38247977-03	-.22345345-05	.19324081 00	-.89799926 00	-.34299694-04
12	.12727946-07	.25245053-07	.38562897-03	-.17858027-03	-.26964919-04	-.91640725 00
13	.15548085-02	-.11598142-04	-.10353177-04	.46471052 00	.61046425 00	.27368247-02

	u_a	v_c	w_a	$\dot{u}_a$	$\dot{v}_a$	$\dot{w}_a$
1						
2						
3						
4						
5						
6						
7	.11578638 01	.17136798 00	.12559605-03	.44755230 03	.77115128 02	-.59621613-01
8	-.20553358 00	.89981989 00	-.54220193-04	-.80318356 02	.41090173 03	.72497709-02
9	-.25291013-04	-.22422369-04	.91557042 00	-.22432233-01	.29358427-02	.41788558 03
10	.83020570-03	-.82777435-05	.52092607-06	.11563647 01	.18632011 00	-.57362745-05
11	-.81012640-04	-.38358649-03	-.19822381-06	-.19015909 00	.90012707 00	.55085566-05
12	-.10399409-06	-.95223410-07	-.38516406-03	-.17462538-04	-.65768425-05	.91650306 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	-.48250352 01	-.92310181 02	-.18068584 01	-.46122032 04	-.12447260 06	-.15230507 04
2	.90131649 01	.29877458 04	.51120154 01	.10345322 05	.29361662 07	.53440137 04
3	.79520804 01	.14466409-01	-.26534988 01	.14134686 05	-.82964308 01	-.33414496 04
4	-.29417458 00	-.33456540 01	-.21917740-01	-.27628678 03	-.39507105 04	-.79933491 01
5	.60949829-02	.64501778-01	.10738451-02	.62735808 01	.88146923 02	.57495273 00
6	.81282548 00	-.21162230-03	-.26463494 00	.14074332 04	-.18215469 00	-.33384978 03
7	.19226153 01	.16868988 05	.11757153 02	.41149549 04	.18165718 08	.14913131 05
8	.38871232 02	-.77902888 04	.30531928 01	.51072404 05	-.80187589 07	.26744752 04
9	.18016742 05	.15671677-01	.76091386 04	.19355043 08	.14367364 01	.75546317 07
10	-.26492183 00	.93103291 02	.14158923-01	-.23357076 03	.10658878 06	.29082035 02
11	.16683689 00	-.37803992 02	-.45742850-02	.24061667 03	-.39737112 05	-.40827014 01
12	.96439028 02	-.29177741-03	.20374521 02	.11102490 06	-.21983482 00	.19785506 05
13	.65853720-01	.13867830 01	.11885794-01	.94351032 02	.12508837 04	.12892688 02

Table C-19 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	-.26460037 02	-.94144024 02	-.11494642 02	-.58606039 01	-.22666154 02	-.11433650 02
2	-.39543850 01	-.51296284 04	-.27129375 01	.23561054 01	.81152321 04	.28035609 00
3	.49812382 00	-.59667247 00	-.32117528 01	.99152633 01	-.30268662 00	.51959000 00
4	-.22512010 01	.42090543 01	-.10009811 01	-.17854840 00	-.76949415 01	-.13631794 01
5	.14922220-01	.30372006-01	-.35973905-03	.10226277-01	.38847624-01	-.50686108-02
6	-.84294302-03	-.24631517-02	-.26105883 00	.10278411 01	-.51824432-04	-.11889083-02
7	-.24230843 02	.18269822 05	-.11565198 02	-.33174936 01	-.13756664 04	-.42464364 01
8	-.63033356 00	-.84527555 04	.13430986 01	.64836751 01	.62461854 03	-.21974724 01
9	-.29311682 00	-.20073016 00	.76091976 04	.18018862 05	-.63332222-02	-.15918725 00
10	-.22538222 01	.10465039 03	-.99656093 00	-.17920233 00	-.11754408 02	-.13651382 01
11	.46295453-01	-.17695628 02	.33689468-01	.19815502-01	-.20259429 02	-.20739940-01
12	-.11529222-02	-.16436777-02	.20378899 02	.96653596 02	.17070591-04	-.64271668-03
13	-.10648143 00	-.11842865 02	-.51111087-01	.10648143-01	.13124901 02	-.53240715-01

	DBX	DBY	DBZ	KS1	KS2	KS3
1	.37939515 03	-.29278639 02	-.18506895 03	-.10854019 04	-.71466109 03	-.11220193 04
2	.31503544 05	.15227985 03	-.94291812 05	.19434780 06	-.19981768 03	.10542666 07
3	.25945527 00	-.19884483 02	.33992435 00	.14862959 02	-.10660740 02	.10509015 02
4	-.11048830 02	-.18760224 01	.64515860 02	-.14191749 03	-.63342635 02	-.90853223 03
5	-.17220246 01	.21677319-01	-.10408708 02	.28567880 01	-.17269508 00	.19323785 02
6	-.74962167-03	-.69819169 01	.15725889-03	-.83403291-01	-.29965622-01	-.85785568-02
7	-.93118452 05	-.20888363 02	.16545946 05	-.45302048 06	-.64607880 03	-.18857133 06
8	.48402266 05	.15584891 03	-.46581869 04	.27606443 06	.23455361 02	.39639730 05
9	.96718918-01	.91130907 05	-.47289929-01	-.17738520 02	.87674065 00	.12089097 02
10	-.45839227 03	-.18767597 01	.14362740 03	-.15112803 04	-.63081214 02	-.19363968 04
11	.76570993 02	.46563549-01	.40055063 03	.23427564 03	.13355516 01	-.53697986 04
12	.15205601-03	.41101113 03	-.92514490-03	-.41448814-01	-.22417582-01	.15795771-01
13	.71847259 02	.48585199 00	-.24868789 03	.45581054 03	-.30517578 01	.32843017 04

	ISP	WTFLO	WT	DTGO
1	.25044930 04	.16874045 03	-.20830647 00	-.11484897 02
2	.12546033 07	.27284245 06	-.14317103 03	.19491911 03
3	-.41143883 01	.24620594 00	.70946763-03	.16030626 00
4	-.90976230 03	-.19945438 03	.10179291 00	-.12329667 01
5	.38020984 00	-.12678097 00	.58523965-03	.19904709 02
6	-.41988492-02	.76026879-03	.55909520-06	.99498619-04
7	.26018649 04	.17744508 03	-.17752199 00	-.11797908 02
8	.12545805 07	.27284246 06	-.14317039 03	.19546806 03
9	-.39564243 01	-.10051368 01	.23709094-03	-.13796443 00
10	-.90967696 03	-.19945018 03	.10179133 00	-.12333934 01
11	.28455199 00	-.12802355 00	.60508688-03	.19904340 02
12	-.41488853-02	-.24457196-03	.76670719-06	-.13211917-03
13	.38134268 04	-.34781801 04	.50892655 00	-.11551514 02

Table C-20. Sensitivity Matrix for 180° Direct, Out-of-Plane Transfer, Orbit Plane Coordinates, + 3 Sigma Perturbations

	u_e	v_e	w_e	$\dot{u}_e$	$\dot{v}_e$	$\dot{w}_e$
1	-.25519161-02	-.29320346-03	-.13868009-02	-.14399818 01	-.22238981 00	-.63592737 00
2	.76632451 00	.99622182 00	.30197458 00	.24797269 03	.43083418 03	.91923951 02
3	-.19404528-03	.12721285-03	.14500614-04	.57851316 00	.53233023-01	-.45601331 00
4	-.51741137-03	-.95954960-03	-.20682090-03	-.14719064 00	-.25827128 00	-.11841619-01
5	-.39580096-04	-.11840940-04	.49053527-06	.18301347-01	.20486717-01	.65357556-02
6	-.24413641-04	.30797129-05	.47555044-05	.66367532-01	-.26674881-02	-.54378611-01
7	-.11598236 01	-.16893388 00	-.18340941-01	-.44114639 03	-.78569450 02	-.81985326 01
8	.96859094 00	.95657511-01	.30505830 00	.32583776 03	.19933757 02	.93281759 02
9	.19094428-01	.64028603-04	-.91557249 00	.80444372 01	.39241708-01	-.41830737 03
10	-.13462120-02	-.95163984-03	-.20954248-03	-.13029711 01	-.44312245 00	-.29574618-01
11	.39928775-04	.37088203-03	.15448716-06	.20617923 00	-.88052729 00	.10737566-01
12	-.20276296-04	.33309128-05	.38926050-03	.83672998-01	-.26427715-02	-.97093394 00
13	.15337444-02	-.13166191-04	.78826129-03	.45402359 00	.58215131 00	.19331404 00

	u_a	v_a	w_a	$\dot{u}_a$	$\dot{v}_a$	$\dot{w}_a$
1						
2						
3						
4						
5						
6						
7	.11577928 01	.16896319 00	.16808531-01	.44762631 03	.75981296 02	.75393385 01
8	-.20239403 00	.90048930 00	-.30527358-02	-.79161494 02	.41110446 03	-.13820991 01
9	-.19299585-01	.57159691-04	.91553917 00	-.76502842 01	.24075786-01	.41785786 03
10	.82883260-03	-.78309648-05	.23989575-05	.11567029 01	.18345710 00	.18577667-01
11	-.79866321-04	-.38259714-03	.51766447-06	-.18747649 00	.90063546 00	-.30472159-02
12	-.41145141-05	-.19651325-06	-.38456857-03	-.17435777-01	.52001664-04	.91632628 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	-.77075133 01	-.92053131 02	-.15076404 02	-.10867210 05	-.11889596 06	-.19365981 05
2	.11280255 04	.29848886 04	-.82864075 01	.11616295 07	.29361551 07	.23549893 05
3	.32129583 01	-.76750171 00	-.16300293 01	.42877113 04	.65289758 03	-.13926447 04
4	-.78165080 00	-.35980410 01	.11563704 00	-.72732690 03	-.40899901 04	-.80119929-02
5	-.39143519-01	.91766718-01	-.30988592-02	-.47508113 02	.10793568 03	.40449954 01
6	.47084186 00	-.17848850 00	-.26046907 00	.62787723 03	.27849661 02	-.25972160 03
7	-.23235588 01	.16612024 05	-.16879653 04	.38585506 05	.17901742 08	-.15761774 07
8	-.64550143 03	-.77751474 04	.28570512 03	-.50005537 06	-.80145631 07	.29668894 06
9	.17744088 05	-.31582425 03	.76678197 04	.19079303 08	-.33726223 06	.76137813 07
10	.90141144 00	.92714977 02	-.15761121 00	.15115747 04	.10653440 06	.13889737 04
11	-.12761429 00	-.37558929 02	-.41827951-01	.15052968 04	-.39516780 05	-.35127626 03
12	.96048767 02	-.18706894 01	.20186952 02	.11044125 06	-.19125903 04	.19549994 05
13	.41064881 00	.11500308 01	-.42885228 00	.47412109 03	.99414062 03	-.37500000 03

Table C-20 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	-.21712551 01	-.49342862 02	.18043187 02	-.52422457 01	-.14423513 02	.20587798 02
2	.10331113 04	-.51214191 04	-.10339243 04	-.79956425 03	.81159095 04	.19295390 04
3	.30192162 01	-.13278049 02	-.69721321 01	.15213657 02	-.62343988 01	.64850455 01
4	.16865665 01	.51995658 01	.25904125 01	.94933794 00	-.42100319 01	.59586565 00
5	.11176594 00	-.36675992 00	-.11694055 00	-.34973875-02	.42328302 00	.64502618-02
6	.28613167 00	-.19814201 01	-.11310930 01	.19189454 01	-.83421770 00	.71658470 00
7	-.17574433 04	.18075050 05	.20913510 03	.33299083 03	-.13517729 04	-.28551540 03
8	.13414554 04	-.83511705 04	-.10695072 04	-.85850249 03	.59202403 03	.22912589 03
9	.33314436 02	-.32935928 03	.76311030 04	.17754342 05	-.70699093 01	.54199807 01
10	.10512276 01	.10553068 03	.30016381 01	.26941044 01	-.81826576 01	.55918126 00
11	.15543303 00	-.17824728 02	-.20137328 00	-.29292888 00	-.19675330 02	.31652774 00
12	.28617605 00	-.36735250 01	.19314996 02	.97501203 02	-.83516620 00	.71815652 00
13	.25301201 01	-.11362475 02	-.29736896 01	.37259833 00	.12384459 02	.32646711 00

	DBX	DBY	DBZ	KS1	KS2	KS3
1	.16221215 03	.80392147 01	.34656236 03	-.89430417 03	.47873370 03	-.41788202 04
2	.31769381 05	-.73099697 04	-.94723660 05	.19908028 06	.21287146 05	.10456391 07
3	.15369947 02	-.15772912 02	.36274672 01	.20590428 03	-.73989073 02	.55018706 03
4	-.12057059 02	.81962550 01	.61651221 02	-.26246442 02	.98646751 02	-.56030500 03
5	.12150944 01	-.54511440 00	-.38495405 01	.18082609 02	.15332685 01	.12003831 03
6	.18904791 01	-.57332467 01	-.31108385 00	.20407749 02	-.17157267 02	.70010362 02
7	-.93342204 05	.16835807 04	.16859241 05	-.45238370 06	-.47726004 03	-.18358423 06
8	.48410480 05	-.76234235 04	-.50556916 04	.27939803 06	.21577712 05	.44587480 05
9	.16329268 04	.91118805 05	.10858541 02	.79825651 04	-.98901601 05	.36946315 03
10	-.45955798 03	.15876705 02	.13959370 03	-.13846983 04	.97961232 02	-.15714371 04
11	.78364969 02	-.19489963 01	.40730593 03	.24492805 03	.10316109 01	-.52681559 04
12	.93312725 01	.41219694 03	-.27317061 00	.41760071 02	.12450309 01	.69570137 02
13	.68745192 02	-.10439225 02	-.24458653 03	.45023600 03	.80566405 02	.31351725 04

	ISP	WTFLO	WT	DTGO
1	-.61214045 04	-.21707081 04	.83091383 00	-.11884549 02
2	.12148066 07	.26880050 06	-.14265310 03	.12395332 03
3	-.21860336 03	-.12519391 03	.16433061-01	-.22701987 02
4	-.73080443 03	-.89920479 02	.80488404-01	-.17019698 01
5	.84838761 01	.10069282 02	-.13283988-02	.19672490 02
6	-.14054705 02	-.94723031 01	.76721034-03	-.36898113 01
7	-.61260571 04	-.21305380 04	.85051262 00	-.11051144 02
8	.12147943 07	.26878139 06	-.14265275 03	.12328688 03
9	-.22325865 03	-.12733423 03	.16056430-01	-.23168478 02
10	-.73082414 03	-.89930516 02	.80480019-01	-.17019698 01
11	.83376390 01	.10012313 02	-.13162407-02	.19672490 02
12	-.14082039 02	-.94752887 01	.76961659-03	-.36898113 01
13	.36889282 04	-.34903564 04	.51243164 00	-.11551921 02

Table C-21. Sensitivity Matrix for 180° Direct, Out-of-Plane Transfer, Orbit Plane Coordinates, - 3 Sigma Perturbations

	u_e	v_e	w_e	$\dot{u}_e$	$\dot{v}_e$	$\dot{w}_e$
1	-.28153458-02	.37285515-03	-.97355705-03	-.24733405 01	-.10614652 01	-.85318496 00
2	.77844697 00	.99834212 00	.29706940 00	.24344513 03	.42775387 03	.94440865 02
3	.33125473-03	.17078030-03	.15296329-03	-.60716981-01	.12171935 01	.38478409 00
4	-.60939643-03	-.97631290-03	-.20278343-03	-.38184217 00	-.39892032 00	-.30626488-01
5	-.38026093-04	-.11528050-04	-.45192481-06	.17364097-01	.23369047-01	.93456211-02
6	.48495409-04	.10317198-04	.22407456-04	.16367479-02	.15357259 00	.50559780-01
7	-.11608830 01	-.16029618 00	-.17832789-01	-.45264371 03	-.78335916 02	-.51755096 01
8	.98092351 00	.97889075-01	.30011775 00	.32333767 03	.17008305 02	.95110665 02
9	.19654552-01	.12349808-03	-.91540653 00	.77155380 01	.12231028 01	-.41751854 03
10	-.14377330-02	-.96784844-03	-.20538104-03	-.15368559 01	-.58240082 00	-.49571955-01
11	.42043306-04	.37134757-03	-.93917902-06	.20587192 00	-.87658840 00	.10711834-01
12	.52690219-04	.10545180-04	.40691983-03	.19114108-01	.15354814 00	-.86592293 00
13	.15636129-02	-.91519671-05	.77643956-03	.45272960 00	.58849475 00	.19756416 00

	u_a	v_a	w_a	$\dot{u}_a$	$\dot{v}_a$	$\dot{w}_a$
1						
2						
3						
4						
5						
6						
7	.11581541 01	.16881612 00	.16973369-01	.44766372 03	.76021523 02	.74099293 01
8	-.20253555 00	.90036353 00	-.31325973-02	-.79165689 02	.41109995 03	-.13675900 01
9	-.19384445-01	.40108174-04	.91545067 00	-.76393523 01	.35830725-01	.41782[illegible]
10	.82990408-03	-.83920596-05	.30840571-05	.11566298 01	.18355963 00	.18716027-01
11	-.80109017-04	-.38327666-03	.24384688-06	-.18726097 00	.90063146 00	-.31668871-02
12	-.42223882-05	-.30352725-06	-.38497028-03	-.17492722-01	.63143294-04	.91636764 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	-.12371888 02	-.94985224 02	-.15975789 02	-.16072634 05	-.12243666 06	-.21131164 05
2	.11395511 04	.29993767 04	-.58224053 01	.11756856 07	.29502499 07	.28953240 05
3	.27453855 01	.22890112 00	-.24722130 01	.78434412 04	.42845510 03	-.15194334 04
4	-.15129144 01	-.42357829 01	-.56411736 00	-.17135544 04	-.44607197 04	-.59310239 03
5	-.35203499-01	.96273575-01	-.63063798-02	-.36625058 02	.11396668 03	.48048966 01
6	.45592407 00	.25020435-01	-.34172168 00	.11625523 04	.31680359 02	-.23414627 03
7	-.22718961 02	.16601050 05	-.16958182 04	.22554777 05	.17895476 08	-.15750498 07
8	-.59473251 03	-.77238204 04	.29058269 03	-.43499690 06	-.79517132 07	.30201826 06
9	.17743005 05	-.31418459 03	.76708472 04	.19081789 08	-.33734430 06	.76176722 07
10	.19997558 00	.92152438 02	-.79766387 00	.57073153 03	.10626961 06	.91841978 03
11	.69971886-01	-.37379697 02	-.52567162-01	.17933300 04	-.39258797 05	-.35219802 03
12	.96033903 02	-.16681230 01	.20106093 02	.11097276 06	-.19103042 04	.19567773 05
13	.48613966 00	.12533623 01	-.42135673 00	.61767577 03	.11259765 04	-.35986328 03

Table C-21 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	.50164906 01	-.73026333 02	-.78614957 01	-.13642556 02	-.37479280 02	-.14180204 02
2	.10273248 04	-.51177315 04	-.10391624 04	-.79269170 03	.81250154 04	.19282107 04
3	.38423036 01	-.91310576 01	.59581515 01	.53025791 00	.24500188 01	-.40334654 01
4	-.62085446 00	.77182203 00	-.17485040 01	.41143405 00	-.68769280 01	-.43120468 01
5	.10530061 00	-.35488891 00	-.10096236 00	-.27328083-01	.45326593 00	-.31138859-01
6	.60842745 00	-.11083248 01	.84767531 00	.14711410 00	.40827459 00	-.44353512 00
7	-.18987672 04	.17972581 05	.95180008 02	.30080200 03	-.15037274 04	-.37519595 03
8	.13614296 04	-.83360771 04	-.10593025 04	-.84570248 03	.62218495 03	.23575659 03
9	.36287568 02	-.32302293 03	.76472303 04	.17740418 05	.39426219 01	-.30052492 01
10	-.12924235 01	.10109125 03	-.13587601 01	.21468649 01	-.10879612 02	-.43556884 01
11	.11783027 00	-.17790154 02	-.17105045 00	-.31086521 00	-.19666489 02	.29162245 00
12	.60803877 00	-.28012345 01	.21296302 02	.95723091 02	.40760147 00	-.44477986 00
13	.26720623 01	-.11366023 02	-.28565872 01	.25194744 00	.12586727 02	.63874000-01

	DBX	DBY	DBZ	KS1	KS2	KS3
1	.14118115 03	-.35128405 01	.34210456 03	-.27995677 04	-.21476720 03	-.55844767 04
2	.32003269 05	-.71341474 04	-.94507356 05	.19785483 06	.21506734 05	.10459404 07
3	.16963947 02	-.15525230 02	.15659155 02	.18098662 03	-.52181442 03	.45780720 03
4	-.15879945 02	.44423292 01	.58524551 02	-.28137886 03	-.78733495 01	-.81909266 03
5	.13227041 01	-.48002985 00	-.46370721 01	.18211988 02	.13357135 01	.12053877 03
6	.24329534 01	-.52786934 01	.17151023 01	.29223237 02	-.66685883 02	.66200218 02
7	-.93472293 05	.15834322 04	.16730282 05	-.46008169 06	-.24870525 04	-.19067890 06
8	.48666028 05	-.74275930 04	-.48182003 04	.27924195 06	.21903554 05	.46046124 05
9	.16383300 04	.91122003 05	.25997087 02	.81180828 04	-.99294220 05	.38073185 03
10	-.46339424 03	.12114858 02	.13644658 03	-.16407696 04	-.87911944 01	-.18311171 04
11	.78461100 02	-.18490104 01	.40651746 03	.24478752 03	.19746500 01	-.52681534 04
12	.98750517 01	.41265192 03	.17504915 01	.50589886 02	-.48340572 02	.65785707 02
13	.69447254 02	-.98320363 01	-.24395088 03	.44840494 03	.71818032 02	.31304932 04

	ISP	WTFLO	WT	DTGO
1	-.64080406 04	-.25284944 04	.80091123 00	-.10741872 02
2	.12406711 07	.26995410 06	-.14246466 03	.12353399 03
3	-.50723626 02	-.33000828 01	.13913851-01	-.24131991 02
4	-.76147561 03	-.10365489 03	.79761696-01	-.17027368 01
5	.14238221 02	.10933970 02	-.11822625-02	.19674530 02
6	.44901577 01	.66679018 01	.49356404-03	-.36889845 01
7	-.64714391 04	-.26676101 04	.77385454 00	-.10169400 02
8	.12406825 07	.26997882 06	-.14245492 03	.12404282 03
9	-.51237150 02	-.10712600 01	.15159874-01	-.23254660 02
10	-.76142323 03	-.10368837 03	.79752739-01	-.17034468 01
11	.14146153 02	.10913067 02	-.11641969-02	.19673913 02
12	.44767532 01	.66583917 01	.49400239-03	-.36893707 01
13	.37500671 04	-.35110412 04	.51277588 00	-.11551921 02

Table C-22. Sensitivity Matrix for 220° Direct, In-Plane Transfer, Orbit Plane Coordinates, + 3 Sigma Perturbations

	u_e	v_e	w_e	$\dot{u}_e$	$\dot{v}_e$	$\dot{w}_e$
1	.12575493-02	.27118641-03	-.16570186-03	.35941142 01	.34427066 01	-.15238842 01
2	.75041916 00	.99641381 00	.59150062-02	.24539552 03	.43322053 03	.58289342 00
3	.10508017-04	-.14183341-04	.10103839-04	-.27931766 00	-.16439833-01	.94778333-01
4	-.55723991-03	-.95424709-03	-.42829799-05	-.11063818-01	-.16173416 00	-.17716918 00
5	.51476378-05	-.31847981-06	.32951600-07	-.71193885-03	.11628243-04	.14025435-03
6	.16577711-05	-.72121832-06	.10094110-05	-.16113495-01	-.97301405-03	.63760972-02
7	-.11564205 01	-.17124180 00	-.43502217-04	-.44709014 03	-.76515422 02	-.14134897 01
8	.95597052 00	.96366212-01	.58531411-02	.32636868 03	.22902384 02	.88099757 00
9	.21266558-04	-.11039306-04	-.91573145 00	-.11645816 00	.23289144-01	-.41785063 03
10	-.13862299-02	-.94633334-03	-.42742880-05	-.11690534 01	-.35058724 00	-.17671661 00
11	.85572627-04	.38229030-03	-.13517484-06	.18743900 00	-.90262822 00	.13889992-02
12	.16989671-05	-.71894556-06	.38557044-03	-.16058180-01	-.87694671-03	-.91016393 00
13	.15116688-02	-.17433975-04	.15301651-04	.48317383 00	.61500730 00	-.49001683-02

	u_a	v_a	w_a	$\dot{u}_a$	$\dot{v}_a$	$\dot{w}_a$
1						
2						
3						
4						
5						
6						
7	.11574007 01	.17161765 00	-.65375723-04	.44757046 03	.77157512 02	-.41507130-01
8	-.20552145 00	.90000704 00	.22489488-04	-.80340635 02	.41089135 03	-.63706378-01
9	.29901493-05	.10879042-04	.91568136 00	.66045522-01	-.17432818-01	.41788709 03
10	.82873859-03	-.78279039-05	-.28427205-06	.11563014 01	.18630240 00	.14409542-04
11	-.80973694-04	-.38260345-03	.79932490-07	-.19022281 00	.90013119 00	.33723019-04
12	.67806592-08	.53683626-07	-.38462682-03	-.19225035-04	-.31030460-04	.91648186 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	.36385926 01	-.91417568 02	-.17000043 01	.44691555 04	-.11946523 06	.51272523 04
2	-.28729441 02	.29965860 04	-.12695311 02	-.26071110 05	.29394806 07	-.11806882 05
3	.13094131 02	-.44242175-01	-.33454529 01	.18831791 05	-.91520162 02	-.37991874 04
4	.32209906 00	-.30696852 01	-.11677866 00	.30520420 03	-.33011662 04	.31295117 03
5	-.30969934-02	.61394718-01	-.28419308-02	-.76115949 01	.81575710 02	-.30631600 01
6	.13029850 01	.20349433-02	-.30411058 00	.18615779 04	.39366139 01	-.36608872 03
7	-.87982385 00	.16824905 05	-.69041963 01	-.26772793 04	.18122552 08	-.74924109 04
8	-.44581221 02	-.78259681 04	-.11235716 02	-.51022027 05	-.80758809 07	-.92165242 04
9	.17998403 05	.37292161-01	.76127322 04	.19338871 08	.79768828 02	.75576923 07
10	.30428663 00	.93253669 02	-.13442931 00	.27891186 03	.10709800 06	.29324480 03
11	-.96615476-01	-.38065117 02	-.21071251-02	-.14717652 03	-.40109846 05	-.14595103 01
12	.96932610 02	.19479435-02	.20351257 02	.11150585 06	.38148778 01	.19772419 05
13	-.70672286-01	.13320655 01	-.33194558-01	-.78613279 02	.11557617 04	-.15136719 02

Table C-22 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	.23855499 02	-.94226922 02	.32207727 02	.14095313 02	.44420390 02	.12877622 02
2	.12070542 01	-.51303690 04	-.25156317 02	-.25989531 02	.81301709 04	-.10054529 01
3	-.28205094 01	.63673652 00	-.49041767 01	.10662328 02	-.65696815 00	-.29888474 01
4	.80119661 00	.24722612 01	.21917391 01	.16527073 01	-.50929154 01	.46870077 00
5	-.24025362-01	.14577728-01	-.16283586-01	-.79871673-02	-.13927837-01	-.12550685-02
6	-.19053095 00	.14973947 00	-.39627278 00	.11539788 01	.43180292-01	-.25427166 00
7	.16238690 02	.18186323 05	.27977520 02	.21318761 02	-.13850441 04	.10247215 02
8	-.28830401 01	-.84404051 04	-.19750283 02	-.24907772 02	.65215302 03	.15423210 01
9	-.14051695 01	.15854762 01	.76122055 04	.17997293 05	.93434852 00	-.22020937 01
10	.79890783 00	.10289895 03	.21921968 01	.16512322 01	-.91732110 01	.46772261 00
11	-.67999850-01	-.17749966 02	-.12286479-01	-.13525996-01	-.20299315 02	.16606975-01
12	-.19099193 00	.14918729 00	.20260433 02	.96784054 02	.43383841-01	-.25290057 00
13	.53228333-01	-.11816690 02	.35485555-01	.70971110-02	.13285792 02	—

	DBX	DBY	DBZ	KS1	KS2	KS3
1	.40208314 03	.18348423 02	-.21914561 03	-.14795806 03		.28236151 04
2	.31132827 05	-.24215558 03	-.94555272 05	.19362261 06		.10530929 07
3	-.29488443 01	-.60695352 01	-.62849026 00	.33763746 02		-.55684574 01
4	-.97797563 01	.52803171 00	.62276738 02	-.18050661 03	-.50454499 02	-.75148961 03
5	-.17641069 01	-.23092376-01	-.89757519 01	.15762724 01	-.13212809 01	.15061594 02
6	-.11289746 00	-.55797350 01	.65048366-02	.19407829 01	.18522275 01	.47009595 01
7	-.93161272 05	-.51093640 01	.16405225 05	-.45459011 06	-.93624993 03	-.18618325 06
8	.48052525 05	-.23344944 03	-.49143990 04	.27548973 06	.23066326 02	.40164807 05
9	-.11498671 01	.91146479 05	.12107176 01	.38657009 02	.42547007 02	.85277002 02
10	-.45716845 03	.51663464 00	.14136632 03	-.15503316 04	-.50886069 02	-.17797924 04
11	.76550646 02	-.38918370-01	.40191505 03	.23172049 03	-.16891779 01	-.53715297 04
12	-.11147489 00	.41241371 03	.52591258-02	.20088606 01	.18943468 01	.47646564 01
13	.70917790 02	-.56923979 00	-.24922899 03	.45633952 03	-.20345052 00	.32893880 04

	ISP	WTFLO	WT	DTGO
1	.12443766 04	.17775111 03	-.19862203 00	-.11097620 02
2	.12190098 07	.27193117 06	-.14333523 03	.19193744 03
3	-.92458051 01	-.18003244 01	-.13119575-02	-.14661061 00
4	-.90875988 03	-.20366901 03	.10563729 00	-.11917816 01
5	-.17235504 01	.70304412 00	-.22088397-04	.19911952 02
6	.29229371 00	.29530060 00	-.16249009-03	-.21215920-01
7	.12053733 04	.18680518 03	-.20785890 00	-.11252602 02
8	.12190053 07	.27193483 06	-.14333158 03	.19181437 03
9	-.43477209 01	.35830801 00	.26132649-04	.33515967 00
10	-.90873849 03	-.20368865 03	.10561541 00	-.11937128 01
11	-.18497695 01	.67020107 00	-.40791861-04	.19915661 02
12	.29331744 00	.29543753 00	-.16308844-03	-.20889741-01
13	.37282043 04	-.34505554 04	.50903808 00	-.11549886 02

Table C-23. Sensitivity Matrix for 220° Direct, In-Plane Transfer, Orbit Plane Coordinates, - 3 Sigma Perturbations

	u_e	v_e	w_e	$\dot{u}_e$	$\dot{v}_e$	$\dot{w}_e$
1	.19044037-02	.94942154-03	.58014950-03	.33971039 00	.55852094 00	.39069323 01
2	.75969760 00	.99692897 00	.17058122-02	.24083853 03	.43411748 03	.11838024 01
3	.57930023-05	.60310510-05	-.12205767-04	.12744783-01	-.96055755-01	-.18022839 00
4	-.54582282-03	-.94676008-03	.34707932-04	-.77850951-01	-.29224851 00	.27667552 00
5	-.51153510-05	-.89670048-06	-.36174116-05	.43084655-02	.29685422-02	-.12419614-02
6	-.45142468-07	.50200069-06	-.54246986-06	-.24698336-02	-.56668285-02	-.11452607-01
7	-.11552000 01	-.17056856 00	.81546687-03	-.44409613 03	-.75485980 02	.33291414 01
8	.96515779 00	.96985882-01	.16626898-02	.32022951 03	.22986293 02	.12964908 01
9	.20735974-05	.57730314-05	-.91570192 00	-.89778509-01	-.49148652-01	-.41800571 03
10	-.13739941-02	-.93839102-03	.34856914-04	-.12320059 01	-.47784648 00	.27644956 00
11	.75842891-04	.38189657-03	-.36580446-05	.19675044 00	-.89654086 00	-.27919794-02
12	-.38366589-08	.50093227-06	.38402247-03	-.25518072-02	-.56912689-02	-.92794233 00
13	.15411275-02	-.13640258-04	.40041676-05	.46531219 00	.60764362 00	.13288234-01

	u_a	v_a	w_a	$\dot{u}_a$	$\dot{v}_a$	$\dot{w}_a$
1						
2						
3						
4						
5						
6						
7	.11577710 01	.17146778 00	.10799513-03	.44747447 03	.77131426 02	.32784121-02
8	-.20568655 00	.89986834 00	-.52895823-04	-.80425137 02	.41086868 03	-.25406138-01
9	-.31377842-04	-.16031609-04	.91560186 00	-.62717584-01	-.36743547-01	.41788907 03
10	.82994331-03	-.83613695-05	.37808477-06	.11563779 01	.18639775 00	.64583177-04
11	-.81257644-04	-.38329332-03	-.16407675-06	-.19031235 00	.90001959 00	-.25002424-04
12	-.99253103-07	-.57707961-07	-.38502202-03	-.17488851-04	-.28866593-04	.91648300 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	.99519925 00	-.98442948 02	-.42987052 01	-.43439723 04	-.11967053 06	-.56838769 04
2	-.16175489 02	.30104348 04	-.16711440 02	-.12285306 05	.29587202 07	-.14801492 05
3	.14561711 02	.93717285 00	-.29847566 01	.15734553 05	.56812280 03	-.41231052 04
4	.57773302-01	-.35058072 01	-.40569112 00	-.26977565 03	-.34142167 04	-.29037920 03
5	.50268381-02	.66249576-01	.11938070-02	.75468615 01	.85792753 02	.54335031 01
6	.14189941 01	.73230263-01	-.29632077 00	.15441602 04	.35158415 02	-.40716510 03
7	.31575589 01	.16831652 05	.42003933 01	.32695752 03	.18138310 08	.42194092 04
8	.21591528 01	-.77798062 04	-.19057538 02	.96830261 04	-.80140730 07	-.16981054 05
9	.17999492 05	.66435192 00	.76126764 04	.19335344 08	.26260481 03	.75570440 07
10	.76866573-01	.92899590 02	-.37971680 00	-.24328300 03	.10709539 06	-.26397410 03
11	.10431067 00	-.37885234 02	-.44457493-02	.14879420 03	-.39856487 05	.18565744 00
12	.97048390 02	.73054876-01	.20360021 02	.11118821 06	.34970646 02	.19731230 05
13	.48185648-02	.14070210 01	-.46579461-01	.18066406 02	.12797851 04	-.40039062 02

Table C-23 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	-.27757200 02	-.11818181 03	-.20048480 02	-.27898620 02	-.13917879 02	-.21229187 02
2	.24121483 00	-.51101606 04	-.12363547 02	-.21095585 02	.81257327 04	.81932467 01
3	.29174225 01	.30033885 01	-.76898018 00	.18045192 02	-.91591785 00	.21383817 01
4	-.20114655 01	.20783958 01	-.18401531 01	-.19067016 01	-.70706940 01	-.16576661 01
5	.20479562-01	.56093733-01	.28335927-02	.22542950-01	.49481364-01	.92198905-02
6	.13212995 00	.14585297 00	-.14143432 00	.16414118 01	-.57999510-01	.91534734-01
7	-.28396612 02	.18190491 05	-.30905492 02	-.34473472 02	-.14029150 04	-.29215091 02
8	.20517493 01	-.84296903 04	-.12669705 02	-.19919421 02	.63206562 03	.61283450 01
9	.12100610 01	.75288036 00	.76137318 04	.18001243 05	-.11072269 01	.10060655 01
10	-.20092538 01	.10250950 03	-.18388963 01	-.19056164 01	-.11138752 02	-.16576661 01
11	.27027337-01	-.17672018 02	.28494632-02	.37851841-01	-.20267467 02	.92198905-02
12	.13163691 00	.14451823 00	.20515471 02	.97270924 02	-.58085247-01	.91534734-01
13	-.74519667-01	-.11859273 02	-.88713888-01	-.88713888-01	.13197078 02	-.46131222-01

	DBX	DBY	DBZ	KS1	KS2	KS3
1	.39667036 03	-.22140346 02	-.22235318 03	-.66303638 03	-.14039432 04	.11435790 04
2	.31366820 05	-.50897476 02	-.94385418 05	.19496726 06	-.23604668 03	.10537164 07
3	.82080200 00	-.17446307 01	.32197740 01	.21156810 03	.22004701 03	.17631666 03
4	-.10266818 02	-.69834629 00	.67832133 02	-.16820658 03	-.11704695 03	-.77777390 03
5	-.17163610 01	.44273916-01	-.98377569 01	.48003016 01	.36548141 00	.21346855 02
6	-.35335141-02	-.53510476 01	.18365811 00	.12714771 02	.14182850 02	.10168162 02
7	-.93167825 05	-.10103718 02	.16486026 05	-.45559448 06	-.14198730 04	-.18683338 06
8	.48289746 05	-.54524247 02	-.47516313 04	.27696203 06	.22292382 02	.39883427 05
9	-.42385491 00	.91147694 05	.22663021 01	.91669558 02	.11199743 03	.85787134 02
10	-.45762443 03	-.69861484 00	.14698004 03	-.15387229 04	-.11660562 03	-.18056130 04
11	.76662370 02	.42103397-01	.40109870 03	.23595814 03	.23491032 01	-.53691306 04
12	-.31192453-02	.41264177 03	.18121167 00	.12709390 02	.14226697 02	.10212999 02
13	.71572416 02	.12649773-01	-.24866608 03	.44962565 03	-.50862629 01	.32875569 04

	ISP	WTFLO	WT	DTGO
1	.25290984 04	.32768578 03	-.21103689 00	-.11981473 02
2	.12446572 07	.27286074 06	-.14315997 03	.19118399 03
3	-.10303019 02	-.66440383 01	.23041349-02	-.60346573-01
4	-.89649721 03	-.18949389 03	.10461772 00	-.11930006 01
5	-.12764762 01	-.16137524 01	.11821603-03	.19916277 02
6	-.21644936 00	-.53026302 00	-.85830058-05	-.20503245-01
7	.25698239 04	.41538589 03	-.24038158 00	-.11826491 02
8	.12446827 07	.27284928 06	-.14315383 03	.19130706 03
9	-.12748463 02	-.10073761 02	.51299808-03	-.54211686 00
10	-.89641322 03	-.18942850 03	.10460839 00	-.11923917 01
11	-.13572830 01	-.15899696 01	.12949648-03	.19914114 02
12	-.21831886 00	-.52789890 00	-.93631130-05	-.20859770-01
13	.37914123 04	-.34704834 04	.50935546 00	-.11551921 02

Table C-24. Sensitivity Matrix for Parking Orbit, In-Plane Transfer, Orbit Plane Coordinates, + 3 Sigma Perturbations

	u_e	v_e	w_e	$\dot{u}_e$	$\dot{v}_e$	$\dot{w}_e$
1	.86955366-04	-.52958669-03	-.10408057-03	.80688953 00	-.14295108 00	-.42883461 00
2	.72715787 00	.99660789 00	.28461407-02	.23214726 03	.42220502 03	.83146319 00
3	-.60397743-05	-.71632118-05	.20393807-04	-.35421508-01	-.69844625-01	.52554842-02
4	-.68945440-03	-.96474444-03	-.25944317-05	-.22992935 00	-.41379013 00	.15149574-02
5	.30329203-08	.40751679-05	-.10988485-06	.24977366-02	.31507950-02	-.89203346-03
6	.21229430-07	-.27530227-07	.11683274-05	.19429525-03	.10999873-03	.56819326-05
7	-.11572707 01	-.17180857 00	-.56878039-04	-.44733553 03	-.74910418 02	-.39457503 00
8	.93249051 00	.96572890-01	.28186455-02	.31283460 03	.11275548 02	.63966312 00
9	.45541472-05	-.23556406-05	-.91568760 00	.43026079-01	-.60882790-03	-.41791083 03
10	-.15183027-02	-.95714520-03	-.26515560-05	-.13861203 01	-.59886336 00	.11952628-02
11	.80683615-04	.38592872-03	-.23878543-06	.19382888 00	-.89429425 00	-.95699312-03
12	.11812002-07	-.29515194-07	.38587047-03	.13107296-03	.90159390-04	-.91645119 00
13	.15240024-02	-.21418897-04	.85279161-05	.46863027 00	.60711253 00	.12549357-02

	u_a	v_a	w_a	$\dot{u}_a$	$\dot{v}_a$	$\dot{w}_a$
1						
2						
3						
4						
5						
6						
7	.11574601 01	.17153421 00	-.40457558-04	.44740398 03	.77149445 02	.10239474 00
8	-.20533729 00	.89997317 00	.21873052-04	-.30235268 02	.41084360 03	-.54158286-01
9	.11616621-04	.14823781-04	.91564230 00	.25966939-01	.12074960-01	.41790975 03
10	.82894911-03	-.74142204-05	-.21201690-06	.11563217 01	.18632923 00	.33087555-04
11	-.80585551-04	-.38282032-03	.70430403-07	-.18997721 00	.90013492 00	.24293373-04
12	.30127560-07	.52858166-07	-.38481234-03	-.22061690-04	-.81570116-05	.91649774 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	.43599759 00	-.10524929 03	.85063517 00	.13740629 04	-.13355453 06	.21609190 02
2	-.61794747 01	.27718533 04	-.33238781 01	-.67516152 04	.27204882 07	-.31832187 04
3	.15518398 02	-.83899136-01	-.37520065 01	.18110239 05	-.12683495 03	-.52848037 04
4	.93115196-02	-.38755602 01	.41518731-02	.48116834 01	-.41947218 04	.68442353 01
5	-.17689051-02	.55884590-01	.36440209-03	-.35369438 01	.68581510 02	.14905756 00
6	.10413530 01	-.44107035-04	-.23873362 00	.12139825 04	.22050612 00	-.34468936 03
7	-.28846481 01	.16836960 05	-.87217455 01	-.54074091 04	.18115717 08	-.97953779 04
8	-.23633153 02	-.80522385 04	-.15176431 01	-.30168969 05	-.83032237 07	-.13106594 04
9	.18020999 05	-.35609866-02	.76119200 04	.19344896 08	.36361103 02	.75661082 07
10	-.73537522-02	.90751250 02	-.18149060-01	-.20340164 02	.10391458 06	-.16445309 02
11	-.90208909-01	-.38087658 02	.67822454-02	-.13482150 03	-.40139666 05	.70602747 01
12	.94970832 02	.11916391-04	.20765397 02	.10857890 06	.13673239 00	.20255230 05
13	-.48185649-01	.93854937 00	-.74955455-02	-.63964843 02	.76416015 03	-.87890624 01

Table C-24 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	-.10676824 01	-.90351960 02	.28440632 01	.82866329 01	.76625082 01	-.10676824 01
2	-.13029835 01	-.50780901 04	-.23236125 01	-.69013829 01	.78275677 04	-.13029835 01
3	-.68063966 00	-.15604245 01	-.48629389 01	.14762352 02	-.10826784 01	-.68063966 00
4	.12056889-01	.39442763 01	.20847450-01	.19857703-01	-.77160452 01	-.15702941-01
5	.71760320-03	.81041775-02	.79488401-02	.65992993-02	.45209704-01	.61020595-02
6	.33940475-02	.16780267-02	-.27051843 00	.10550049 01	.15662833-02	.34785500-02
7	.25814153 01	.18271430 05	-.99837206 00	-.90363017 01	-.13988184 04	-.40925411 01
8	-.25703182 01	-.83953990 04	-.30740180 01	-.25296932 01	.34287363 03	.75077163 00
9	.87116699 00	.48814588 00	.76119734 04	.18021561 05	.47560121 00	.13268211 00
10	.19178940-01	.10274825 03	.17146589-01	.14204527-01	-.11837565 02	-.11480561-01
11	.93611838-02	-.17394836 02	.20832358-01	.39824239-01	-.20567656 02	.47465501-01
12	.40921530-02	.44730827-03	.20734417 02	.94984532 02	.54082592-03	.29217641-02
13	-.70971110-02	-.12537047 02	-.14194222-01	-.24839889-01	.13441928 02	-.24839889-01

	DBX	DBY	DBZ	KS1	KS2	KS3
1	.41640610 03	.25543020 01	-.40279475 02	-.11507678 04	-.61213789 02	-.32115968 03
2	.30380510 05	-.99603104 02	-.90882064 05	.18556579 06	-.74704390 02	.10100524 07
3	-.10538405 01	-.72658771 02	.18288155 00	-.23173508 02	-.39023341 02	-.42513963 02
4	-.12155311 02	.10773769 00	.82419539 02	-.20174444 03	-.25655128 00	-.99824177 03
5	-.24904373 01	.23976132-02	-.13974769 02	.35336975 01	.65124178 00	.19654708 02
6	.41829946-02	-.12236702 02	.20211117-02	.14564238 00	.24189065 00	.36682193-01
7	-.93147343 05	.27643466 01	.16631526 05	-.45115009 06	.14800114 03	-.18830310 06
8	.47291387 05	-.94054803 02	-.12424141 04	.26667960 06	-.14736491 03	-.43393429 04
9	.33277542 00	.91078590 05	.61050811 00	.33990166 02	.49946907 02	.50114154 02
10	-.45953958 03	.10919587 00	.16150393 03	-.15881225 04	-.26297731 00	-.20071215 04
11	.75800441 02	.31646802-01	.39698301 03	.23911897 03	.11221215 01	-.52687103 04
12	.47343986-02	.40575213 03	.22931992-02	.15503873 00	.16516014 00	.58251349-01
13	.73251675 02	-.36368098 00	-.24774581 03	.45776367 03	-.81380208 00	.32476807 04

	ISP	WTFLO	WT	DTGO
1	-.11789581 04	-.74406803 02	-.42459191-01	-.20134681 02
2	.11701106 07	.25723858 06	-.13719004 03	.28991096 03
3	-.16227172 01	-.14498267 01	-.11503420-03	-.66103864 00
4	-.11192712 04	-.24816936 03	.13115510 00	-.12243012 01
5	.60654291-01	.93412340 00	-.14681102-03	.19702527 02
6	.62466408-02	.36862040-02	.18077605-05	-.48351624-05
7	-.11189683 04	-.93657902 02	-.39644393-01	-.13910400 02
8	.11700950 07	.25724469 06	-.13719056 03	.29140505 03
9	.95092625 00	.40551326 00	-.20635419-03	.11943125 00
10	-.11192269 04	-.24816588 03	.13116155 00	-.12251492 01
11	-.39081843-01	.91435737 00	-.11980653-03	.19704695 02
12	.54332515-02	.34780163-02	.19112323-05	-.11159957-03
13	.37054260 04	-.34281616 04	.51469237 00	-.11549886 02

Table C-25. Sensitivity Matrix for Parking Orbit, In-Plane Transfer, Orbit Plane Coordinates, - 3 Sigma Perturbations

	u_e	v_e	w_e	$\dot{u}_e$	$\dot{v}_e$	$\dot{w}_e$
1	.25062697-03	.20020502-04	.14130632-03	-.91850724 00	-.14156202 01	.52586529 00
2	.73892677 00	.99789632 00	-.27945920-02	.23482635 03	.42379451 03	-.89077207 00
3	.11026741-04	.26870017-05	.17304862-04	.95886937-01	.98903663-02	.18558159-01
4	-.70168779-03	-.96627631-03	.31051746-05	-.23106615 00	-.41600838 00	.15700977-02
5	-.12909658-08	.54316282-05	.92414091-08	.27519356-02	.34169163-02	.19832328-03
6	-.28286163-08	.19591997-07	.12323175-05	-.27182858-03	-.45404623-04	.18916358-03
7	-.11572736 01	-.17141113 00	-.93276040-04	-.44996677 03	-.77002720 02	.52681670 00
8	.94421341 00	.97963934-01	-.27487680-02	.31485348 03	.12667196 02	-.75470034 00
9	-.18545373-05	.44428425-05	-.91566071 00	-.35827190-01	-.15113426-01	-.41787693 03
10	-.15304786-02	-.95821397-03	.30883776-05	-.13892489 01	-.60256544 00	.20708138-02
11	.80355028-04	.38823983-03	.50896343-07	.18803880 00	-.89743563 00	-.10936323-05
12	.30224326-08	.21427625-07	.38592802-03	-.19247241-03	-.23678823-04	-.91630669 00
13	.15516373-02	-.17570926-04	-.81355823-05	.47616656 00	.61183063 00	-.61054187-03

	u_a	v_a	w_a	$\dot{u}_a$	$\dot{v}_a$	$\dot{w}_c$
1						
2						
3						
4						
5						
6						
7	.11579719 01	.17131134 00	.98156362-04	.44759391 03	.77131497 02	-.52251802-01
8	-.20541050 00	.89987212 00	-.35850647-04	-.80354710 02	.41087480 03	.59623401-01
9	-.18395616-04	-.99088327-05	.91558261 00	-.45231787-01	-.19505319-01	.41793452 03
10	.83058181-03	-.83195329-05	.35040513-06	.11564889 01	.18634498 00	.81600883-05
11	-.80734548-04	-.38336748-03	-.10968208-06	-.18998527 00	.90010200 00	-.67525081-04
12	-.46756080-07	-.47441715-07	-.38511521-03	.19495618-04	-.14103114-04	.91646302 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	.74859484-01	-.10662411 03	-.85579242 00	.51898737 03	-.13594135 06	.74803176 03
2	.54222689 01	.27908679 04	.32284752 01	.63517316 04	.27403878 07	.31981782 04
3	.12917729 02	.63252757-01	-.33745459 01	.17723886 05	.22393765 03	-.52938268 04
4	-.47134518-02	-.38724964 01	-.49804257-02	-.64525284 01	-.41987989 04	-.18234640 01
5	.24589057-02	.55807959-01	-.65683752-03	.37690687 01	.69771955 02	-.16453352 00
6	.85517787 00	-.41598544-03	-.24246145 00	.11720472 04	-.22445976 00	-.35786365 03
7	.30784696 01	.16847240 05	.85188986 01	.42689633 04	.18134446 08	.96003503 04
8	.23193317 02	-.80010019 04	.12876567 01	.30274538 05	-.82404406 07	.17698453 04
9	.18017859 05	-.64196933-01	.76117012 04	.19344137 08	-.48367610 02	.75658221 07
10	.12676464-01	.90829193 02	.17923563-01	.17937962 02	.10401623 06	.20934675 02
11	.96252164-01	-.37929635 02	-.71658372-02	.13514758 03	-.39908986 05	-.64910433 01
12	.94784683 02	-.30574267-03	.20761952 02	.10853708 06	-.57003411-01	.20242087 05
13	.45508669-01	.10408100 01	.74955455-02	.65917968 02	.89550780 03	.87890624 01

Table C-25 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	.10676824 01	-.10659789 03	-.21379719 01	.94490388 00	-.11113451 02	.62163161 00
2	.13029835 01	-.50406486 04	.30868813 01	.13377110 01	.78447967 04	.64792687 01
3	.68063966 00	.74557436 00	-.25556557 01	.15356224 02	.23771941 00	.11707519 01
4	.32800243-02	.38701202 01	-.32670786-01	-.45063805-01	-.78266038 01	-.12161332-01
5	-.44069892-02	.73628361-02	-.68206112-02	-.32004523-02	.50562398-01	-.91828502-02
6	-.14448243-02	-.37181956-02	-.27669725 00	.99089389 00	-.10187768-02	-.12332205-02
7	-.15137330 01	.18214524 05	.18021415 01	.43541545 00	-.13734197 04	-.15137330 01
8	.38733018 01	-.83558956 04	.30677403 00	.32226888 01	.34510648 03	.38733018 01
9	-.19052733 00	-.41889053 00	.76108080 04	.18019940 05	.80154386-02	-.19052733 00
10	-.24088315-02	.10264672 03	-.31670260-01	-.43441702-01	-.11954376 02	-.15014993-01
11	-.57029427-02	-.17431522 02	-.27281486-01	-.33638047-01	-.20639579 02	-.51675216-01
12	.48757371-03	-.21274828-02	.20727862 02	.94921952 02	-.59571364-03	-.66231164-03
13	.35485556-02	-.12395105 02	.14194222-01	.31937000-01	.13434831 02	.31937000-01

	DBX	DBY	DBZ	KS1	KS2	KS3
1	.41276079 03	.71577552 00	-.47082206 02	-.12787854 04	-.12712044 02	-.73216091 03
2	.30635675 05	.96752159 02	-.90671450 05	.18737605 06	-.14808141 02	.10115194 07
3	.26608204 00	-.65321016 02	.98054667 00	.48848825 02	.48288678 02	.18279062 02
4	-.12485453 02	-.12556609 00	.81930540 02	-.20448281 03	-.19160539 00	-.10046432 04
5	-.24708333 01	.50827560-02	-.14908149 02	.29284667 01	-.55206179 00	.21482995 02
6	-.50853644-02	-.11858989 02	-.19164870-02	-.10252181 00	-.29663746-03	-.21010372 00
7	-.93178781 05	-.40269721 01	.16644704 05	-.45501712 06	.12712044 02	-.18882383 06
8	.47543371 05	.91190841 02	-.10381398 04	.26886632 06	.14808141 02	-.30069271 04
9	-.52645610 00	.91084709 05	-.51434699 00	-.32552463 02	-.48288678 02	-.15427252 02
10	-.45987983 03	-.13060482 00	.16101517 03	-.15940479 04	-.75451916-01	-.20150154 04
11	.75812770 02	-.35664516-01	.39602507 03	.23560863 03	-.15296242 01	-.52731683 04
12	-.43072223-02	.40613054 03	-.14389036-02	-.12235201 00	.59660216-01	-.20499535 00
13	.74026472 02	.36368098 00	-.24729042 03	.46590169 03	.81380208 00	.32503255 04

	ISP	WTFLO	WT	DTGO
1	.12231261 04	.29266551 02	.35841202-01	-.16564017 02
2	.11940242 07	.25822871 06	-.13704010 03	.29097461 03
3	.10611092 01	.84443393 00	.41659681-03	.43356450-01
4	-.11432262 04	-.24939192 03	.13099510 00	-.12257469 01
5	-.15690722 00	.10249814 01	-.74182319-04	.19703966 02
6	-.23889137-02	-.39240445-02	-.35563095-05	-.49258267-03
7	.11313104 04	-.47772904 01	.61183158-01	-.17176150 02
8	.11940307 07	.25822671 06	-.13704474 03	.29022757 03
9	-.88313245 00	-.30395822 00	-.40465747-03	-.34687385 00
10	-.11432608 04	-.24942310 03	.13100162 00	-.12244889 01
11	-.29953869 00	.98238188 00	-.77797220-04	.19703904 02
12	-.92754460-03	-.38010365-02	-.36073523-05	.36804574-03
13	.37675781 04	-.34493408 04	.51498291 00	-.11551921 02

Table C-26. Sensitivity Matrix for Parking Orbit, In-Plane Transfer, Orbit Plane Coordinates, + 5 Sigma Perturbations

	u_e	v_e	w_e	$\dot{u}_e$	$\dot{v}_e$	$\dot{w}_e$
1	-.79179052-04	-.30129447-03	-.37241889-04	.42616960 00	.42009561-01	-.65128738 00
2	.72349035 00	.99624878 00	.46622293-02	.23218673 03	.42238715 03	.57831627 00
3	-.33123802-05	-.60241165-06	.20591756-04	-.25912535-01	-.41739023-01	.76765967-02
4	-.68868745-03	-.94300011-03	.23721610-05	-.22696517 00	-.41137560 00	.78070755-03
5	.32191967-06	-.20844591-05	-.21395838-05	.28406834-02	.34240908-02	-.33390405-03
6	-.29465945-08	-.95884813-08	.11197728-05	.47523999-04	.15142354-03	.14020276-03
7	-.11576053 01	-.17191290 00	-.15066862-03	-.44730712 03	-.75291603 02	.22700029 00
8	.92879768 00	.96216385-01	.46746065-02	.31268924 03	.11280034 02	.24821270 00
9	-.26612093-05	-.41687512-05	-.91569482 00	.16800419-01	.11566238-01	-.41791106 03
10	-.15177577-02	-.93576042-03	.22550450-05	-.13828503 01	-.59694621 00	.76534807-03
11	.80682939-04	.35059381-03	-.22413729-05	.19456041 00	-.89631642 00	-.82467837-03
12	-.67152405-09	-.96315508-08	.38583552-03	.76207018-04	.72745085-04	-.91636667 00
13	.15151937-02	-.18073620-04	.15784535-04	.46833617 00	.60890702 00	.10992654-03

	u_a	v_a	w_a	$\dot{u}_a$	$\dot{v}_a$	$\dot{w}_a$
1						
2						
3						
4						
5						
6						
7	.11574300 01	.17159408 00	-.73253534-04	.44749866 03	.77058126 02	-.43366024-01
8	-.20535509 00	.90001792 00	.31234633-04	-.80271568 02	.41087095 03	-.14374595-02
9	.11189913-04	.18009459-04	.91566568 00	.13277989-01	-.53956490-02	.41789358 03
10	.82874675-03	-.71403697-05	-.36436609-06	.11563880 01	.18630953 00	-.32946117-06
11	-.80752041-04	-.38262979-03	.12559473-06	-.18997271 00	.90010585 00	.66764843-06
12	.53944288-07	.87542489-07	-.38470950-03	.37703509-05	-.98028704-05	.91647565 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	.36764733 00	-.10438717 03	.33331017 00	.68983086 02	-.13499618 06	.72554843 03
2	-.91970154 01	.27665232 04	-.53265426 01	-.10041794 05	.27171593 07	-.53082136 04
3	.14395392 02	-.13131281-01	-.34970693 01	.19916244 05	-.36966204 02	-.45921675 04
4	.91824710-02	-.38662805 01	.47461759-02	.47263105 01	-.41881354 04	.46974756 01
5	-.41173219-02	.53255599-01	.60716764-03	-.64307248 01	.70869805 02	.52987711 00
6	.96030177 00	.29327310-03	-.22984069 00	.13287010 04	.38019001 00	-.30247488 03
7	-.51926345 01	.16836899 05	-.12447349 02	-.78297504 04	.18113526 08	-.16193037 05
8	-.38338469 02	-.80688556 04	-.31037360 01	-.49945702 05	-.83228277 07	-.27857646 04
9	.18019697 05	-.27557806-03	.76120200 04	.19346657 08	.23181180 02	.75666932 07
10	-.19185662-01	.90735181 02	-.31814488-01	-.37663519 02	.10388366 06	-.34273962 02
11	-.15774086 00	-.38144332 02	.97645139-02	-.23168487 03	-.40222248 05	.76572947 01
12	.94889578 02	.23041436-03	.20774407 02	.10869359 06	.21387727 00	.20297417 05
13	-.76775800-01	.90107164 00	-.14134457-01	-.10284849 03	.71583719 03	-.12013641 02

Table C-26 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	-.64075838 00	-.91561122 02	.69144600 00	.62332206 01	-.34849604 01	-.11468881 01
2	-.78197191 00	-.50909815 04	-.26484257 01	-.94039086 01	.78272975 04	-.48254424 01
3	-.40847876 00	-.56430722 00	-.47463280 01	.14045814 02	-.93513676 00	-.60562921 00
4	-.55782618-02	.38980463 01	.21154393-02	.12314773-01	-.77397852 01	.19027357-02
5	.33082122-02	.50455488-02	.43115883-02	.18792700-02	.49829256-01	-.10522800-02
6	.24172344-02	.96162740-03	-.26169944 00	.96338180 00	-.30866702-03	-.97028394-03
7	.90845109 00	.18280108 05	.28976659 01	-.42897546 01	-.14007027 04	-.56860140 01
8	-.23245216 01	-.84125508 04	-.40909816 01	-.59837885 01	.34791473 03	-.35841334-01
9	.11434301 00	.32499892 00	.76115180 04	.18020064 05	.21469971 00	.25624102 00
10	-.65125445-03	.10272186 03	.56792480-02	.13247117-01	-.11858254 02	.77295120-02
11	.25795690-02	-.17393464 02	.15333722-01	.23288858-01	-.20532271 02	.42837554-01
12	.17680940-02	.73867611-03	.20742189 02	.94892005 02	.97846405-04	-.33330944-03
13	-.21296286-02	-.12560549 02	-.17037029-01	-.31944429-01	.13423049 02	-.14907400-01

	DBX	DBY	DBZ	KS1	KS2	KS3
1	.41069324 03	-.14045038 01	-.33090964 02	-.11081196 04	.76272266 01	-.61295243 03
2	.30317679 05	-.15525067 03	-.90944105 05	.18627269 06	.88848849 01	.10102227 07
3	-.54793213 00	-.66319805 02	-.16627762 00	.25954353 01	-.28973207 02	-.22157091 02
4	-.12128195 02	.16059919 00	.84416616 02	-.19951880 03	.49385276 00	-.99978379 03
5	-.25032777 01	-.13345353-01	-.14547481 02	.39609201 01	.31215052 00	.18585358 02
6	.15533398-02	-.11863062 02	-.15319060-03	.72578686-01	.94067983-01	.10376204 00
7	-.93164142 05	-.11834110 01	.16664837 05	-.45203078 06	-.14078341 03	-.18969831 06
8	.47223806 05	-.15399312 03	-.13133759 04	.26764171 06	.25826547 02	-.38704351 04
9	.14619100 00	.91085218 05	.65361161-01	.18542116 02	.45642658 01	.63809745 01
10	-.45952509 03	.16555240 00	.16349942 03	-.15867623 04	.47705542 00	-.20089163 04
11	.75773696 02	-.10252148-01	.39639664 03	.23875192 03	.14426508 01	-.52681361 04
12	.16739301-02	.40612701 03	-.29816316-03	.27504192-01	.74250732-01	.91027911-01
13	.73042911 02	-.55986850 00	-.24732713 03	.45935058 03	-.61035155 00	.32495117 04

	ISP	WTFLO	WT	DRGO
1	-.18019575 04	-.36160744 02	-.57766276-01	-.18114705 02
2	.11623545 07	.25689960 06	-.13723142 03	.29039974 03
3	.40062415 00	.30429213 00	-.65371670-03	-.31644776 00
4	-.11061378 04	-.24425354 03	.13197962 00	-.12237468 01
5	-.25895745 01	-.30953025 00	-.39864499-03	.19705446 02
6	.23797275-02	.40115188-02	.36768876-06	.59743609-03
7	-.18179282 04	-.43274550 02	-.75374305-01	-.18267250 02
8	.11623469 07	.25690276 06	-.13722683 03	.29022204 03
9	-.53085765-01	.41192992 00	.16321872-03	.26301638 00
10	-.11061136 04	-.24423987 03	.13197032 00	-.12245013 01
11	-.26782361 01	-.31021923 00	-.38461938-03	.19705483 02
12	.22866592-02	.34504777-02	-.15136396-06	.81120964-04
13	.36870982 04	-.34203486 04	.51478548 00	-.11550293 02

Table C-27. Sensitivity Matrix for Parking Orbit, Out-of-Plane Transfer, Orbit Plane Coordinates, + 3 Sigma Perturbations

	u_e	v_e	w_e	$\dot{u}_e$	$\dot{v}_e$	$\dot{w}_e$
1	.14150506-03	.21491171-03	-.14772014-03	-.22622821 00	.13915787 00	.33726812 00
2	.74536944 00	.99803521 00	-.30891447 00	.23544559 03	.41730476 03	-.93546717 02
3	.37496533-03	-.11472628-03	-.34313482-03	.54325721 00	.27290727 01	.10819895 01
4	-.70128952-03	-.95695318-03	.27829808-03	-.23394724 00	-.40883249 00	.91002982-01
5	-.18024993-04	.10318186-04	.33500894-04	.12959375-01	.12276345-01	-.90921823-02
6	.31381585-04	.85566980-06	-.27409921-04	.51890609-01	.22488967 00	.82807328-01
7	-.11575668 01	-.16885807 00	.16665309-01	-.44687801 03	-.73962537 02	.71301458 01
8	.94770098 00	.97677381-01	-.31195187 00	.31393508 03	.56787739 01	-.94558814 02
9	-.18905399-01	-.35561034-04	-.91586272 00	-.69640173 01	.27855892 01	-.41680634 03
10	-.15301911-02	-.94878450-03	.28106184-03	-.13904694 01	-.59146175 00	.10924148 00
11	.61612746-04	.39330584-03	.34022346-04	.19806571 00	-.88925958 00	-.10724537-01
12	.27397794-04	.61130212-06	.35729969-03	.34689981-01	.22497762 00	-.83349562 00
13	.15030420-02	-.21116998-04	-.84032574-03	.44486068 00	.55711170 00	-.20914122 00

	u_a	v_a	w_a	$\dot{u}_a$	$\dot{v}_a$	$\dot{w}_a$
1						
2						
3						
4						
5						
6						
7	.11583590 01	.16880145 00	-.16788981-01	.44765869 03	.75943201 02	-.74668701 01
8	-.20250029 00	.90032531 00	.30615293-02	-.79140008 02	.41115411 03	.13676903 01
9	.19272457-01	-.74847592-04	.91542484 00	.76463134 01	-.46246749-01	.41784116 03
10	.83080241-03	-.85183996-05	-.24528601-05	.11566399 01	.18349079 00	-.18698746-01
11	-.79905277-04	-.38343319-03	-.53001204-06	-.18734372 00	.90058436 00	.32086472-02
12	.39484507-05	.19239859-06	-.38511887-03	.17329253-01	-.92179217-04	.91630293 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	.51170698 01	-.96187759 02	.15818238 02	.67475828 04	-.12385415 06	.22827896 05
2	-.11216902 04	.27845687 04	-.13568463 02	-.11536258 07	.27383125 07	-.47895709 05
3	.95961698 01	.34144129 00	-.16509289 00	.12572220 05	.17486611 04	-.31962671 04
4	.11597742 01	-.38921202 01	.23838117 00	.12016430 04	-.42174930 04	.34041440 03
5	.56734282-01	.85643821-01	-.20939196-02	.73360524 02	.93781142 02	-.39473694 01
6	.83615971 00	.67671626-01	-.12862983-01	.10787345 04	.17142479 03	-.27972887 03
7	.18323423 02	.16611535 05	.17019225 04	-.28908251 05	.17895376 08	.15786906 07
8	.64823988 03	-.79492435 04	-.31173352 03	.49493710 06	-.81893189 07	-.32196076 06
9	.17753528 05	.31528018 03	.76764359 04	.19081831 08	.33964370 06	.76357462 07
10	-.48719712 00	.90777094 02	.52778324 00	-.99259783 03	.10421790 06	-.11138449 04
11	.15157366 00	-.37903147 02	.34806297-01	-.14681070 04	-.39950761 05	.34197462 03
12	.94793828 02	.17321560 01	.21240230 02	.10873537 06	.20753852 04	.20593303 05
13	-.52522357 00	.11768006 01	.36085697 00	-.59912109 03	.10502930 04	.32812500 03

Table C-27 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	.18998102 02	-.89904874 02	-.17096499 02	.38674514 00	-.16792047 02	-.11123792 02
2	-.10022850 04	-.50364275 04	.99326457 03	.75110334 03	.78292214 04	-.18639091 04
3	.66717439 01	.21244211 02	.28134222 01	.84473407 01	.54333537 02	.14273420 02
4	.12530274 01	.38868536 01	-.10098138 01	-.68537538 00	-.77658627 01	.18544592 01
5	-.13425359 00	-.39566949 00	.85089560-01	.52938546-01	.29718870 00	-.37367168-01
6	.67127881 00	.17625012 01	.31225729 00	.78556101 00	.46352160 01	.12406531 01
7	.18232706 04	.17995934 05	-.11489642 03	-.30556655 03	-.13969694 04	.28226640 03
8	-.13292066 04	-.82646207 04	.10052900 04	.80339974 03	.29742894 03	-.17139814 03
9	.38776381 02	.33681499 03	.76515613 04	.17752753 05	.56907663 02	.13581233 02
10	.19249279 01	.10262360 03	-.14110691 01	-.23896569 01	-.11885665 02	.18795470 01
11	-.17406850 00	-.17577145 02	.12534050 00	.32075842 00	-.20630790 02	-.37884677 00
12	.67271973 00	.34280975 01	.21568825 02	.94743807 02	.46393212 01	.12408789 01
13	-.24946345 01	-.11901855 02	.27749704 01	-.36195267 00	.12501561 02	-.19162200 00

	DBX	DBY	DBZ	KS1	KS2	KS3
1	.37151059 03	-.72925780 01	-.53187649 02	-.99977042 03	-.73301993 02	-.49118745 03
2	.31174645 05	.70370209 04	-.90830847 05	.18931173 06	.20946659 05	.10032303 07
3	.99127032 01	-.89411166 01	.30462861 01	.12188413 04	.10795169 04	.98253187 03
4	-.16747527 02	-.65994938 01	.82657304 02	-.20396289 03	-.20696158 02	-.99452813 03
5	.23734504 00	.52268241 00	-.95701538 01	.13142028 02	-.51877817 00	.10970121 03
6	.10609086 01	-.66398722 01	.50414282 00	.10147843 03	.89312894 02	.78149539 02
7	-.93205029 05	-.15897808 04	.16392518 05	-.45477418 06	-.91152295 03	-.18066894 06
8	.47826999 05	.73293431 04	-.11622285 04	.26940077 06	.20848139 05	.18439770 04
9	-.16096374 04	.91128827 05	-.61818702 01	-.65299344 04	.99920584 05	.11813330 04
10	-.46426400 03	-.14269487 02	.16059431 03	-.16072267 04	-.20655215 02	-.19889523 04
11	.77380121 02	.19084026 01	.40154934 03	.24614853 03	-.10123417 01	-.51903685 04
12	-.63741720 01	.41128547 03	.46503004 00	.79522799 02	.71727276 02	.78716104 02
13	.70832404 02	.99142598 01	-.24232854 03	.43172200 03	.71411133 02	.30861409 04

	ISP	WTFLO	WT	DTGO
1	.14507247 04	.14138848 03	.29625461-01	-.68235608 01
2	.11831438 07	.25263752 06	-.13545518 03	.21557651 03
3	.17812772 03	.30926784 01	.23930274-01	.41969718 02
4	-.11225936 04	-.24334976 03	.12941678 00	-.11209535 01
5	-.10253561 02	-.12610067 02	-.63368429-03	.19496181 02
6	.11081049 02	-.41503037 01	.27601864-02	.37436700 01
7	.14688812 04	.19257709 03	.32455262-01	-.12392280 02
8	.11831364 07	.25261127 06	-.13545961 03	.21864350 03
9	.18061920 03	.67775304 01	.24660938-01	.42012273 02
10	-.11225563 04	-.24333603 03	.12941975 00	-.11210877 01
11	-.10304054 02	-.12665359 02	-.63200766-03	.19499224 02
12	.11103301 02	-.41390033 01	.27588476-02	.37434723 01
13	.37221923 04	-.34824829 04	.51987547 00	-.11549886 02

Table C-28. Sensitivity Matrix for Parking Orbit, Out-of-Plane Transfer, Orbit Plane Coordinates, - 3 Sigma Perturbations

	u_e	v_e	w_e	$\dot{u}_e$	$\dot{v}_e$	$\dot{w}_e$
1	-.59759062-03	-.48452068-03	.53114647-03	.97923927-01	-.37107235 00	.15599194 00
2	.73110425 00	.99469854 00	-.30160058 00	.23616073 03	.41791368 03	-.94314787 02
3	-.44892583-04	-.59101519-03	.51139134-03	-.36717493 00	-.10262651 01	.15424525 01
4	-.69460540-03	-.96225976-03	.30042963-03	-.23337255 00	-.40836775 00	.91969072-01
5	.50244997-04	-.18532819-06	-.28365628-04	.18569425-01	.22980480-01	-.11806764-01
6	-.36800249-05	-.38255135-04	.41569093-04	-.43742109-01	-.81715010-01	.13105357 00
7	-.11583043 01	-.16941686 00	.17359253-01	-.45236064 03	-.76917181 02	.11436946 02
8	.93350511 00	.94229413-01	-.30470566 00	.31656340 03	.74059638 01	-.96646584 02
9	-.19339495-01	-.52736357-03	-.91503201 00	-.81289197 01	-.95834873 00	-.41618477 03
10	-.15238015-02	-.95456673-03	.30319551-03	-.13919712 01	-.59196037 00	.11210837 00
11	.12930192-03	.38269072-03	-.27954385-04	.20729072 00	-.87653307 00	-.15765120-01
12	-.76806899-05	-.38506410-04	.42629649-03	-.61143222-01	-.81623230-01	-.78520342 00
13	.14353840-02	-.20951079-04	-.79296118-03	.45729616 00	.58750188 00	-.21747388 00

	u_a	v_a	w_a	$\dot{u}_a$	$\dot{v}_a$	$\dot{w}_a$
1						
2						
3						
4						
5						
6						
7	.11578397 01	.16902527 00	-.16928561-01	.44765869 03	.75943201 02	-.74668701 01
8	-.20243362 00	.90043338 00	.31057407-02	-.79140008 02	.41115411 03	.13676903 01
9	.19290901-01	-.54829799-04	.91548621 00	.76463134 01	-.46246749-01	.41784116 03
10	.82918176-03	-.75897269-05	-.30184686-05	.11568310 01	.18357643 00	-.18782099-01
11	-.79849266-04	-.38288701-03	-.33664762-06	-.18735005 00	.90058522 00	.31985335-02
12	.40384635-05	.30877643-06	-.38482900-03	.17450333-01	-.51625066-04	.91629766 00
13						

	PHIS	PHIT	PHIU	OMX	OMY	OMZ
1	.46244575 01	-.95929378 02	.16960464 02	.59643572 04	-.12440883 06	.23662156 05
2	-.11292895 04	.27719141 04	-.22638581 02	-.11640341 07	.27233641 07	-.55591361 05
3	.29930443 01	.69300438-01	-.72345170 01	.13078718 05	-.47420320 04	-.64201561 04
4	.11707002 01	-.38455942 01	.23960425 00	.12235044 04	-.41872755 04	.34345620 03
5	.72772712-01	.89762418-01	.17754704-01	.73060724 02	.11283080 03	.50575765 01
6	.28440664 00	.14163017-01	-.62965561 00	.11089997 04	-.38171318 03	-.56054602 03
7	-.40233640 01	.16593171 05	.16843746 04	-.50167052 05	.17873582 08	.15542932 07
8	.60879905 03	-.79923796 04	-.31588685 03	.44062703 06	-.82459276 07	-.32410441 06
9	.17745598 05	.31479979 03	.76723285 04	.19080464 08	.33284546 06	.76359650 07
10	-.51556333 00	.90742230 02	.48528092 00	-.10236022 04	.10413692 06	-.11581998 04
11	-.17868588-01	-.38063664 02	.64675463-01	-.17372813 04	-.40168109 05	.36509163 03
12	.94242774 02	.16780226 01	.20623991 02	.10876264 06	.15207642 04	.20304777 05
13	-.53164832 00	.11029160 01	.40047629 00	-.69433593 03	.98535155 03	.33984375 03

Table C-28 Continued

	EXY	EXZ	EYX	EYZ	EZX	EZY
1	.26618825 02	-.96706525 02	.33682886-01	-.99132281 01	-.83254983 01	.14639315 01
2	-.10276430 04	-.50511227 04	.99541839 03	.74427904 03	.78327000 04	-.18719061 04
3	-.14795425 02	-.32085054 02	-.39731423 02	.85465798 01	-.33495609 02	-.19172384 02
4	.12513781 01	.38614261 01	-.10243330 01	-.68618262 00	-.77603807 01	.17945702 01
5	-.65582334-01	-.26221396 00	.20761963 00	.70876934-01	.53071119 00	.56987759-01
6	-.12580541 01	-.27030917 01	-.34151651 01	.73345110 00	-.28562139 01	-.16701151 01
7	.18224287 04	.17958289 05	-.13678028 03	-.30640990 03	-.14303436 04	.28769431 03
8	-.13362653 04	-.82596691 04	.10238779 04	.80235249 03	.32433895 03	-.16522383 03
9	.14831616 02	.27946780 03	.76064589 04	.17751231 05	-.34703354 02	-.21308920 02
10	.19408340 01	.10260039 03	-.14405695 01	-.23859115 01	-.11888431 02	.18291410 01
11	-.78446655-01	-.17393495 02	.28275064 00	.40017084 00	-.20340206 02	-.20021529 00
12	-.12599930 01	-.10425422 01	.17840533 02	.94689773 02	-.28539652 01	-.16711704 01
13	-.23420466 01	-.11497320 02	.31049861 01	-.43292378 00	.13193530 02	.10645667-01

	DBX	DBY	DBZ	KS1	KS2	KS3
1	.33664178 03	-.89892998 00	-.87652929 02	-.15948499 04	-.51235183 03	-.48407679 03
2	.30927332 05	.68551019 04	-.91052071 05	.19051512 06	.21367218 05	.10028836 07
3	-.35925873 02	-.71884753 02	-.37291270 02	-.21065973 04	-.12658172 04	-.11443982 04
4	-.16216626 02	-.64155295 01	.83083086 02	-.20399334 03	-.23184934 02	-.99453024 03
5	.32848531 00	.62661251 00	-.86175266 01	.22559390 02	.67338001 01	.11400994 03
6	-.28784112 01	-.11808942 02	-.28553055 01	-.17782399 03	-.11164647 03	-.10067973 03
7	-.93260462 05	-.16286934 04	.16375462 05	-.46084189 06	-.15873352 04	-.18470396 06
8	.47590337 05	.71585457 04	-.13724536 04	.27214240 06	.21963889 05	.31376582 04
9	-.16567270 04	.91063522 05	-.47302267 02	-.10088740 05	.97445822 05	-.11092079 04
10	-.46374911 03	-.14093979 02	.16102839 03	-.16084936 04	-.23590637 02	-.19895795 04
11	.77491616 02	.20169849 01	.40253695 03	.25758334 03	.77798022 01	-.51810504 04
12	-.10314852 02	.40611647 03	-.28985472 01	-.20008773 03	-.12931517 03	-.10032909 03
13	.70503509 02	.98035741 01	-.24251513 03	.46407064 03	.88704427 02	.31058756 04

	ISP	WTFLO	WT	DTGO
1	-.10854565 04	-.81651042 02	-.46403365-01	-.14866524 02
2	.11587257 07	.25181281 06	-.13562345 03	.21891943 03
3	.71430027 01	-.76248958 02	-.31539812-01	.42571198 02
4	-.11079294 04	-.24329315 03	.12958841 00	-.11194995 01
5	.53561874 01	.69020068 01	-.56606056-03	.19505981 02
6	-.43683115 01	-.91475178 01	-.18847300-02	.37443193 01
7	-.11162120 04	.52436678 02	-.48914283-01	-.13002460 02
8	.11587277 07	.25179889 06	-.13562258 03	.21789480 03
9	.97815583 01	-.75672411 02	-.32606610-01	.41622123 02
10	-.11079290 04	-.24322215 03	.12958687 00	-.11200194 01
11	.52414442 01	.69067793 01	-.55451746-03	.19500542 02
12	-.43442243 01	-.91455210 01	-.18881715-02	.37447061 01
13	.36515930 04	-.34719177 04	.51990478 00	-.11551921 02

APPENDIX D

COVARIANCE MATRICES

This appendix contains all the covariance matrices generated in this study. The two types of covariance matrices presented describe the statistical properties at insertion of the actual dispersions (or errors) from the reference trajectory $\left[E(\delta X_A)(\delta X_A)^T\right] = \Sigma_A$, and of the dispersions (or errors) in the estimate from the actual trajectory $\left[E(\delta X_E - \delta X_A)(\delta X_E - \delta X_A)^T\right] = \Sigma_U$. The state vectors described by the matrices consist of seven components; the first six describing the position and velocity, and the seventh pertaining to weight.

The matrices in this appendix are presented in selenocentric and orbit plane coordinates for the direct ascent cases, and in selenocentric, orbit plane, and the special parking orbit coordinates for the parking orbit cases. These coordinate systems are described in detail in Appendix B.

Each table consists of the two covariance matrices describing the actual errors from the reference trajectory, and the errors in the estimate of the actual trajectory in a particular coordinate system and for a particular trajectory.

Table D-1. Covariance Matrix for 140° Direct, In-Plane Transfer, Selenocentric Coordinates

COVARIANCE MATRIX OF THE ACTUAL ERRORS FROM REFERENCE

	x	y	z	$\dot{x}$	$\dot{y}$	$\dot{z}$
1	.13615122 08	-.80325199 07	-.31213484 07	.11991116 05	.11379985 05	.47487435 04
2	-.80325199 07	.85874270 07	.23745737 07	-.60118396 03	-.23887756 04	-.42746299 04
3	-.31213484 07	.23745737 07	.34209280 07	-.18658189 03	-.40854229 04	.63497424 04
4	.11991116 05	-.60118394 03	-.18658189 03	.39260408 02	.18663354 02	.76155460 01
5	.11379985 05	-.23887756 04	-.40854229 04	.18663353 02	.26006557 02	-.70830220 01
6	.47487435 04	-.42746298 04	.63497424 04	.76155460 01	-.70830219 01	.41591362 02
7	-.28672685 11	-.10560628 11	-.47916403 10	-.10365002 09	-.80587829 08	-.34730192 08

	wt
1	-.28672686 11
2	-.10560628 11
3	-.47916403 10
4	-.10365002 09
5	-.80587829 08
6	-.34730192 08
7	.21145861 16

COVARIANCE MATRIX OF THE ERRORS IN THE ESTIMATE OF THE ACTUAL

	x	y	z	$\dot{x}$	$\dot{y}$	$\dot{z}$
1	.27696108 07	.63012855 06	.26248798 06	.82688042 04	.38610069 04	.16078692 04
2	.63012855 06	.16917722 07	-.31773484 06	.25272269 04	.37365970 04	-.16818576 04
3	.26248798 06	-.31773484 06	.23677982 07	.10380259 04	-.16616133 04	.72877692 04
4	.82688042 04	.25272269 04	.10380259 04	.38992266 02	.16446637 02	.67088050 01
5	.38610069 04	.37365970 04	-.16616133 04	.16446637 02	.21307754 02	-.86947305 01
6	.16078692 04	-.16818576 04	.72877692 04	.67088050 01	-.86947305 01	.40029674 02
7	-.21681012 11	-.16264574 11	-.70214429 10	-.10309596 09	-.78217061 08	-.33748502 08

	wt
1	-.21681012 11
2	-.16264574 11
3	-.70214429 10
4	-.10309596 09
5	-.78217061 08
6	-.33748502 08
7	.21145861 16

Table D-2. Covariance Matrix for 180° Direct, In-Plane Transfer, Selenocentric Coordinates

COVARIANCE MATRIX OF THE ACTUAL ERRORS FROM REFERENCE

	x	y	z	$\dot{x}$	$\dot{y}$	$\dot{z}$
1	.13332442 08	-.77739164 07	-.30198601 07	.14701735 05	.12369089 05	.51752754 04
2	-.77739164 07	.83594042 07	.22838084 07	-.27251391 04	-.31454926 04	-.46249591 04
3	-.30198601 07	.22838084 07	.33878500 07	-.10173398 04	-.43870584 04	.62218566 04
4	.14701735 05	-.27251390 04	-.10173398 04	.42029845 02	.21306733 02	.86812475 01
5	.12369089 05	-.31454926 04	-.43870584 04	.21306733 02	.27671776 02	-.63897821 01
6	.51752754 04	-.46249591 04	.62218566 04	.86812475 01	-.63897821 01	.41662500 02
7	-.26737245 05	.20807053 05	.81202001 04	-.17148389 02	-.23256974 02	-.97924060 01

	wt
1	-.26737246 05
2	.20807053 05
3	.81202001 04
4	-.17148389 02
5	-.23256974 02
6	-.97924061 01
7	.30664982 03

COVARIANCE MATRIX OF THE ERRORS IN THE ESTIMATE OF THE ACTUAL

	x	y	z	$\dot{x}$	$\dot{y}$	$\dot{z}$
1	.27722063 07	.63115083 06	.26276948 06	.82769714 04	.38609550 04	.15852397 04
2	.63115083 06	.16925764 07	-.31868290 06	.25309525 04	.37386225 04	-.16855670 04
3	.26276948 06	-.31868290 06	.23698471 07	.10397569 04	-.16638934 04	.72923057 04
4	.82769714 04	.25309525 04	.10397569 04	.39009351 02	.16434608 02	.66527232 01
5	.38609550 04	.37386225 04	-.16638934 04	.16434608 02	.21291749 02	-.87045088 01
6	.15852397 04	-.16855670 04	.72923057 04	.66527232 01	-.87045089 01	.39757406 02
7	.44280164 03	-.84605644 03	-.33496862 03	.20189472 01	-.38745705 01	-.15312507 01

	wt
1	.44280164 03
2	-.84605643 03
3	-.33496862 03
4	.20189473 01
5	-.38745705 01
6	-.15312507 01
7	.30664982 03

Table D-3. Covariance Matrix for 180° Direct, Out-of-Plane Transfer, Selenocentric Coordinates

COVARIANCE MATRIX OF THE ACTUAL ERRORS FROM REFERENCE

	x	y	z	$\dot{x}$	$\dot{y}$	$\dot{z}$
1	.13318116 08	-.77384871 07	-.29983494 07	.12465559 05	.10393495 05	.41203592 04
2	-.77384871 07	.82157538 07	.23158036 07	-.10847857 04	-.17181895 04	-.34855516 04
3	-.29983494 07	.23158036 07	.34017790 07	-.30733978 03	-.38239963 04	.64732666 04
4	.12465559 05	-.10847857 04	-.30733978 03	.39451855 02	.18386489 02	.78300169 01
5	.10393495 05	-.17181895 04	-.38239963 04	.18386489 02	.25147147 02	-.74940591 01
6	.41203592 04	-.34855516 04	.64732667 04	.78300169 01	-.74940591 01	.40142194 02
7	-.26450769 05	.20523347 05	.80318588 04	-.13729099 02	-.20847860 02	-.85537392 01

	wt
1	-.26450769 05
2	.20523347 05
3	.80318588. 04
4	-.13729099 02
5	-.20847860 02
6	-.85537393 01
7	.30728467 03

COVARIANCE MATRIX OF THE ERRORS IN THE ESTIMATE OF THE ACTUAL

	x	y	z	$\dot{x}$	$\dot{y}$	$\dot{z}$
1	.27577146 07	.62121702 06	.23704234 06	.81944498 04	.39189695 04	.13663430 04
2	.62121702 06	.16175435 07	-.23815710 06	.24305604 04	.35466690 04	-.12604402 04
3	.23704234 06	-.23815710 06	.24129555 07	.10670194 04	-.17706307 04	.73324372 04
4	.81944498 04	.24305604 04	.10670194 04	.38784662 02	.16245713 02	.69496245 01
5	.39189694 04	.35466690 04	-.17706307 04	.16245713 02	.21569633 02	-.89621429 01
6	.13663430 04	-.12604402 04	.73324372 04	.69496245 01	-.89621429 01	.39352718 02
7	.44985696 03	-.83734625 03	-.31537599 03	.20367074 01	-.38066531 01	-.14831369 01

	wt
1	.44985696 03
2	-.83734625 03
3	-.31537599 03
4	.20367075 01
5	-.38066531 01
6	-.14831369 01
7	.30728467 03

Table D-4. Covariance Matrix for 220° Direct, In-Plane Transfer, Selenocentric Coordinates

COVARIANCE MATRIX OF THE ACTUAL ERRORS FROM REFERENCE

	x	y	z	$\dot{x}$	$\dot{y}$	$\dot{z}$
1	.13344359 08	-.77995534 07	-.30317760 07	.13893891 05	.12042989 05	.50254162 04
2	-.77995534 07	.83860859 07	.22972232 07	-.20952630 04	-.29006958 04	-.45000159 04
3	-.30317760 07	.22972232 07	.33897714 07	-.78858328 03	-.42970498 04	.62324146 04
4	.13893891 05	-.20952630 04	-.78858330 03	.41184561 02	.20533348 02	.82669351 01
5	.12042989 05	-.29006959 04	-.42970499 04	.20533348 02	.27085197 02	-.66356206 01
6	.50254162 04	-.45000159 04	.62324145 04	.82669351 01	-.66356206 01	.41283939 02
7	-.26935472 05	.21012826 05	.82041472 04	-.15249667 02	-.22628188 02	-.94865262 01

	wt
1	-.26935472 05
2	.21012826 05
3	.82041471 04
4	-.15249667 02
5	-.22628188 02
6	-.94865262 01
7	.30731947 03

COVARIANCE MATRIX OF THE ERRORS IN THE ESTIMATE OF THE ACTUAL

	x	y	z	x	$\dot{y}$	$\dot{z}$
1	.27688498 07	.62906600 06	.26219815 06	.82568750 04	.38482397 04	.15814960 04
2	.62906600 06	.16908252 07	-.31765443 06	.25207853 04	.37286281 04	-.16785838 04
3	.26219816 06	-.31765443 06	.23665426 07	.10355523 04	-.16570914 04	.72708143 04
4	.82568750 04	.25207853 04	.10355523 04	.38892628 02	.16347393 02	.66174788 01
5	.38482397 04	.37286281 04	-.16570914 04	.16347393 02	.37300172 04	.15774308 04
6	.15814960 04	-.16785838 04	.72708143 04	.66174788 01	.15774308 04	.71792042 03
7	.46425271 03	-.84799345 03	-.33312120 03	.21171785 01	-.26212027 03	-.11195899 03

	wt
1	.46425271 03
2	-.84799344 03
3	-.33312119 03
4	.21171785 01
5	-.26212028 03
6	-.11195899 03
7	.30731947 03

Table D-5. Covariance Matrix for Parking Orbit, In-Plane Transfer, Selenocentric Coordinates

COVARIANCE MATRIX OF THE ACTUAL ERRORS FROM REFERENCE

	x	y	z	$\dot{x}$	$\dot{y}$	$\dot{z}$
1	.98037027 07	-.72833916 07	-.28811447 07	.16389353 05	.96762963 04	.39776195 04
2	-.72833916 07	.10129761 08	.30241531 07	-.68173988 04	-.50703553 04	-.52673590 04
3	-.28811447 07	.30241531 07	.36931544 07	-.26848724 04	-.51294167 04	.57520262 04
4	.16389353 05	-.68173988 04	-.26848724 04	.49844176 02	.18599418 02	.75603552 01
5	.96762964 04	-.50703553 04	-.51294167 04	.18599418 02	.22563312 02	-.76886117 01
6	.39776195 04	-.52673590 04	.57520262 04	.75603552 01	-.76886117 01	.39034001 02
7	-.21718621 05	.23804762 05	.94375269 04	-.24195550 02	-.23422596 02	-.96447477 01

	wt
1	-.21718621 05
2	.23804763 05
3	.94375269 04
4	-.24195551 02
5	-.23422596 02
6	-.96447477 01
7	.30411077 03

COVARIANCE MATRIX OF THE ERRORS IN THE ESTIMATE OF THE ACTUAL

	x	y	z	$\dot{x}$	$\dot{y}$	$\dot{z}$
1	.29671074 07	.40297727 06	.16658399 06	.91769814 04	.27607529 04	.11246457 04
2	.40297728 06	.15236553 07	-.38734123 06	.15001251 04	.28311102 04	-.19982088 04
3	.16658399 06	-.38734123 06	.23393533 07	.61504277 03	-.19876973 04	.70290868 04
4	.91769814 04	.15001251 04	.61504277 03	.43227845 02	.11464200 02	.46273954 01
5	.27607529 04	.28311102 04	-.19876973 04	.11464200 02	.16154203 02	-.10219148 02
6	.11246457 04	-.19982088 04	.70290868 04	.46273953 01	-.10219148 02	.37693440 02
7	.26715239 03	-.90934232 03	-.35980728 03	.11767523 01	-.41838701 01	-.16530988 01

	wt
1	.26715239 03
2	-.90934232 03
3	-.35980728 03
4	.11767523 01
5	-.41838701 01
6	-.16530988 01
7	.30411077 03

Table D-6. Covariance Matrix for Parking Orbit, Out-of-Plane Transfer, Selenocentric Coordinates

COVARIANCE MATRIX OF THE ACTUAL ERRORS FROM REFERENCE

	x	y	z	$\dot{x}$	$\dot{y}$	$\dot{z}$
1	.96027341 07	-.71162492 07	-.28394658 07	.16218402 05	.94673558 04	.38243674 04
2	-.71162492 07	.10028634 08	.29247395 07	-.67236016 04	-.48427811 04	-.53826011 04
3	-.28394659 07	.29247395 07	.35957517 07	-.27358345 04	-.49546425 04	.56269609 04
4	.16218402 05	-.67236016 04	-.27358345 04	.50096208 02	.18555810 02	.70196291 01
5	.94673558 04	-.48427810 04	-.49546425 04	.18555810 02	.22240262 02	-.75091670 01
6	.38243674 04	-.53826011 04	.56269609 04	.70196291 01	-.75091671 01	.39093396 02
7	-.20951499 05	.23104976 05	.91432207 04	-.23329576 02	-.22637208 02	-.94408162 01

	wt
1	-.20951499 05
2	.23104976 05
3	.91432207 04
4	-.23329576 02
5	-.22637208 02
6	-.94408162 01
7	.30331622 03

COVARIANCE MATRIX OF THE ERRORS IN THE ESTIMATE OF THE ACTUAL

	x	y	z	$\dot{x}$	$\dot{y}$	$\dot{z}$
1	.29479936 07	.39000773 06	.16379553 06	.91161412 04	.26792727 04	.12319747 04
2	.39000773 06	.15933124 07	-.44927060 06	.14666816 04	.29369933 04	-.24186481 04
3	.16379553 06	-.44927060 06	.22461630 07	.54759069 03	-.18398412 04	.68306661 04
4	.91161412 04	.14666816 04	.54759069 03	.43375227 02	.11511945 02	.43628346 01
5	.26792727 04	.29369933 04	-.18398412 04	.11511945 02	.15817778 02	-.99492637 01
6	.12319747 04	-.24186481 04	.68306661 04	.43628345 01	-.99492637 01	.38148850 02
7	.27310786 03	-.88818496 03	-.36292739 03	.12393328 01	-.40613845 01	-.16043063 01

	wt
1	.27310786 03
2	-.88818496 03
3	-.36292738 03
4	.12393328 01
5	-.40613845 01
6	-.16043063 01
7	.30331622 03

Table D-7. Covariance Matrix for 140° Direct, In-Plane Transfer, Selenocentric Coordinates

COVARIANCE MATRIX OF THE ACTUAL ERRORS FROM REFERENCE

	u	v	w	$\dot{u}$	$\dot{v}$	$\dot{w}$
1	.27324762 07	-.68675321 06	-.58189941 03	.84946290 04	-.23625047 04	-.16095667 02
2	-.68675323 06	.20395782 08	-.21138281 04	-.15321724 05	-.56800306 03	.37267459 01
3	-.58190617 03	-.21138261 04	.24952172 07	-.43437901 01	-.73406247 01	.80254561 04
4	.84946290 04	-.15321724 05	-.43437725 01	.49940324 02	-.11032882 02	-.12561294 00
5	-.23625047 04	-.56800315 03	-.73406178 01	-.11032883 02	.12597401 02	-.64405378-01
6	-.16095674 02	.37267326 01	.80254560 04	-.12561301 00	-.64405437-01	.44320599 02
7	-.27441277 11	.14268351 11	.20735095 05	-.13404862 09	.21791700 08	-.20693942 03

	wt
1	-.27441277 11
2	.14268351 11
3	.20682723 05
4	-.13404862 09
5	.21791700 08
6	-.20693942 03
7	.21145861 16

COVARIANCE MATRIX OF THE ERRORS IN THE ESTIMATE OF THE ACTUAL

	u	v	w	$\dot{u}$	$\dot{v}$	$\dot{w}$
1	.27485144 07	-.70076819 06	-.66271390 03	.86827485 04	-.23789116 04	-.16464622 02
2	-.70076818 06	.15871602 07	-.12510807 04	-.38293152 04	.26604480 04	.77613213 01
3	-.66271224 03	-.12510757 04	.24935064 07	-.21686163 01	-.72299151 01	.79499732 04
4	.86827485 04	-.38293153 04	-.21686191 01	.44352812 02	-.13184088 02	-.11435554 00
5	-.23789116 04	.26604480 04	-.72299340 01	-.13184088 02	.12537931 02	-.62822416-01
6	-.16464637 02	.77613292 01	.79499732 04	-.11435574 00	-.62822509-01	.43438947 02
7	-.27552839 11	.49743705 10	-.12278836 06	-.13173804 09	.23037683 08	.50373068 02

	wt
1	-.27552839 11
2	.49743705 10
3	-.12272916 06
4	-.13173804 09
5	.23037683 08
6	.50373068 02
7	.21145861 16

Table D-8. Covariance Matrix for 180° Direct, In-Plane Transfer, Orbit Plane Coordinates

COVARIANCE MATRIX OF THE ACTUAL ERRORS FROM REFERENCE

	u	v	w	$\dot{u}$	$\dot{v}$	$\dot{w}$
1	.27353555 07	-.72293154 06	-.36123285 03	.85302795 04	-.23699662 04	-.12075779 01
2	-.72293157 06	.19846476 08	-.19947590 04	-.18686853 05	.12121491 04	-.10935799 02
3	-.36123344 03	-.19947489 04	.24978638 07	-.12785258 01	-.70478178 01	.80356696 04
4	.85302794 04	-.18686853 05	-.12785227 01	.55037109 02	-.11888308 02	-.31512489-02
5	-.23699663 04	.12121492 04	-.70478364 01	-.11888308 02	.12191297 02	-.40637785-01
6	-.12075382 01	-.10935848 02	.80356696 04	-.31512199-02	-.40637761-01	.44135711 02
7	-.40279481 03	.34836605 05	-.47793850 01	-.30323886 02	-.33625296 01	-.25153691-01

	wt
1	-.40279479 03
2	.34836606 05
3	-.47793524 01
4	-.30323886 02
5	-.33625298 01
6	-.25153671-01
7	.30664982 03

COVARIANCE MATRIX OF THE ERRORS IN THE ESTIMATE OF THE ACTUAL

	u	v	w	$\dot{u}$	$\dot{v}$	$\dot{w}$
1	.27510205 07	-.70189537 06	-.38960511 03	.86848234 04	-.23878355 04	-.13306808 01
2	-.70189537 06	.15875634 07	-.11883213 04	-.38255167 04	.26665184 04	-.68618630 01
3	-.38959781 03	-.11883184 04	.24960457 07	-.19799115 01	-.68632463 01	.79565575 04
4	.86848234 04	-.38255167 04	-.19799058 01	.44295026 02	-.13211744 02	-.79762311-02
5	-.23878355 04	.26665184 04	-.68632483 01	-.13211744 02	.12551529 02	-.38954607-01
6	-.13306757 01	-.68618791 01	.79565576 04	-.79761796-02	-.38954592-01	.43211948 02
7	-.40374821 03	-.92792908 03	-.48723717 01	-.18539477 01	-.42421015 01	-.24997208-01

	wt
1	-.40374820 03
2	-.92792908 03
3	-.48723724 01
4	-.18539476 01
5	-.42421015 01
6	-.24997208-01
7	.30664982 03

Table D-9. Covariance Matrix for 180° Direct, Out-of-Plane Transfer, Orbit Plane Coordinates

COVARIANCE MATRIX OF THE ACTUAL ERRORS FROM REFERENCE

	u	v	w	$\dot{u}$	$\dot{v}$	$\dot{w}$
1	.27179575 07	-.81272611 06	-.63265610 05	.84833726 04	-.23070041 04	-.21881617 03
2	-.81272613 06	.19751295 08	-.46084483 05	-.14600562 05	.87634201 03	-.45595054 03
3	-.63265629 05	-.46084494 05	.24663957 07	.29138422 01	.81861844 02	.78609213 04
4	.84833724 04	-.14600562 05	.29138124 01	.49192560 02	-.11617502 02	.64775200-01
5	-.23070040 04	.87634206 03	.81861819 02	-.11617502 02	.12311949 02	.47195601 00
6	-.21881619 03	-.45595050 03	.78609213 04	.64775285-01	.47195606 00	.43236684 02
7	-.52547604 03	.34425062 05	-.23124217 02	-.26038113 02	-.42734045 01	-.20623546 00

	wt
1	-.52547602 03
2	.34425063 05
3	-.23124128 02
4	-.26038113 02
5	-.42734046 01
6	-.20623544 00
7	.30728467 03

COVARIANCE MATRIX OF THE ERRORS IN THE ESTIMATE OF THE ACTUAL

	u	v	w	$\dot{u}$	$\dot{v}$	$\dot{w}$
1	.27299159 07	-.68964942 06	-.62400811 05	.85845696 04	-.23235543 04	-.20537779 03
2	-.68964940 06	.15921773 07	-.81204510 05	-.38064832 04	.26352694 04	-.47893750 03
3	-.62400814 05	-.81204514 05	.24661202 07	.10178423 02	.86489527 02	.78537164 04
4	.85845696 04	-.38064833 04	.10178426 02	.44199956 02	-.13018537 02	.84416399-01
5	-.23235543 04	.26352695 04	.86489532 02	-.13018537 02	.12430488 02	.49681636 00
6	-.20537778 03	-.47893750 03	.78537165 04	.84416371-01	.49681635 00	.43076566 02
7	-.38498597 03	-.92432712 03	-.19676487 02	-.17703141 01	-.42074389 01	-.43872348-01

	wt
1	-.38498597 03
2	-.92432712 03
3	-.19676487 02
4	-.17703141 01
5	-.42074389 01
6	-.43872359-01
7	.30728467 03

Table D-10. Covariance Matrix for 220° Direct, In-Plane Transfer, Orbit Plane Coordinates

COVARIANCE MATRIX OF THE ACTUAL ERRORS FROM REFERENCE

	u	v	w	$\dot{u}$	$\dot{v}$	$\dot{w}$
1	.27307801 07	-.70220644 06	-.33214354 03	.85008176 04	-.23704095 04	-.38978535 00
2	-.70220647 06	.19895463 08	-.40430403 04	-.17658750 05	.71984230 03	-.14622336 02
3	-.33214472 03	-.40430178 04	.24939719 07	.22933155 02	-.75844033 01	.80049492 04
4	.85008176 04	-.17658750 05	.22933238 02	.53385840 02	-.11708616 02	.11689104 00
5	-.23704095 04	.71984225 03	-.75843595 01	-.11708616 02	.12265472 02	-.43965124-01
6	-.38975226 00	-.14622361 02	.80049492 04	.11689094 00	-.43965205-01	.43902383 02
7	-.35013041 03	.35131807 05	-.73633004 01	-.28560878 02	-.43423435 01	-.41356302-01

	wt
1	-.35013030 03
2	.35131806 05
3	-.73632730 01
4	-.28560877 02
5	-.43423437 01
6	-.41356299-01
7	.30731947 03

COVARIANCE MATRIX OF THE ERRORS IN THE ESTIMATE OF THE ACTUAL

	u	v	w	$\dot{u}$	$\dot{v}$	$\dot{w}$
1	.27462652 07	-.70094117 06	-.71936689 03	.86582632 04	-.23826390 04	-.30166627 01
2	-.70094119 06	.15877172 07	-.11309555 04	-.38181356 04	.26661911 04	-.65799723 01
3	-.71937095 03	-.11309513 04	.24922349 07	-.26412885 01	-.75442896 01	.79318625 04
4	.86582632 04	-.38181356 04	-.26413008 01	.25805222 04	.21528650 04	-.48757832 02
5	-.23826390 04	.26661911 04	-.75443007 01	.21528650 04	.18623197 04	-.41670423 02
6	-.30166955 01	-.65799776 01	.79318625 04	-.48757831 02	-.41670420 02	.43988171 02
7	-.39095301 03	-.94482799 03	-.69968149 01	-.21535092 03	-.18669161 03	.40688215 01

	wt
1	-.39095300 03
2	-.94482799 03
3	-.69968155 01
4	-.21535093 03
5	-.18669161 03
6	.40688210 01
7	.30731947 03

Table D-11. Covariance Matrix for Parking Orbit, In-Plane Transfer, Orbit Plane Coordinates

COVARIANCE MATRIX OF THE ACTUAL ERRORS FROM REFERENCE

	u	v	w	$\dot{u}$	$\dot{v}$	$\dot{w}$
1	.27313166 07	-.74260762 06	-.49707048 03	.83931069 04	-.23683967 04	-.19572121 01
2	-.74260772 06	.18400095 08	-.19704064 04	-.20157432 05	.83396799 03	-.10498313 02
3	-.49706061 03	-.19704328 04	.24952053 07	-.10658135 01	-.65025274 01	.78439485 04
4	.83931068 04	-.20157432 05	-.10658300 01	.57283882 02	-.11058353 02	-.41017706-02
5	-.23683966 04	.83396791 03	-.65025254 01	-.11058353 02	.12094163 02	-.36708828-01
6	-.19571950 01	-.10498301 02	.78439485 04	-.41016883-02	-.36708751-01	.42063441 02
7	-.46189741 03	.33574078 05	-.49660393 01	-.34783361 02	-.41449949 01	-.25195884-01

	wt
1	-.46189726 03
2	.33574078 05
3	-.49659478 01
4	-.34783361 02
5	-.41449949 01
6	-.25195975-01
7	.30411077 03

COVARIANCE MATRIX OF THE ERRORS IN THE ESTIMATE OF THE ACTUAL

	u	v	w	$\dot{u}$	$\dot{v}$	$\dot{w}$
1	.27482166 07	-.70147758 06	-.57656379 03	.85450124 04	-.23876569 04	-.23532009 01
2	-.70147757 06	.15879688 07	-.11455539 04	-.37474318 04	.26678087 04	-.64736929 01
3	-.57655803 03	-.11455520 04	.24939303 07	-.19905660 01	-.63688733 01	.78243567 04
4	.85450124 04	-.37474319 04	-.19905692 01	.42753842 02	-.12938012 02	-.83741342-02
5	-.23876569 04	.26678087 04	-.63688717 01	-.12938012 02	.12551836 02	-.35479665-01
6	-.23532056 01	-.64737055 01	.78243567 04	-.83741404-02	-.35479736-01	.41769808 02
7	-.41610817 03	-.92442667 03	-.49424428 01	-.19543607 01	-.42192512 01	-.25353641-01

	wt
1	-.41610817 03
2	-.92442667 03
3	-.49424428 01
4	-.19543607 01
5	-.42192512 01
6	-.25353641-01
7	.30411077 03

Table D-12. Covariance Matrix for Parking Orbit, Out-of-Plane Transfer, Orbit Plane Coordinates

COVARIANCE MATRIX OF THE ACTUAL ERRORS FROM REFERENCE

	u	v	w	$\dot{u}$	$\dot{v}$	$\dot{w}$
1	.27134645 07	-.73493440 06	.62459519 05	.83385767 04	-.23429405 04	.20362930 03
2	-.73493434 06	.18046949 08	.37249627 05	-.19815302 05	.91515291 03	.14084848 03
3	.62459542 05	.37249617 05	.24667050 07	.35309651 02	-.93107473 02	.77488521 04
4	.83385767 04	-.19815302 05	.35309662 02	.57193107 02	-.11177474 02	.20712391 00
5	-.23429405 04	.91515295 03	-.93107449 02	-.11177474 02	.12284388 02	-.54677851 00
6	.20362928 03	.14084846 03	.77488522 04	.20712409 00	-.54677841 00	.41952367 02
7	-.43843091 03	.32499406 05	.81443151 01	-.33593215 02	-.41628772 01	.87323311-01

	wt
1	-.43843091 03
2	.32499406 05
3	.81443151 01
4	-.33593215 02
5	-.41628771 01
6	.87323309-01
7	.30331622 03

COVARIANCE MATRIX OF THE ERRORS IN THE ESTIMATE OF THE ACTUAL

	u	v	w	$\dot{u}$	$\dot{v}$	$\dot{w}$
1	.27283990 07	-.68992069 06	.61861366 05	.84658912 04	-.23546409 04	.20655664 03
2	-.68992069 06	.15925048 07	.78440341 05	-.37399046 04	.26552579 04	.45340702 03
3	.61861372 05	.78440342 05	.24665651 07	-.14059034 02	-.99900389 02	.77626510 04
4	.84658912 04	-.37399046 04	-.14059033 02	.42841762 02	-.12957366 02	-.10126763 00
5	-.23546408 04	.26552580 04	-.99900387 02	-.12957366 02	.12569180 02	-.56206366 00
6	.20655663 03	.45340700 03	.77626509 04	-.10126763 00	-.56206370 00	.41930911 02
7	-.39744375 03	-.91497475 03	.60280449 01	-.18112860 01	-.41621230 01	-.23732891-01

	wt
1	-.39744375 03
2	-.91497475 03
3	.60280413 01
4	-.18112860 01
5	-.41621230 01
6	-.23732877-01
7	.30331622 03

Table D-13. Covariance Matrix for Parking Orbit, In-Plane Transfer, Special Elements

COVARIANCE MATRIX OF THE ACTUAL ERRORS FROM REFERENCE

	R	λ	β	θ	w	$\dot{w}$
1	.27313166 07	-.38911743 00	-.14008137 01	-.12907765 00	-.49707048 03	-.19572121 01
2	-.38911740 00	.13900872-05	.43889249-06	.30583234-07	-.24570101-02	-.13723144-04
3	-.14008137 01	.43889249-06	.11819470-05	.82767592-07	.53676723-03	.25724269-05
4	-.12907766 00	.30583232-07	.82767589-07	.55590854-06	-.34249475-03	-.18247796-05
5	-.49706061 03	-.24570100-02	.53676734-03	-.34249472-03	.24952053 07	.78439485 04
6	-.19571950 01	-.13723115-04	.25724217-05	-.18247822-05	.78439485 04	.42063441 02
7	-.46189741 03	-.15897396-02	.50480935-03	.58357372-02	-.49660393 01	-.25195884-01

	wt
1	-.46189726 03
2	-.15897396-02
3	.50480937-03
4	.58357372-02
5	-.49659478 01
6	-.25195975-01
7	.30411077 03

COVARIANCE MATRIX OF THE ERRORS IN THE ESTIMATE OF THE ACTUAL

	R	λ	β	θ	w	w
1	.27482166 07	-.39320913 00	-.14356528 01	-.12192856 00	-.57656379 03	-.23532009 01
2	-.39320912 00	.14490523-05	.44155458-06	.14789500-06	-.24220554-02	-.13343645-04
3	-.14356528 01	.44155458-06	.12310873-05	.70756712-07	.56195775-03	.26516811-05
4	-.12192856 00	.14789500-06	.70756712-07	.47976135-07	-.19911717-03	-.11252381-05
5	-.57655803 03	-.24220559-02	.56195782-03	-.19911660-03	.24939303 07	.78243567 04
6	-.23532056 01	-.13343672-04	.26516831-05	-.11252400-05	.78243567 04	.41769808 02
7	-.41610817 03	-.16104581-02	.51692587-03	-.16068084-03	-.49424428 01	-.25353641-01

	wt
1	-.41610817 03
2	-.16104581-02
3	.51692587-03
4	-.16068084-03
5	-.49424428 01
6	-.25353641-01
7	.30411077 03

Table D-14. Covariance Matrix for Parking Orbit, Out-of-Plane Transfer, Special Elements

COVARIANCE MATRIX OF THE ACTUAL ERRORS FROM REFERENCE

	R	λ	β	θ	w	ẇ
1	.27134645 07	-.38292994 00	-.13922462 01	-.12774359 00	.62459519 05	.20362930 03
2	-.38292993 00	.14179985-05	.44316157-06	.35951745-07	-.23089491-01	-.16395413-03
3	-.13922462 01	.44316158-06	.11900054-05	.82613017-07	-.12909825-01	-.62234076-04
4	-.12774358 00	.35951740-07	.82613016-07	.54523644-06	.64745998-02	.24481761-04
5	.62459542 05	-.23089496-01	-.12909824-01	.64745906-02	.24667050 07	.77488521 04
6	.20362928 03	-.16395409-03	-.62234104-04	.24481758-04	.77488522 04	.41952367 02
7	-.43843091 03	-.15922486-02	.47481905-03	.56489269-02	.81443151 01	.87323311-01

	wt
1	-.43843091 03
2	-.15922485-02
3	.47481908-03
4	.56489269-02
5	.81443151 01
6	.87323309-01
7	.30331622 03

COVARIANCE MATRIX OF THE ERRORS IN THE ESTIMATE OF THE ACTUAL

	R	λ	β	θ	w	ẇ
1	.27283990 07	-.38460579 00	-.14232783 01	-.11991947 00	.61861366 05	.20655664 03
2	-.38460578 00	.14548776-05	.44579691-06	.14744489-06	-.25667581-01	-.16900311-03
3	-.14232783 01	.44579690-06	.12346881-05	.70384080-07	-.11069969-01	-.60344648-04
4	-.11991947 00	.14744489-06	.70384081-07	.48112931-07	.13634210-01	.78809536-04
5	.61861372 05	-.25667581-01	-.11069969-01	.13634211-01	.24665651 07	.77626510 04
6	.20655663 03	-.16900313-03	-.60344636-04	.78809531-04	.77626509 04	.41930911 02
7	-.39744375 03	-.15863602-02	.48921049-03	-.15903754-03	.60280449 01	-.23732891-01

	wt
1	-.39744375 03
2	-.15863602-02
3	.48921049-03
4	-.15903754-03
5	.60280413 01
6	-.23732877-01
7	.30331622 03

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