# NASA Contractor Report 4102

# A Simulation Study of the Flight Dynamics of Elastic Aircraft

## Volume Two—Data

Martin R. Waszak, John B. Davidson,
and David K. Schmidt

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# A Simulation Study of the Flight Dynamics of Elastic Aircraft

*Volume Two—Data*

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# ACKNOWLEDGMENTS

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# LIST OF SYMBOLS

| Symbol | Meaning |
|---|---|
| $C_{(\cdot)}$ | aerodynamic coefficient for the parameter $(\cdot)$ |
| $F_{pitch}, F_{roll}, F_s$ | stick input forces, lbs |
| $I_{xx}, I_{yy}$, etc. | mass moments of inertia, slug-ft$^2$ |
| $K_{(\cdot)}$ | control gains |
| $\underline{L}$ | aerodynamic rolling moment in body axes, ft-lbs |
| $M$ | Mach number and vehicle mass, slugs |
| $\underline{M}$ | aerodynamic pitching moment in body axes, ft-lbs |
| $\mathit{M}_y$ | generalized modal mass for antisymmetric mode, slug-ft$^2$ |
| $\mathit{M}_z$ | generalized modal mass for symmetric modes, slug-ft$^2$ |
| $\underline{N}$ | aerodynamic yawing moment in body axes, ft-lbs |
| $P_\varepsilon$ | longitudinal tracking error, degrees |
| $Q_{\eta_y}$ | generalized force for antisymmetric mode, ft-lbs |
| $Q_{\eta_z}$ | generalized force for symmetric mode, ft-lbs |
| $R_\varepsilon$ | lateral tracking error, degrees |
| $S$ | wing planform area, ft$^2$ |
| $T$ | total vehicle thrust force, lbs |
| $U, V, W$ | velocity components of vehicle body axes, ft/sec |
| $\underline{W}$ | vehicle weight, lbs |
| $V_{TOT}$ | total velocity, ft/sec |
| $V_0$ | trim velocity, ft/sec |
| $X, Y, Z$ | aerodynamic force components in body axes, lbs |
| $a_{n_{(\cdot)}}, a_{y_{(\cdot)}}$ | normal and lateral accelerations, g's |
| $b$ | wing span, ft |
| $\bar{c}$ | mean aerodynamic chord, ft |
| $g$ | gravitational acceleration, ft/sec$^2$ |
| $h$ | altitude, ft |
| $l_{cp}$ | distance from cg to cockpit in x-direction, ft |
| $n_{z_{(\cdot)}}, n_{y_{(\cdot)}}$ | normal and lateral accelerations, g's |

| Symbol | Meaning |
|--------|---------|
| $p$ | roll rate of vehicle body axes, rad/sec |
| $q$ | pitch rate of vehicle body axes, rad/sec |
| $q_M$ | pitch rate of the ideal body-reference (mean) axes, rad/sec |
| $q_T$ | total pitch rate measured at cockpit location, rad/sec |
| $r$ | yaw rate of vehicle body axes, rad/sec |
| $s$ | Laplace variable |
| $t$ | time, sec |
| $x, y, z$ | coordinate directions of the vehicle body axes |
| $z_{cp}$ | distance from cg to cockpit in negative z-direction, ft |
| | |
| $\Lambda$ | wing sweep, degrees |
| $\Phi_{cp}^y$ | modal displacement at cockpit in y-direction, ft |
| $\Phi_{cp}^z$ | modal displacement at cockpit in z-direction, ft |
| $\Phi_{cp}^\phi$ | fuselage torsional displacement mode shape at cockpit, rad |
| | |
| $\alpha$ | angle of attack, degrees |
| $\beta$ | sideslip angle, degrees |
| $\gamma$ | flight path angle, degrees |
| $\delta_{cv}$ | forward control vane deflection, degrees |
| $\delta_{long}, \delta_{lat}$ | longitudinal and lateral stick deflections, inches |
| $\delta_p$ | pilot stick input, inches |
| $\delta_{ped}$ | rudder pedal deflection, inches |
| $\delta_{RL}, \delta_{RU}$ | lower and upper split rudder deflections, degrees |
| $\delta_{DH}$ | differential horizontal tail deflection, degrees |
| $\delta_t$ | symmetric horizontal tail deflection, degrees |
| $\delta_S$ | spoiler deflection, degrees (right spoiler positive) |
| $\varepsilon_{(\cdot)}$ | tracking errors |
| $\zeta_y, \zeta_z$ | antisymmetric and symmetric modal damping ratios |
| $\eta_y$ | antisymmetric generalized modal coordinate, ft |
| $\eta_z$ | symmetric generalized modal coordinate, ft |
| $\eta_1, \eta_2$ | random variables to drive command signals |
| $\rho$ | atmospheric density, slug/ft$^3$ |

| Symbol | Meaning |
|---|---|
| $\sigma_{(\cdot)}^{2}$ | variance of parameter $(\cdot)$ |
| $\tau_{(\cdot)}$ | time delay and time constant, sec |
| $\phi, \theta, \psi$ | standard Euler angles |
| $\omega$ | frequency, rad/sec |
| $\omega_y$ | invacuo vibration frequency of antisymmetric mode, rad/sec |
| $\omega_z$ | invacuo vibration frequency of symmetric mode, rad/sec |
| $\omega_\theta, \omega_\phi$ | corner frequencies of tracking command filter, rad/sec |

### subscripts

| | |
|---|---|
| C | commanded |
| D | displayed |
| ERROR | error |
| TOT | total |
| TRIM | trim |
| c, cmd, com | commanded |
| cg | center of gravity |
| cp | cockpit |
| n | normal |
| p | pitch |
| r | roll |
| y | antisymmetric mode and lateral direction |
| z | symmetric mode |
| $\gamma$ | flight path |
| $\epsilon$ | error |
| $\theta$ | pitch |
| $\phi$ | roll |
| $\psi$ | yaw |

| Symbol | Meaning |
|---|---|

operations

| $\hat{(\cdot)}$ | measured response of $(\cdot)$ |
| $\dot{(\cdot)}$ | time derivative of $(\cdot)$ |
| $|\cdot|$ | magnitude of $(\cdot)$ |

abbreviations

| AGT | Adage Graphics Terminal |
| A/D | Analogue-to-Digital Converter |
| CRT | Cathode Ray Tube |
| D/A | Digital-to-Analogue Converter |
| ESC | Eigenspace Assignment Controller |
| ETAY | lateral axis structural mode status |
| ETAZ | longitudinal axis structural mode status |
| FNE | engine thrust parameter |
| KQ | gain on pitch-rate feedback in SCAS |
| OMEGAY | antisymmetric mode frequency |
| OMEGAZ | symmetric mode frequency |
| PLA | Power Lever Angle |
| RMS | Root-Mean-Square |
| SCAS | Stability and Control Augmentation System |
| SPDH | Speed Hold (Phugoid Augmentation Controller) |
| THCINC | thrust increment |
| THCDEC | thrust decrement |
| VMS | Langley Visual/Motion Simulator |

# ABSTRACT

The simulation experiment described herein addresses the effects of structural flexibility on the dynamic characteristics of a generic family of aircraft. The simulation was performed using the NASA Langley Visual/Motion Simulator facility. The vehicle models were obtained as part of this research project. The simulation results include complete response data and subjective pilot ratings and comments and so allow a variety of analyses. The subjective ratings and analysis of the time histories indicate that increased flexibility can lead to increased tracking errors, degraded handling qualities, and changes in the frequency content of the pilot inputs. These results, furthermore, are significantly affected by the visual cues available to the pilot.

# APPENDICES

# Appendix 1
## Aerodynamic Data

This appendix consists of the aerodynamic force and moment coefficients and generalized force and moment coefficients for the elastic vehicle model. These nondimensional coefficients are tabulated for various values of vehicle angle on attack, $\alpha$ in degrees. The coefficients that are tabulated correspond to the coefficients which appear in the table of aerodynamic forces and moments, Table 2 in Chapter 2. The values of the coefficients correspond to the forces and moments that occur for the geometry, mass and inertia, and flight condition of the baseline study vehicle.

## Table A.1 - Aerodynamic Force Data

| ALPHA | $C_x$ | $C_{x_q}$ | $C_{x\delta_s}$ | $C_{x\delta_t}$ | $C_{x\delta_{cv}}$ |
|---|---|---|---|---|---|
| -10 | 0.010 | 1.0 | -0.0003 | 0.0042 | 0.0006 |
| -5 | -0.013 | 0 | -0.0003 | 0.0032 | |
| 0 | -0.028 | -2.0 | -0.0005 | 0.0027 | |
| 5 | 0.020 | 1.0 | -0.0007 | 0.0024 | |
| 7.5 | 0.030 | 5.0 | -0.0006 | 0.0016 | |
| 10 | 0.008 | 7. | -0.0002 | 0.0012 | |
| 12.5 | -0.002 | 6.5 | 0.0001 | 0.0018 | |
| 15 | -0.008 | 4.0 | 0.0001 | 0.0018 | |
| 17.5 | -0.013 | 2.0 | 0.0001 | 0.0016 | |
| 20 | -0.015 | 1.0 | 0.0001 | 0.0012 | $\downarrow$ |

| ALPHA | $C_{y_\beta}$ | $C_{y\delta_s}$ | $C_{y\delta_{DH}}$ | $C_{y\delta_{RU}}$ | $C_{y\delta_{RL}}$ | $C_{y\eta_y}$ | $C_{y\dot\eta_y}$ |
|---|---|---|---|---|---|---|---|
| -10 | -0.0131 | -0.00020 | -0.0006 | 0.00292 | 0.00128 | -0.0090 | -0.016 |
| -5 | -0.0130 | -0.00020 | -0.0005 | 0.00227 | 0.00113 | -0.0090 | -0.016 |
| 0 | -0.0110 | -0.00020 | -0.0005 | 0.00187 | 0.00103 | -0.009 | -0.016 |
| 5 | -0.0100 | -0.00020 | -0.0005 | 0.00147 | 0.00103 | -0.009 | -0.016 |
| 7.5 | -0.0100 | -0.0020 | -0.0004 | 0.00157 | 0.00103 | -0.009 | -0.016 |
| 10 | -0.0100 | -0.00020 | -0.0002 | 0.00167 | 0.00103 | -0.009 | -0.016 |
| 12.5 | -0.0100 | -0.00016 | -0.0003 | 0.00177 | 0.00103 | -0.009 | -0.016 |
| 15 | -0.0100 | -0.00010 | -0.0004 | 0.00177 | 0.00103 | -0.009 | -0.016 |
| 17.5 | -0.0090 | -0.00007 | -0.0004 | 0.00177 | 0.00103 | -0.009 | -0.016 |
| 20 | -0.0080 | 0 | -0.0003 | 0.00177 | 0.00103 | -0.009 | -0.016 |

| ALPHA | $C_z$ | $C_{z_q}$ | $C_{z\delta_s}$ | $C_{z\delta_t}$ | $C_{z\eta_z}$ | $C_{z\dot\eta_z}$ | $C_{z\delta_{cv}}$ |
|---|---|---|---|---|---|---|---|
| -10 | 0.14 | -10.0 | 0.0036 | -0.0058 | -0.0288 | -0.0848 | -0.0016 |
| -5 | -0.09 | 18.0 | 0.0036 | -0.0066 | -0.0288 | -0.0848 | |
| 0 | -0.34 | 18.0 | 0.0036 | -0.0078 | -0.0288 | -0.0848 | |
| 5 | -0.60 | -15.0 | 0.0036 | -0.0061 | -0.0288 | -0.0848 | |
| 7.5 | -0.66 | -37.0 | 0.0030 | -0.0040 | -0.0288 | -0.0848 | |
| 10 | -0.66 | -55.0 | 0.0016 | -0.0021 | -0.0288 | -0.0848 | |
| 12.5 | -0.70 | -51.0 | 0.0008 | -0.0010 | -0.0288 | -0.0848 | |
| 15 | .-0.73 | -50.0 | 0.0003 | -0.0003 | -0.0288 | -0.0848 | |
| 17.5 | -0.73 | -40.0 | 0 | -0.0012 | -0.0288 | -0.0848 | |
| 20 | -0.73 | -35.0 | 0 | -0.0028 | -0.0288 | -0.0848 | $\downarrow$ |

Table A.2 - Aerodynamic Moment Data

| ALPHA | $C_{0\beta}$ | $C_{0p}$ | $C_{0r}$ | $C_{0\delta_a}$ | $C_{0\delta_{DH}}$ | $C_{0\delta_{RU}}$ |
|---|---|---|---|---|---|---|
| -10 | 0.0014 | -0.074 | -0.15 | 0.00029 | 0.00010 | 0.00015 |
| -5 | 0.0004 | -0.074 | 0 | 0.00041 | 0.00030 | 0.00006 |
| 0 | -0.0010 | -0.077 | 0.15 | 0.00041 | 0.00028 | 0.00014 |
| 5 | -0.0023 | -0.070 | 0.30 | 0.00041 | 0.00032 | 0.00024 |
| 7.5 | -0.0033 | -0.047 | 0.38 | 0.00033 | 0.00032 | 0.00024 |
| 10 | -0.0043 | -0.047 | 0.43 | 0.00022 | 0.00030 | 0.00026 |
| 12.5 | -0.0049 | -0.020 | 0.48 | 0.00016 | 0.00028 | 0.00021 |
| 15 | -0.0049 | 0 | 0.50 | 0.00011 | 0.00023 | 0.00010 |
| 17.5 | -0.0049 | 0 | 0.45 | 0.00005 | 0.00022 | 0.00010 |
| 20 | -0.0049 | 0 | 0.38 | 0 | 0.00022 | 0.00009 |

| $C_{0\delta_{RL}}$ | $C_{0\eta_y}$ | $C_{0\dot{\eta}_y}$ |
|---|---|---|
| 0.00004 | 0.0678 | 0.0243 |
| 0.00002 | 0.0678 | 0.0243 |
| 0.00003 | 0.0678 | 0.0243 |
| 0.00005 | 0.0678 | 0.0243 |
| 0.00006 | 0.0678 | 0.0243 |
| 0.00006 | 0.0678 | 0.0243 |
| 0.00005 | 0.0678 | 0.0243 |
| 0.00003 | 0.0678 | 0.0243 |
| 0.00002 | 0.0678 | 0.0243 |
| 0.00002 | 0.0678 | 0.0243 |

| ALPHA | $C_m$ | $C_{m_q}$ | $C_{m_\alpha}$ | $C_{m\delta_e}$ | $C_{m\delta_f}$ | $C_{m\eta_z}$ | $C_{m\dot{\eta}_z}$ | $C_{m\delta_{cv}}$ |
|---|---|---|---|---|---|---|---|---|
| -10 | 0.029 | -35.0 | -4.0 | 0.0080 | -0.042 | -0.0321 | -0.159 | 0.014 |
| -5 | -0.111 | -35.0 | -4.0 | 0.0080 | -0.042 | -0.0321 | -0.159 | |
| 0 | -0.252 | -34.7 | -4.2 | 0.0090 | -0.045 | -0.0321 | -0.159 | |
| 5 | -0.399 | -35.2 | -5.2 | 0.0090 | -0.046 | -0.0321 | -0.159 | |
| 7.5 | -0.358 | -34.0 | -5.6 | 0.0090 | -0.046 | -0.0321 | -0.159 | |
| 10 | -0.300 | -28.8 | -6.0 | 0.0080 | -0.045 | 0 | 0 | |
| 12.5 | -0.260 | -20.0 | -6.6 | 0.0070 | -0.043 | 0 | 0 | |
| 15 | -0.265 | -11.5 | -4.5 | 0 | -0.039 | 0 | 0 | |
| 17.5 | 0 | -13.0 | -2.6 | 0 | -0.034 | 0 | 0 | |
| 20 | 0 | -13.2 | -0.8 | 0 | -0.028 | 0 | 0 | |

Table A.2 - Aerodynamic Moment Data  concluded

| ALPHA | $C_{n_\beta}$ | $C_{n_{\dot\beta}}$ | $C_{n_p}$ | $C_{n_r}$ | $C_{n\delta_a}$ | $C_{n\delta_{DH}}$ | $C_{n\delta_{RU}}$ | $C_{n\delta_{RL}}$ |
|---|---|---|---|---|---|---|---|---|
| -10 | 0.0020 | 0.051 | 0.038 | -0.140 | 0.00015 | 0.00016 | -0.00031 | -0.00044 |
| -5 | 0.0019 | 0.065 | -0.027 | -0.135 | 0.00016 | 0.00013 | -0.00031 | -0.00044 |
| 0 | 0.0020 | 0.075 | -0.080 | -0.135 | 0.00018 | 0.00012 | -0.00030 | -0.00044 |
| 5 | 0.0023 | 0.070 | -0.085 | -0.130 | 0.00018 | 0.00012 | -0.00030 | -0.00044 |
| 7.5 | 0.0022 | 0.060 | -0.065 | -0.130 | 0.00021 | 0.00007 | -0.00034 | -0.00045 |
| 12.5 | 0.0019 | 0.133 | 0.055 | -0.080 | 0.00021 | 0.00003 | -0.00032 | -0.00051 |
| 15 | 0.0017 | 0.228 | 0.030 | -0.030 | 0.00014 | 0.00008 | -0.00026 | -0.00052 |
| 17.5 | 0.0012 | 0.288 | 0.025 | -0.025 | 0.00006 | 0.00009 | -0.00026 | -0.00046 |
| 20 | 0.0005 | 0.309 | 0.015 | -0.030 | 0 | 0.00003 | -0.00026 | -0.00038 |

| ALPHA | $C_{n\eta_y}$ | $C_{n\dot\eta_y}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|
| -10 | 0.0080 | 0.0052 | | | | | | |
| -5 | 0.0080 | 0.0052 | | | | | | |
| 0 | 0.0080 | 0.0052 | | | | | | |
| 5 | 0.0080 | 0.0052 | | | | | | |
| 7.5 | 0.0080 | 0.0052 | | | | | | |
| 10 | 0.0080 | 0.0052 | | | | | | |
| 12.5 | 0.0080 | 0.0052 | | | | | | |
| 15 | 0.0080 | 0.0052 | | | | | | |
| 17.5 | 0.0080 | 0.0052 | | | | | | |
| 20 | 0.0080 | 0.0052 | | | | | | |

Table A.3 - Aerodynamic Structural Data

| ALPHA | $C_{\eta_y}$ | $C_{\eta_y\beta}$ | $C_{\eta_y P}$ | $C_{\eta_y r}$ | $C_{\eta_y\delta_s}$ | $C_{\eta_y\delta_{DH}}$ | $C_{\eta_y\delta_{RU}}$ |
|---|---|---|---|---|---|---|---|
| -10 | 0 | -0.00046 | 0.00157 | 0.00077 | -0.0219 | -0.0064 | 0.00367 |
| -5 | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| 0 | | | | | | | |
| 5 | | | | | | | |
| 7.5 | | | | | | | |
| 10 | | | | | | | |
| 12.5 | | | | | | | |
| 15 | | | | | | | |
| 17.5 | | | | | | | |
| 20 | | | | | | | |

| ALPHA | $C_{\eta_y\delta_{RL}}$ | $C_{\eta_y\eta_y}$ | $C_{\eta_y\dot{\eta}_y}$ | $C_{\eta_y\delta_{cv}}$ | | | |
|---|---|---|---|---|---|---|---|
| -10 | 0.0011 | -1.700 | -0.923 | 0 | | | |
| -5 | ↓ | ↓ | ↓ | ↓ | | | |
| 0 | | | | | | | |
| 5 | | | | | | | |
| 7.5 | | | | | | | |
| 10 | | | | | | | |
| 12.5 | | | | | | | |
| 15 | | | | | | | |
| 17.5 | | | | | | | |
| 20 | | | | | | | |

Table A.3 - Aerodynamic Structural Data  concluded

| ALPHA | $C_{\eta_z}$ | $C_{\eta_z\alpha}$ | $C_{\eta_z\dot\alpha}$ | $C_{\eta_z q}$ | $C_{\eta_z\delta_s}$ | $C_{\eta_z\delta_t}$ | $C_{\eta_z\eta_z}$ |
|---|---|---|---|---|---|---|---|
| -10 | 0 | -0.00113 | 0 | -1.452 | 0.0009 | -0.00342 | 0.00064 |
| -5 | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| 0 | | | | | | | |
| 5 | | | | | | | |
| 7.5 | | | | | | | |
| 10 | | | | | | | |
| 12.5 | | | | | | | |
| 15 | | | | | | | |
| 17.5 | | | | | | | |
| 20 | | | | | | | |

| ALPHA | $C_{\eta_z\dot\eta_z}$ | $C_{\eta_z\delta_{cv}}$ | | | | | |
|---|---|---|---|---|---|---|---|
| -10 | -0.00966 | -0.00227 | | | | | |
| -5 | ↓ | ↓ | | | | | |
| 0 | | | | | | | |
| 5 | | | | | | | |
| 7.5 | | | | | | | |
| 10 | | | | | | | |
| 12.5 | | | | | | | |
| 15 | | | | | | | |
| 17.5 | | | | | | | |
| 20 | | | | | | | |

# Appendix 2
# Structural Mode Data

The control point locations and corresponding normalized structural deflections for the study vehicle are presented in this appendix. Figure A.1 depicts the locations of the control points. Figure A.2 presents the sign conventions for the mode shapes and their deflections and slopes. The modal deflections are defined to be positive in the positive coordinate directions. They are normalized so that the deflection at the nose (i.e. fuselage station 0) is one foot. The structural coordinates are defined so that the x-axis lies along the longitudinal axis of the vehicle and is directed forward. The y-axis lies in the plane of the wings, is orthogonal to the x-axis and points out the right wing. The z-axis is orthogonal to the xy-plane and is directed downward. The origin of the xyz-coordinate system is at the center of mass of the aircraft.

The deflections of the control points for the lowest frequency symmetric and antisymmetric modes are presented in the tables that follow. This mode shape data was used to obtain the mode shape plots presented in Figure 3 in Chapter 2.
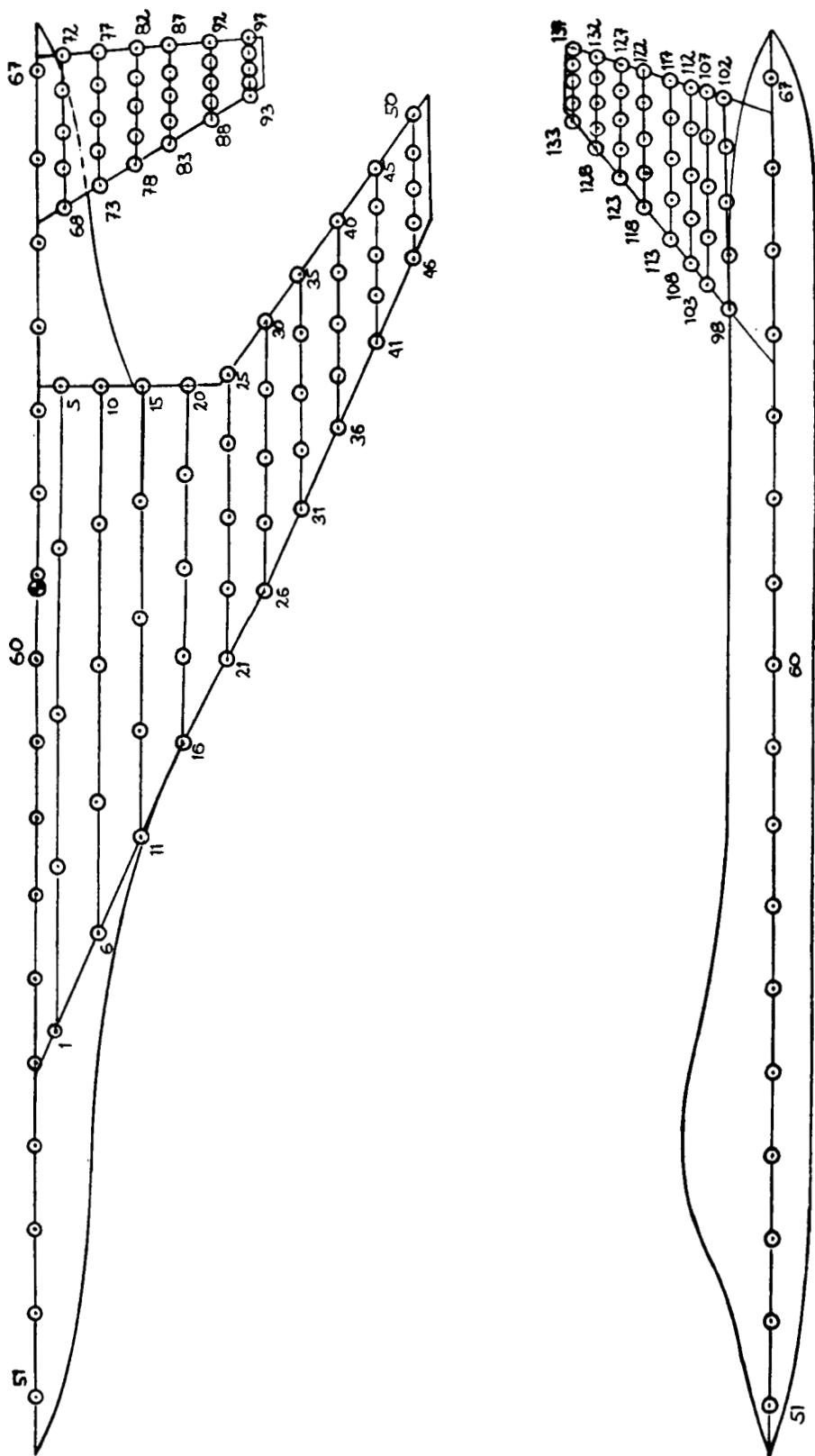
Figure A.1 - Structural Control Point Locations

# MODE SHAPE SIGN CONVENTIONS
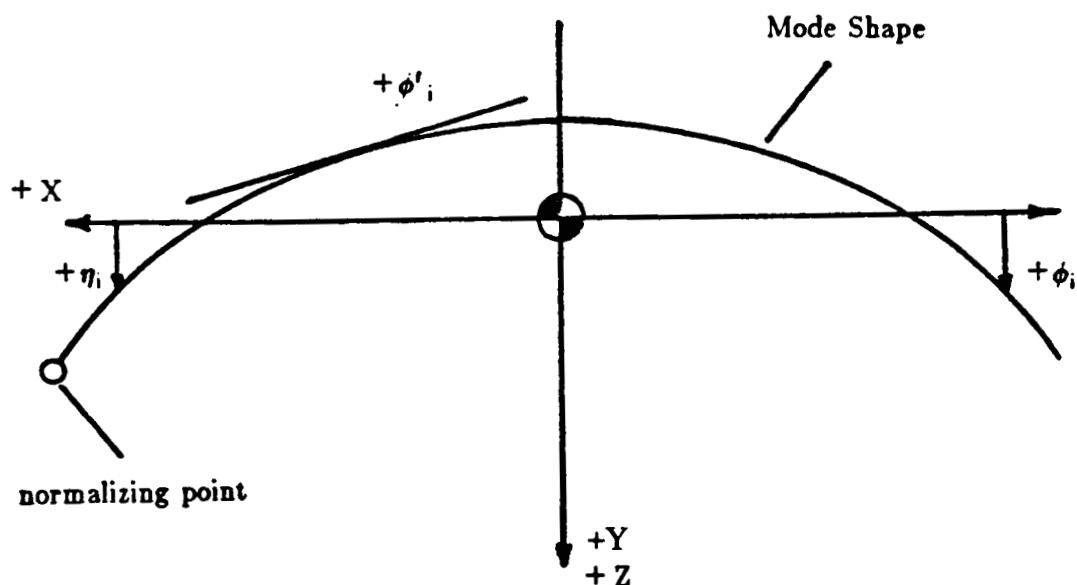


$\phi_i \triangleq$ mode deflection (feet)

$\phi'_i \triangleq$ mode slope (feet/feet)

$\eta_i \triangleq$ generalized deflection (dimensionless)

Figure A.2 - Mode Shape Sign Conventions

Table A.4 - Modal Data : Wing

| Control Point | Fuselage Station (in.) | Butt Plane (in.) | Wing Deflections (ft.) | |
|---|---|---|---|---|
| | | | Symmetric Mode | Antisymmetric Mode |
| 1 | 509.0 | 24.0 | 0.134767 | -0.00529188 |
| 2 | 708.25 | 24.0 | -0.138436 | -0.00511932 |
| 3 | 907.25 | 24.0 | -0.141176 | -0.00496657 |
| 4 | 1106.8 | 24.0 | -0.0709361 | 0.175614 |
| 5 | 1306.0 | 24.0 | 0.0143585 | 0.470995 |
| 6 | 625.0 | 72.0 | -0.0953299 | -0.0155787 |
| 7 | 795.25 | 72.0 | -0.154605 | -0.0151372 |
| 8 | 965.5 | 72.0 | -0.124002 | -0.00717671 |
| 9 | 1135.8 | 72.0 | -0.0587528 | 0.718319 |
| 10 | 1306.0 | 72.0 | 0.0143585 | 1.41295 |
| 11 | 740.0 | 120.0 | -0.188116 | 0.711527 |
| 12 | 881.5 | 120.0 | -0.157258 | 0.216667 |
| 13 | 1023.0 | 120.0 | -0.101854 | -0.216821 |
| 14 | 1164.5 | 120.0 | -0.0359900 | -0.00717671 |
| 15 | 1306.0 | 120.0 | 0.0400484 | -1.61333 |
| 16 | 858.0 | 171.0 | -0.182679 | 0.412947 |
| 17 | 970.0 | 171.0 | -0.125595 | -0.227527 |
| 18 | 1082.0 | 171.0 | -0.0686746 | -0.952831 |
| 19 | 1194.0 | 171.0 | -0.0058470 | -2.02406 |
| 20 | 1306.0 | 171.0 | 0.0712297 | -3.58068 |
| 21 | 963.0 | 225.0 | -0.130195 | -0.352080 |
| 22 | 1052.5 | 225.0 | -0.0807926 | -0.949884 |
| 23 | 1142.0 | 225.0 | -0.0289801 | -1.79710 |
| 24 | 1231.5 | 225.0 | 0.0330662 | -2.97565 |
| 25 | 1321.0 | 225.0 | 0.107921 | -4.55961 |
| 26 | 1053.0 | 269.0 | -0.0837392 | -1.07092 |
| 27 | 1135.2 | 269.0 | -0.0341160 | -1.88686 |
| 28 | 1217.5 | 269.0 | 0.0233756 | -2.96850 |
| 29 | 1299.8 | 269.0 | 0.0927204 | -4.42628 |
| 30 | 1382.0 | 269.0 | 0.175921 | -6.30396 |
| 31 | 1147.0 | 313.0 | -0.0248385 | -2.22464 |
| 32 | 1220.8 | 313.0 | 0.0298222 | -3.28454 |
| 33 | 1294.5 | 313.0 | 0.0928292 | -4.62097 |
| 34 | 1368.2 | 313.0 | 0.168843 | -6.34319 |
| 35 | 1442.0 | 313.0 | 0.256431 | -8.40589 |
| 36 | 1242.0 | 358.0 | 0.0501250 | -3.89604 |
| 37 | 1307.4 | 358.0 | 0.109710 | -5.19295 |
| 38 | 1372.8 | 358.0 | 0.178917 | -6.77517 |
| 39 | 1438.1 | 358.0 | 0.257035 | -8.62406 |
| 40 | 1503.5 | 358.0 | 0.339823 | -1.06203 |
| 41 | 1339.0 | 403.0 | 0.145596 | -6.19584 |
| 42 | 1395.8 | 403.0 | 0.211324 | -7.73575 |
| 43 | 1452.5 | 403.0 | 0.280700 | -9.39314 |
| 44 | 1509.2 | 403.0 | 0.354708 | -11.1836 |
| 45 | 1566.0 | 403.0 | 0.433277 | -13.0908 |
| 46 | 1434.0 | 447.0 | 0.264467 | -9.20502 |
| 47 | 1482.5 | 447.0 | 0.327487 | -10.7275 |
| 48 | 1531.5 | 447.0 | 0.392753 | -12.3092 |
| 49 | 1580.2 | 447.0 | 0.459351 | -13.9266 |
| 50 | 1629.0 | 447.0 | 0.525813 | -15.5401 |

Table A.5 - Modal Data : Fuselage, Tail

| Control Point | Fuselage Station (in.) | Butt Plane (in.) | Fuselage Displacement (ft.) | |
|---|---|---|---|---|
| | | | Symmetric Mode | Antisymmetric Mode |
| 51 | 72.0 | 0.0 | 1.00 | 1.00 |
| 52 | 172.0 | 0.0 | 0.725128 | 0.752280 |
| 53 | 272.0 | 0.0 | 0.444520 | 0.500628 |
| 54 | 372.0 | 0.0 | 0.220083 | 0.291652 |
| 55 | 472.0 | 0.0 | 0.0557356 | 0.131140 |
| 56 | 572.0 | 0.0 | −0.0556486 | 0.0287140 |
| 57 | 672.0 | 0.0 | −0.123779 | −0.0395304 |
| 58 | 772.0 | 0.0 | −0.152392 | −0.0799198 |
| 59 | 872.0 | 0.0 | −0.149516 | −0.106551 |
| 60 | 972.0 | 0.0 | −0.121980 | −0.123343 |
| 61 | 1072.0 | 0.0 | −0.0850331 | −0.136570 |
| 62 | 1172.0 | 0.0 | −0.0435321 | −0.146232 |
| 63 | 1272.0 | 0.0 | 0.0124225 | −0.150222 |
| 64 | 1372.0 | 0.0 | 0.0476976 | −0.146850 |
| 65 | 1472.0 | 0.0 | 0.102925 | −0.133034 |
| 66 | 1572.0 | 0.0 | 0.182146 | −0.109942 |
| 67 | 1683.0 | 0.0 | 0.283587 | −0.0858145 |

| Control Point | Fuselage Station (in.) | Butt Plane (in.) | Horizontal Tail Displacement (ft.) | |
|---|---|---|---|---|
| | | | Symmetric Mode | Antisymmetric Mode |
| 68 | 1509.0 | 2.6 | 0.139051 | 0.579749 |
| 69 | 1557.75 | 2.6 | 0.167729 | 0.580116 |
| 70 | 1606.5 | 2.6 | 0.196390 | 0.580502 |
| 71 | 1655.25 | 2.6 | 0.225057 | 0.508069 |
| 72 | 1704.0 | 2.6 | 0.253724 | 0.581237 |
| 73 | 1538.0 | 7.0 | 0.155290 | 1.53797 |
| 74 | 1580.75 | 7.0 | 0.183866 | 1.59169 |
| 75 | 1623.5 | 7.0 | 0.212379 | 1.65005 |
| 76 | 1666.25 | 7.0 | 0.241100 | 1.71845 |
| 77 | 1709.0 | 7.0 | 0.269892 | 1.78918 |
| 78 | 1564.0 | 11.2 | 0.175834 | 2.62599 |
| 79 | 1601.25 | 11.2 | 0.200924 | 2.64232 |
| 80 | 1638.5 | 11.2 | 0.226280 | 2.68232 |
| 81 | 1675.75 | 11.2 | 0.251626 | 2.74309 |
| 82 | 1713.0 | 11.2 | 0.276976 | 2.80618 |
| 83 | 1592.0 | 15.6 | 0.198652 | 3.64985 |
| 84 | 1623.0 | 15.6 | 0.220458 | 3.69440 |
| 85 | 1654.0 | 15.6 | 0.242372 | 3.74502 |
| 86 | 1685.0 | 15.6 | 0.264412 | 3.81121 |
| 87 | 1716.0 | 15.6 | 0.286702 | 3.87768 |
| 88 | 1621.0 | 20.1 | 0.225144 | 4.81932 |
| 89 | 1646.0 | 20.1 | 0.243351 | 4.86860 |
| 90 | 1671.0 | 20.1 | 0.261732 | 4.92077 |
| 91 | 1696.0 | 20.1 | 0.280271 | 4.97623 |
| 92 | 1721.0 | 20.1 | 0.298967 | 5.03478 |
| 93 | 1649.0 | 24.6 | 0.253577 | 6.02821 |
| 94 | 1668.0 | 24.6 | 0.267826 | 6.08184 |
| 95 | 1687.0 | 24.6 | 0.282179 | 6.13875 |
| 96 | 1706.0 | 24.6 | 0.296624 | 6.19836 |
| 97 | 1725.0 | 24.6 | 0.311216 | 6.26058 |

Table A.5 - Modal Data : Fuselage, Tail concluded

| Control Point | Fuselage Station (in.) | Butt Plane (in.) | Vertical Tail Displacement (ft.) Antisymmetric Mode Only |
|---|---|---|---|
| 98 | 1406.4 | 84.54 | 0.960609 |
| 99 | 1470.02 | 84.54 | 1.02464 |
| 100 | 1533.65 | 84.54 | 1.08966 |
| 101 | 1597.27 | 84.54 | 1.13121 |
| 102 | 1660.9 | 84.54 | 1.17671 |
| 103 | 1433.9 | 107.5 | 1.50415 |
| 104 | 1492.65 | 107.5 | 1.57845 |
| 105 | 1551.4 | 107.5 | 1.60744 |
| 106 | 1610.15 | 107.5 | 1.65526 |
| 107 | 1668.9 | 107.5 | 1.72058 |
| 108 | 1458.4 | 127.23 | 1.96203 |
| 109 | 1512.65 | 127.23 | 1.99865 |
| 110 | 1566.9 | 127.23 | 2.05256 |
| 111 | 1621.15 | 127.23 | 2.10676 |
| 112 | 1675.4 | 127.23 | 2.16116 |
| 113 | 1488.9 | 152.0 | 2.48309 |
| 114 | 1537.4 | 152.0 | 2.55807 |
| 115 | 1585.9 | 152.0 | 2.63681 |
| 116 | 1634.4 | 152.0 | 2.73140 |
| 117 | 1682.9 | 152.0 | 2.82589 |
| 118 | 1527.9 | 184.62 | 3.17362 |
| 119 | 1569.4 | 184.62 | 3.32290 |
| 120 | 1610.9 | 184.62 | 3.43652 |
| 121 | 1652.4 | 184.62 | 3.53246 |
| 122 | 1693.9 | 184.62 | 3.68473 |
| 123 | 1563.4 | 213.31 | 4.00473 |
| 124 | 1598.4 | 213.31 | 4.07662 |
| 125 | 1633.4 | 213.31 | 4.16280 |
| 126 | 1668.4 | 213.31 | 4.29739 |
| 127 | 1703.4 | 213.31 | 4.44783 |
| 128 | 1598.4 | 242.18 | 4.74522 |
| 129 | 1627.15 | 242.18 | 4.85121 |
| 130 | 1655.9 | 242.18 | 4.95758 |
| 131 | 1684.65 | 242.18 | 5.07749 |
| 132 | 1713.4 | 242.18 | 5.26976 |
| 133 | 1635.4 | 269.15 | 5.51623 |
| 134 | 1658.02 | 269.15 | 5.61797 |
| 135 | 1680.65 | 269.15 | 5.74599 |
| 136 | 1703.27 | 269.15 | 5.89924 |
| 137 | 1725.9 | 269.15 | 6.04927 |

# Appendix 3
## SCAS Gain Schedules and Nonlinear Effects

The gain schedules that were used in the stability and control augmentation systems for the study vehicle are presented in this appendix. Nonlinear properties and gearing effects in the control system are also presented here. Figures A.3 and A.4 depict the variation of the pitch SCAS gains $K_{M\theta}$ and $K_{h\theta}$ with variations in flight condition (i.e. Mach number and altitude, respectively). Figure A.5 depicts the variation of the yaw SCAS gain $K_{h\psi}$ with variations in altitude. Figure A.6 presents the nonlinear relationship between longitudinal stick displacement and symmetric horizontal tail deflections. Figure A.7 presents the relationship between lateral stick displacement and spoiler deflections. Finally, Figure A.8 depicts the limits that are imposed on differential tail displacement due to commanded symmetric tail displacement.

Figure A.3 - Pitch Axis Gain Schedule : $K_{M\theta}$
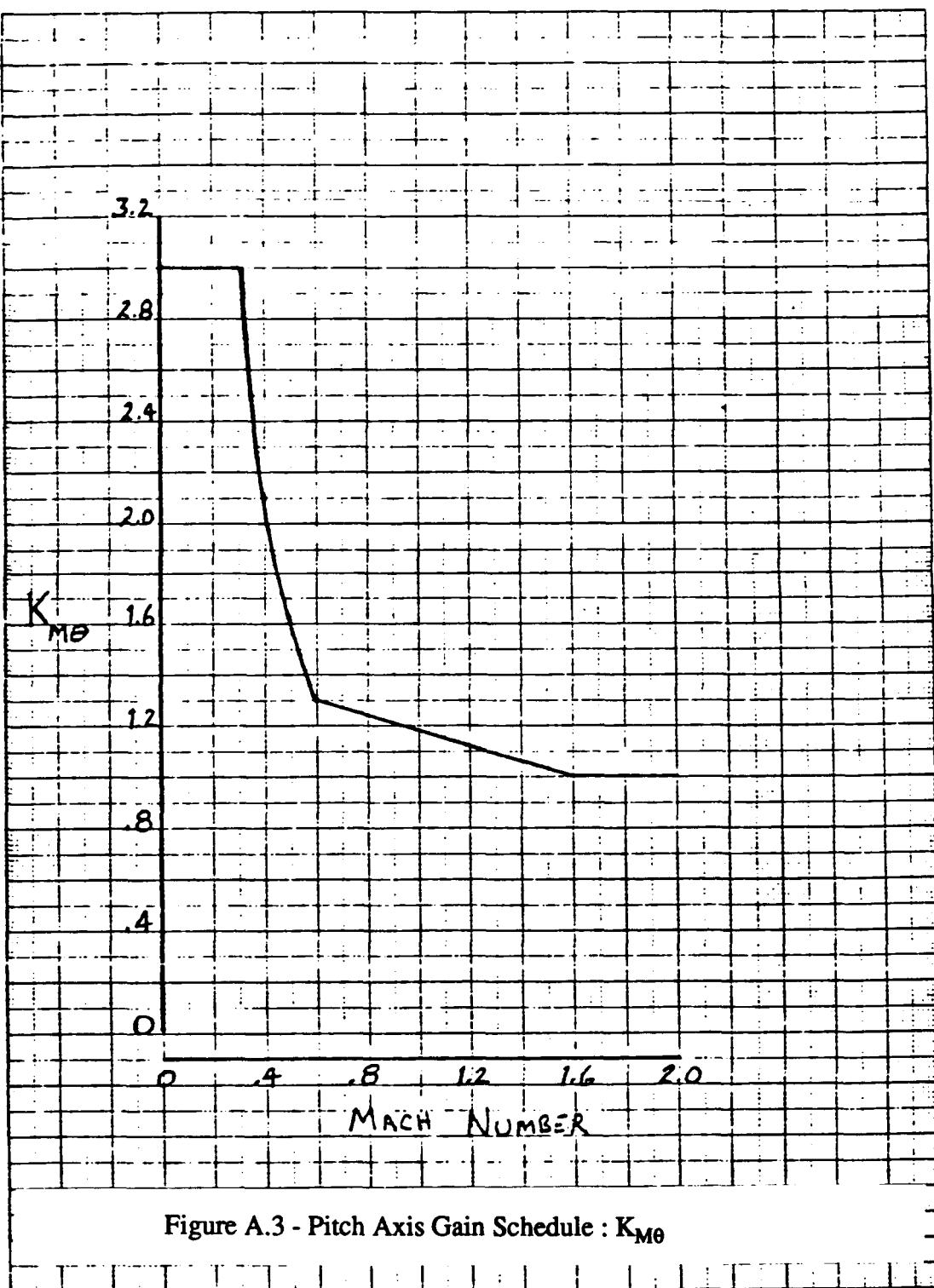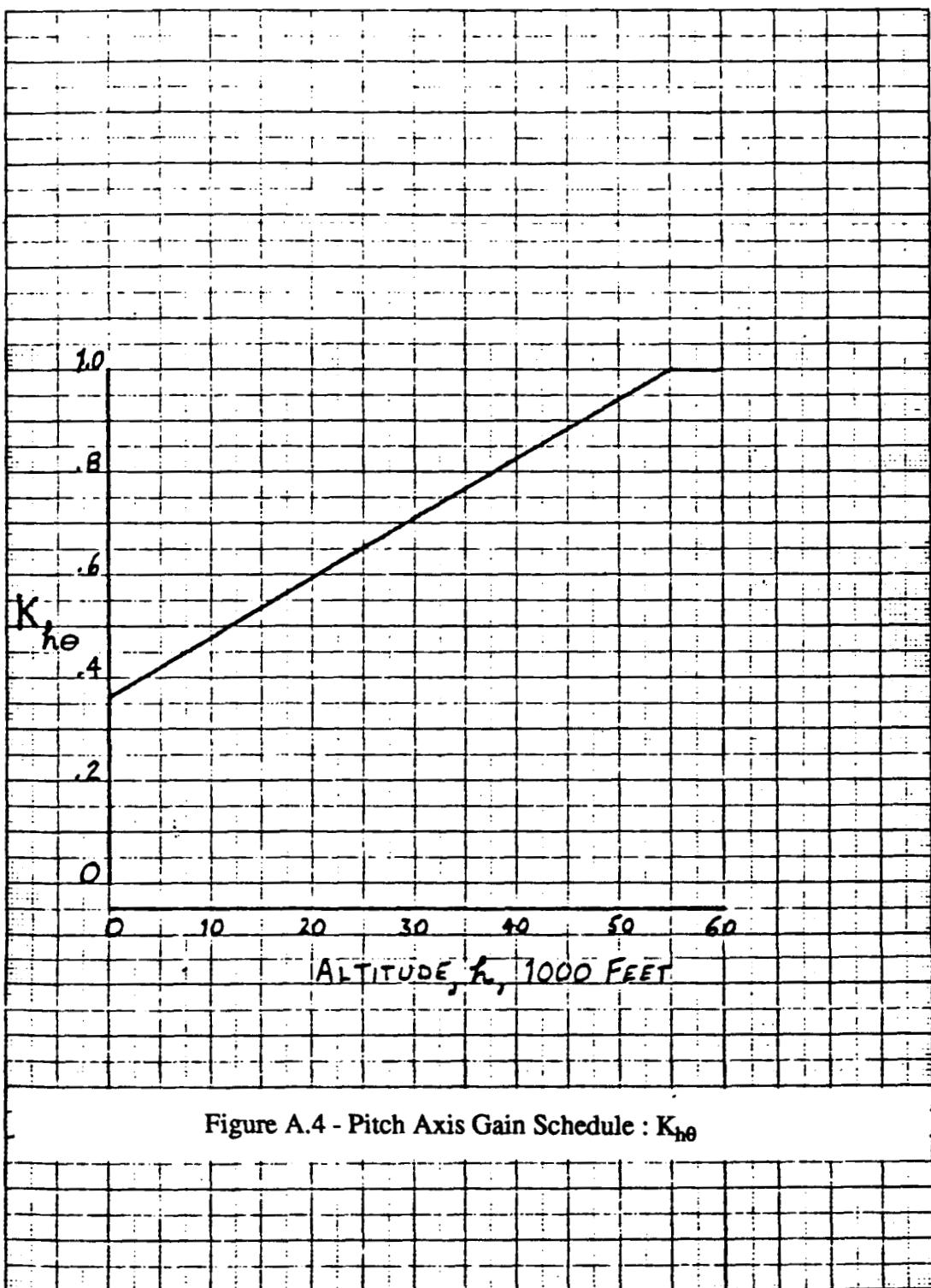
Figure A.4 - Pitch Axis Gain Schedule : $K_{h\theta}$

Figure A.5 - Yaw Axis Gain Schedule : $K_{h\psi}$

Figure A.6 - Pitch Axis Gearing Effects :
Tail Surface Deflection vs.Stick Displacement
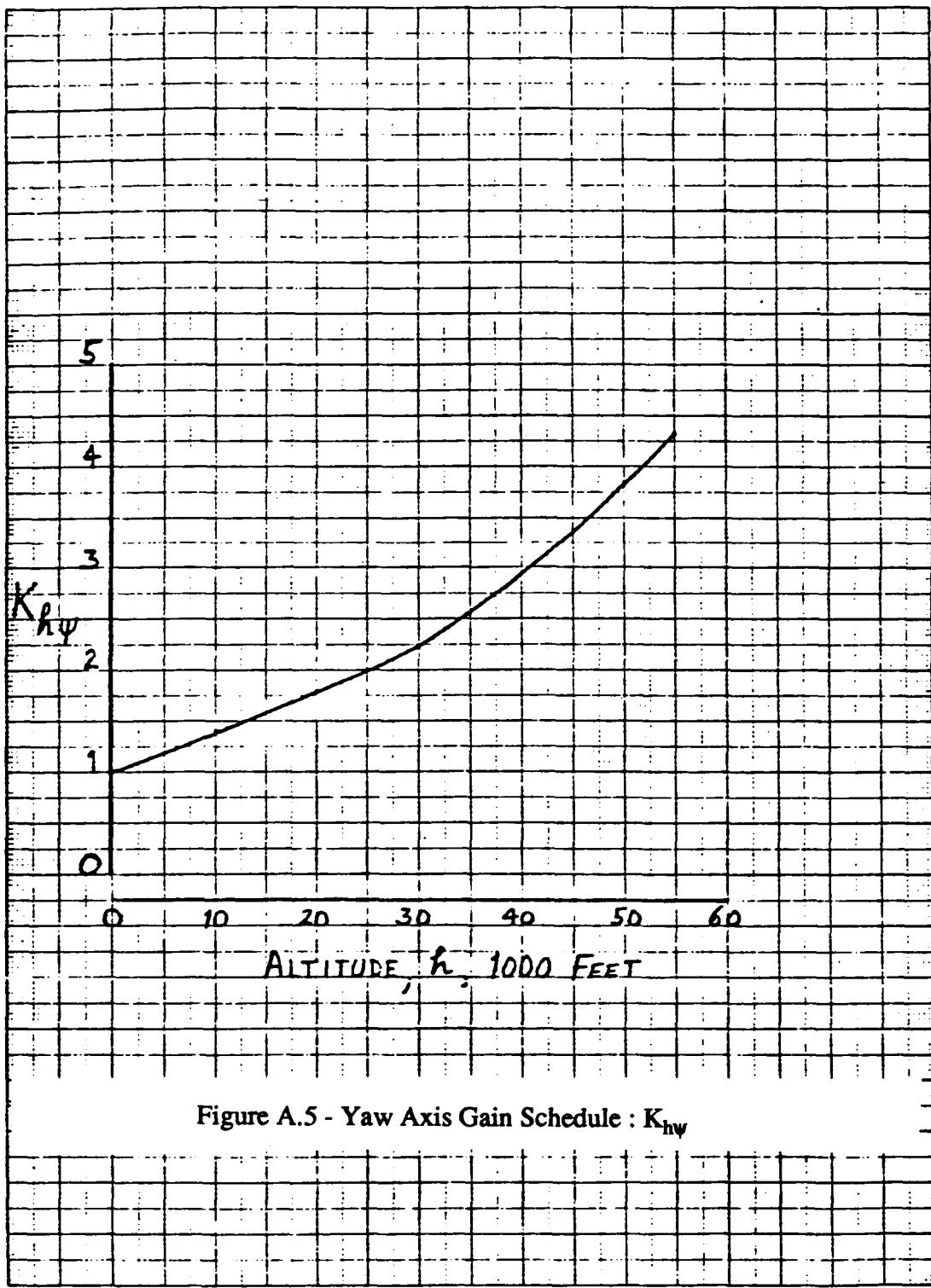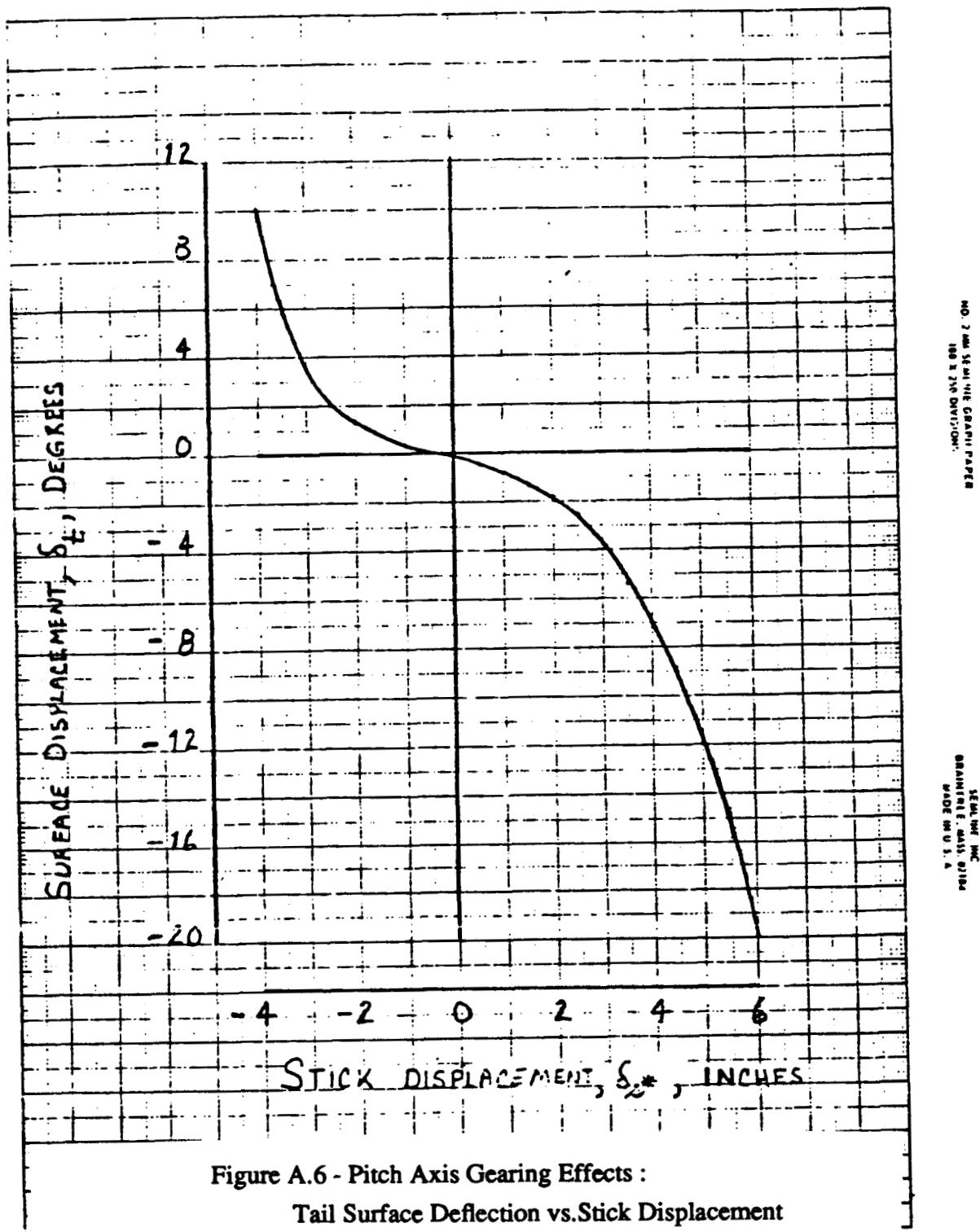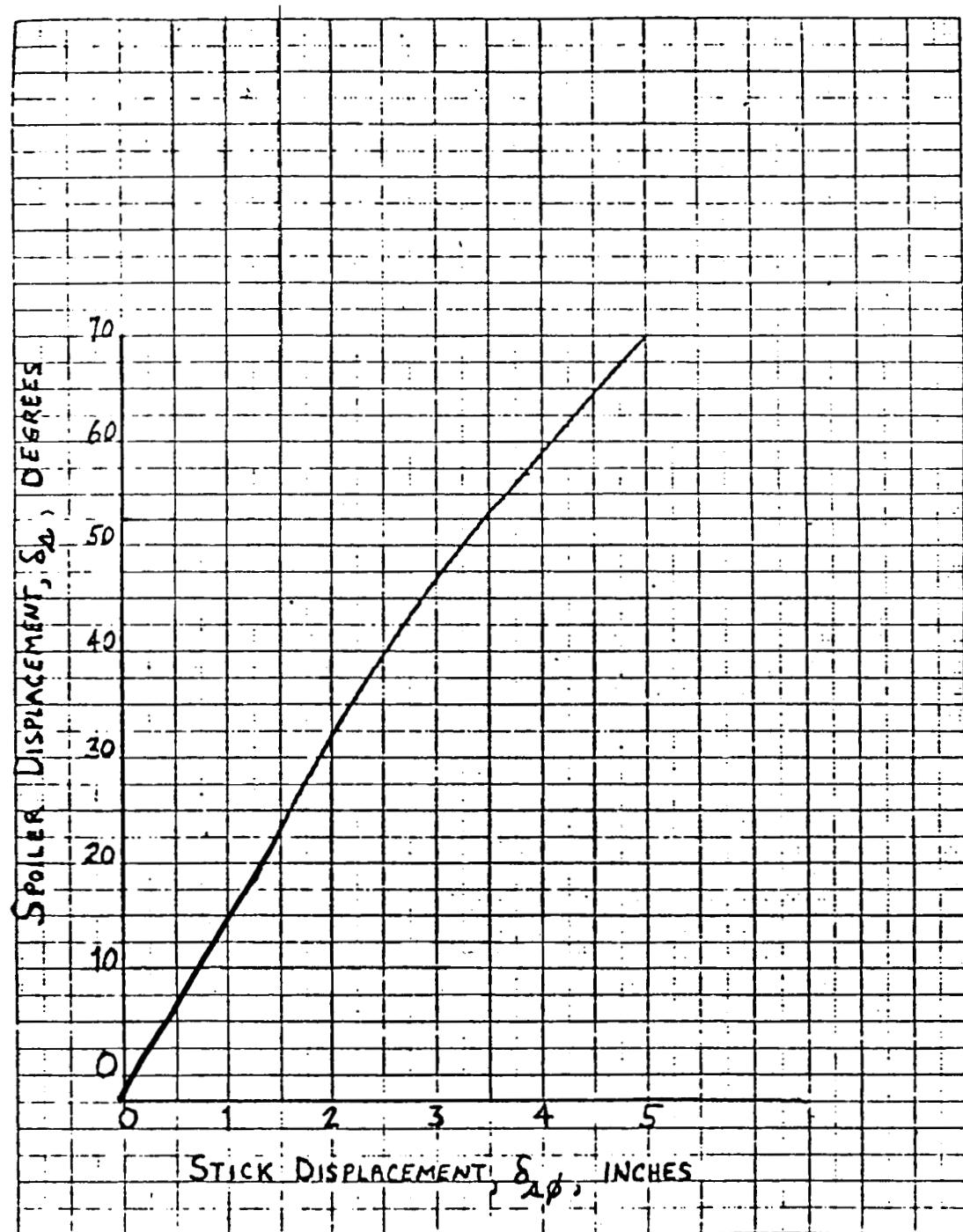
Figure A.7 - Pitch Axis Gearing Effects :

Spoiler Surface Deflection vs. Stick Displacement
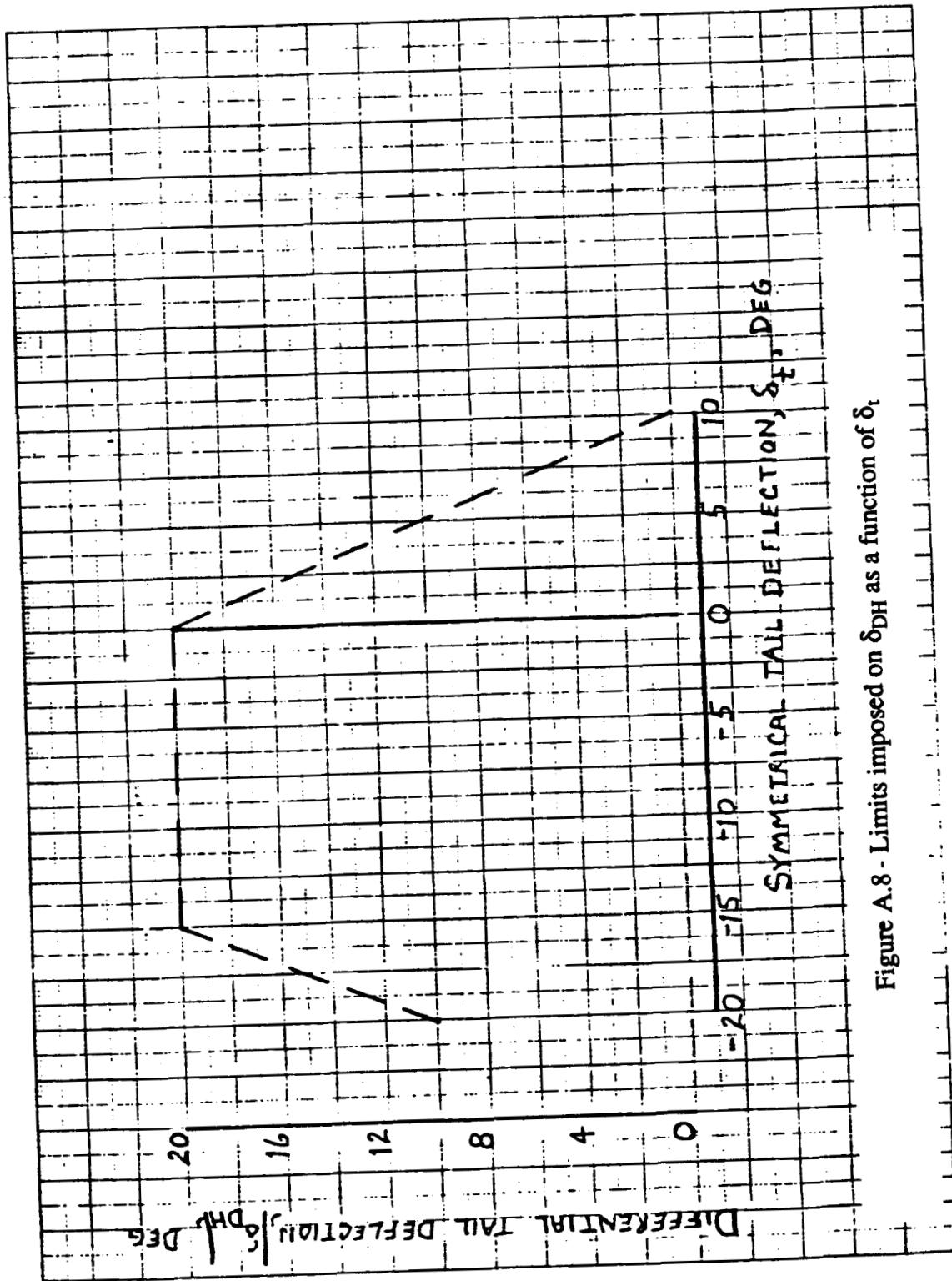
Figure A.8 - Limits imposed on $\delta_{DH}$ as a function of $\delta_t$

# Appendix 4
## Configuration Listings

This appendix contains the specifications for the vehicle configurations that were studied in the simulation experiment. It also contains a chronological listing of the runs that were completed. The first table below presents the values for the dynamic parameters that were assigned to each configuration. These dynamic parameters specify the degree of flexibility in terms of the structural mode vibration frequencies $,\omega_y$ and $\omega_z$, which correspond to the antisymmetric and symmetric modes, respectively. The parameters "ETAY" and "ETAZ" indicate whether or not the antisymmetric or symmetric modes, respectively, were implemented in the simulation. The dynamic parameters also indicate the control system status. The SCAS status is indicated by the parameter SCAS which takes on values of either ON or OFF, if ON the stability and control augmentation systems were enabled. The gain on pitch rate in the pitch SCAS, KQ, is also indicated since this parameter was varied throughout the experiment. The status of the phugoid augmentation controller (i.e. the "speed hold") is indicated by the SPDH parameter. When this value is ON the phugoid augmentation was enabled and when OFF the phugoid augmentation was not used. An additional parameter, OLD CASE, is included in the configuration list. This parameter indicates the case number assigned to the combination of experimental and dynamic parameters when the experiment was conducted. The old case number is useful when cross referencing the experimental data.

The chronological listing provides the case number associated with each simulation run that was made during the experiment. This chronological listing provides a means by which any run number or configuration number can be cross referenced. It also gives some indication of the availability of various forms of data that was collected during the simulation study such as digitally tabulated response data or strip chart plots of vehicle responses.

Table A.6 - Configuration Specifications

| CASE NO. | ETAY | ETAZ | OMEGY | OMEGZ | SCAS | KQ | SPDH | OLD CASE |
|----------|------|------|-------|-------|------|-----|------|----------|
| 1A-11-1 | OFF | OFF | – | – | ON | 2.0 | OFF | 4 |
| 1A-11-2 | OFF | ON | 2.0 | 2.0 | ON | 2.0 | OFF | 10 |
| 1A-11-3 | OFF | ON | 2.0 | 1.75 | ON | 2.0 | OFF | 16 |
| 1A-11-4 | OFF | ON | 2.0 | 1.5 | ON | 2.0 | ON | 22 |
| 1A-21-1 | OFF | OFF | – | – | ON | 1.6 | OFF | 1* |
| 1A-21-2 | OFF | OFF | – | – | ON | 2.0 | OFF | 1 |
| 1A-21-3 | OFF | ON | 2.0 | 2.0 | ON | 2.0 | OFF | 7 |
| 1A-21-4 | OFF | ON | 2.0 | 1.5 | ON | 2.0 | ON | 21 |
| 1B-11-1 | OFF | OFF | – | – | ON | 2.0 | OFF | 5 |
| 1B-11-2 | ON | OFF | 2.0 | 2.0 | ON | 2.0 | OFF | 11 |
| 1B-11-3 | ON | OFF | 1.5 | 2.0 | ON | 2.0 | ON | 32 |
| 1B-21-1 | OFF | OFF | – | – | ON | 1.6 | OFF | 2* |
| 1B-21-2 | OFF | OFF | – | – | ON | 2.0 | OFF | 2 |
| 1B-21-3 | ON | OFF | 2.0 | 2.0 | ON | 2.0 | OFF | 8 |
| 1B-21-4 | ON | OFF | 1.5 | 2.0 | ON | 2.0 | ON | 31 |
| 1C-11-1 | OFF | OFF | – | – | ON | 2.0 | OFF | 6 |
| 1C-11-2 | ON | ON | 2.0 | 2.0 | ON | 2.0 | OFF | 12 |
| 1C-11-3 | ON | ON | 2.0 | 2.0 | ON | 2.0 | ON | 13 |
| 1C-11-4 | ON | ON | 2.0 | 1.75 | ON | 2.0 | ON | 18 |
| 1C-11-5 | ON | ON | 2.0 | 1.5 | ON | 2.0 | ON | 24 |
| 1C-11-6 | ON | ON | 1.5 | 2.0 | ON | 2.0 | ON | 34 |
| 1C-11-7 | ON | ON | 1.0 | 2.0 | ON | 2.0 | ON | 40 |
| 1C-11-8 | ON | ON | 2.0 | 1.0 | ON | 2.0 | ON | 49 |
| 1C-12-1 | ON | ON | 2.0 | 2.0 | ON | 2.0 | ON | 14,50 |
| 1C-12-2 | ON | ON | 2.0 | 1.75 | ON | 2.0 | ON | 19 |
| 1C-12-3 | ON | ON | 2.0 | 1.5 | ON | 2.0 | ON | 25,48,51 |
| 1C-12-4 | ON | ON | 2.0 | 1.25 | ON | 2.0 | ON | 27 |
| 1C-12-5 | ON | ON | 2.0 | 1.0 | ON | 2.0 | ON | 29,47,52 |
| 1C-12-6 | ON | ON | 1.5 | 2.0 | ON | 2.0 | ON | 35 |
| 1C-12-7 | ON | ON | 1.0 | 2.0 | ON | 2.0 | ON | 41 |
| 1C-12-8 | ON | ON | 2.0 | 0.8 | ON | 2.0 | ON | 45,53 |
| 1C-12-9 | ON | ON | 2.0 | 0.9 | ON | 2.0 | ON | 46 |
| 1C-12-10 | ON | ON | 2.0 | 2.0 | ON | 1.6 | ON | 54 |
| 1C-12-11 | ON | ON | 2.0 | 1.5 | ON | 1.6 | ON | 55 |
| 1C-12-12 | ON | ON | 2.0 | 1.0 | ON | 1.6 | ON | 56 |
| 1C-12-13 | ON | ON | 2.0 | 0.8 | ON | 1.6 | ON | 57 |
| 1C-12-14 | ON | ON | 2.0 | 2.0 | OFF | – | ON | 58 |
| 1C-12-15 | ON | ON | 2.0 | 1.5 | OFF | – | ON | 59 |
| 1C-12-16 | ON | ON | 2.0 | 1.0 | OFF | – | ON | 60 |
| 1C-12-17 | OFF | OFF | – | – | ON | 2.0 | ON | 29* |

Table A.6 - Configuration Specifications concluded

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1C-21-1 | OFF | OFF | - | - | ON | 1.6 | OFF | 3* |
| 1C-21-2 | OFF | OFF | - | - | ON | 2.0 | OFF | 3 |
| 1C-21-3 | ON | ON | 2.0 | 2.0 | ON | 2.0 | OFF | 9,111 |
| 1C-21-4 | ON | ON | 2.0 | 1.75 | ON | 2.0 | ON | 17 |
| 1C-21-5 | ON | ON | 2.0 | 1.5 | ON | 2.0 | ON | 23 |
| 1C-21-6 | ON | ON | 1.5 | 2.0 | ON | 2.0 | ON | 33 |
| 1C-21-7 | ON | ON | 1.0 | 2.0 | ON | 2.0 | ON | 39 |
| 1C-21-8 | ON | ON | 2.0 | 2.0 | ON | ESC | OFF | 113 |
| | | | | | | | | |
| 1C-22-1 | ON | ON | 2.0 | 2.0 | ON | 2.0 | ON | 20 |
| 1C-22-2 | ON | ON | 2.0 | 1.5 | ON | 2.0 | ON | 26 |
| 1C-22-3 | ON | ON | 2.0 | 1.25 | ON | 2.0 | ON | 28 |
| 1C-22-4 | ON | ON | 2.0 | 1.0 | ON | 2.0 | ON | 30 |
| 1C-22-5 | ON | ON | 1.5 | 2.0 | ON | 2.0 | ON | 36 |
| 1C-22-6 | ON | ON | 1.0 | 2.0 | ON | 2.0 | ON | 42 |
| 1C-22-7 | ON | ON | 2.0 | 1.0 | ON | 1.6 | ON | 56B |
| 1C-22-8 | ON | ON | 2.0 | 0.8 | ON | 2.0 | ON | 45B |
| 1C-22-9 | ON | ON | 2.0 | 1.5 | ON | ESC | OFF | 75 |
| 1C-22-10 | ON | ON | 2.0 | 1.5 | ON | 2.0 | OFF | 76 |
| 1C-22-11 | ON | ON | 2.0 | 2.0 | ON | 2.0 | OFF | 77,110 |
| 1C-22-12 | ON | ON | 2.0 | 2.0 | ON | ESC | OFF | 112 |
| | | | | | | | | |
| 2C-11-1 | OFF | OFF | - | - | ON | 1.6 | ON | 61 |
| 2C-11-2 | ON | ON | 2.0 | 2.0 | ON | 1.6 | ON | 62 |
| 2C-11-3 | ON | ON | 2.0 | 2.0 | ON | 1.6 | ON | 63 |
| 2C-11-4 | ON | ON | 2.0 | 2.0 | ON | 1.6 | ON | 64 |
| 2C-11-5 | ON | ON | 2.0 | 2.0 | ON | 2.0 | ON | 78 |
| 2C-11-6 | ON | ON | 2.0 | 1.5 | ON | 2.0 | ON | 79,85 |
| 2C-11-7 | ON | ON | 2.0 | 1.0 | ON | 2.0 | ON | 80 |
| 2C-11-8 | ON | ON | 2.0 | 1.5 | ON | 2.0 | OFF | 91 |
| 2C-11-9 | ON | ON | 2.0 | 1.5 | ON | 2.0 | OFF | 92 |
| 2C-11-10 | ON | ON | 2.0 | 1.0 | ON | 2.0 | OFF | 93 |
| 2C-11-11 | ON | ON | 2.0 | 1.0 | ON | 2.0 | ON | 93B |
| 2C-11-12 | ON | ON | 2.0 | 0.8 | ON | 2.0 | OFF | 94 |
| 2C-11-13 | ON | ON | 2.0 | 0.8 | ON | 2.0 | ON | 94B |
| | | | | | | | | |
| 2C-12-1 | ON | ON | 2.0 | 2.0 | ON | 2.0 | ON | 82 |
| 2C-12-2 | ON | ON | 2.0 | 1.0 | ON | 2.0 | ON | 83 |
| 2C-12-3 | ON | ON | 2.0 | 1.5 | ON | 2.0 | ON | 84 |
| 2C-12-4 | OFF | OFF | - | - | ON | 2.0 | OFF | 90 |
| 2C-12-5 | OFF | OFF | - | - | ON | 2.0 | ON | 90B |
| 2C-12-6 | ON | ON | 2.0 | 2.0 | OFF | - | OFF | 114 |
| | | | | | | | | |
| 2C-21-1 | ON | ON | 2.0 | 1.0 | ON | 2.0 | ON | 81,101 |
| 2C-21-2 | ON | ON | 2.0 | 2.0 | ON | 2.0 | ON | 99 |
| 2C-21-3 | ON | ON | 2.0 | 1.5 | ON | 2.0 | ON | 100 |
| 2C-21-4 | ON | ON | 2.0 | 1.0 | ON | 2.0 | OFF | 93C |

## Table A.7 - List of Simulation Runs

| DATE | RUN | CASE | COMMENT |
|------|-----|------|---------|
| 4/30 | 1 | 1A-21-1 | no taped data, limited strips |
|      | 2 | 1B-21-1 | " " |
|      | 3 | 1C-21-1 | " " |
|      | 4 | 1A-21-2 | " " |
|      | 5 | 1A-21-2 | " " |
| 5/2  | 1 | 1A-21-1 | |
|      | 2 | 1B-21-2 | |
|      | 3 | 1C-21-2 | |
|      | 4 | 1A-11-1 | |
|      | 5 | 1B-11-1 | |
|      | 6 | 1C-11-1 | |
| 5/3  | 1 | 1C-11-1 | tau(3) = 0 |
|      | 2 | 1C-11-1 | |
|      | 3 | 1A-21-3 | |
|      | 4 | 1B-21-3 | |
|      | 5 | 1C-21-3 | |
|      | 6 | 1A-11-2 | |
|      | 7 | 1B-11-2 | |
|      | 8 | 1C-11-2 | |
|      | 9 | 1C-11-3 | |
|      | 10 | 1C-12-1 | |
|      | 11 | 1A-21-4 | |
| 5/7  | 1 | 1C-11-1 | |
|      | 2 | 1A-11-2 | |
|      | 3 | 1C-11-2 | |
|      | 4 | 1C-11-3 | |
|      | 5 | 1A-21-3 | |
|      | 6 | 1B-21-3 | |
|      | 7 | 1C-21-3 | |
|      | 8 | 1C-11-3 | |
|      | 9 | 1C-12-1 | |
| 5/8  | 1 | 1C-11-1 | |
|      | 2 | 1C-11-3 | |
|      | 3 | 1C-12-1 | |
|      | 4 | 1A-11-3 | |
|      | 5 | 1A-11-3 | |
|      | 6 | 1C-21-4 | |
|      | 7 | 1C-21-4 | |
|      | 8 | 1C-11-4 | |

Table A.7 - List of Simulation Runs continued

| 5/10 | 1 | 1C-21-2 | not on tape |
|------|----|---------|-------------|
|      | 2 | 1C-11-3 | ″ |
|      | 3 | 1C-11-4 | ″ |
|      | 4 | 1C-12-2 | ″ |
|      | 5 | 1C-22-1 | ″ |
|      | 6 | 1C-11-4 | ″ |
|      | 7 | 1A-21-4 | ″ |
|      | 8 | 1A-11-4 | ″ |
|      | 9 | 1C-11-5 | ″ |
| 5/14 | 1 | 1A-21-4 | |
|      | 2 | 1A-11-4 | |
|      | 3 | 1C-21-5 | |
|      | 4 | 1C-11-5 | |
|      | 5 | 1C-12-3 | |
|      | 6 | 1C-22-2 | |
| 5/16 | 1 | ? | tape only, no comment no strip |
| 5/17 | 1 | 1C-12-4 | |
|      | 2 | 1C-22-3 | |
|      | 3 | 1C-12-5 | |
|      | 4 | 1C-12-17 | |
|      | 5 | 1C-22-3 | |
|      | 6 | 1C-22-4 | |
|      | 7 | 1B-21-4 | |
|      | 8 | 1B-11-3 | |
|      | 9 | 1C-21-6 | |
|      | 10 | 1C-11-6 | |
|      | 11 | 1C-12-6 | |
|      | 12 | 1C-22-5 | |
| 5/21 | 1 | 1C-12-8 | |
|      | 2 | 1C-12-9 | |
|      | 3 | 1C-12-8 | |
|      | 4 | 1C-12-5 | |
|      | 5 | ? | on tape only |
|      | 6 | 1C-12-3 | |
|      | 7 | 1C-12-1 | |
|      | 8 | 1C-11-3 | |
|      | 9 | 1C-11-5 | |
|      | 10 | 1C-11-8 | |
| 5/22 | 1-4 | 1C-12-1 | no strips, some comments |

Table A.7 - List of Simulation Runs  concluded

| | | | |
|---|---|---|---|
| 6/3 | 1 | 1C-22-9 | |
| | 2 | 1C-22-10 | |
| | 3 | 1C-22-11 | |
| | 4 | 2C-11-5 | |
| | 5 | 2C-11-6 | |
| | 6 | 2C-11-7 | |
| | 7 | 2C-21-1 | |
| 6/4 | 1 | 1C-22-9 | |
| | 2 | 1C-22-10 | |
| | 3 | 1C-22-9 | |
| | 4 | 1C-22-11 | |
| | 5 | 2C-21-4 | |
| | 6 | 2C-11-7 | |
| | 7 | 2C-11-5 | |
| | 8 | 2C-12-1 | |
| | 9 | 2C-12-2 | |
| | 10 | 2C-12-3 | |
| | 11 | 2C-11-6 | |
| 6/6 | 1 | 2C-12-4 | |
| | 2 | 2C-11-8 | |
| | 3 | 2C-11-9 | |
| | 4 | 2C-11-10 | |
| | 5 | 2C-11-12 | |
| | 6 | 2C-11-11 | |
| | 7 | 2C-11-13 | |
| | 8 | 2C-21-2 | |
| | 9 | 2C-21-3 | |
| | 10 | 2C-21-1 | |
| | 11 | 2C-12-5 | |
| 6/11 | 1 | 1C-22-12 | |
| | 2 | 1C-22-11 | |
| | 3 | 1C-21-3 | |
| | 4 | 1C-21-8 | |
| | 5 | 1C-21-8 | |
| | 6 | 1C-22-12 | |
| | 7 | 1C-22-11 | no tape, no strips |
| | 8 | 1C-22-12 | ″ |
| | 9 | 1C-21-8 | ″ |
| | 10 | 2C-12-6 | ″ |

Table A.7 - List of Simulation Runs  continued

| | | | |
|---|---|---|---|
| 5/24 | 1 | 1C-12-1 | |
| | 2 | 1C-12-3 | |
| | 3 | 1C-12-5 | |
| | 4 | 1C-12-8 | |
| | 5 | 1C-12-10 | |
| | 6 | 1C-12-11 | |
| | 7 | 1C-12-12 | |
| | 8 | 1C-12-13 | |
| | 9 | 1C-12-10 | |
| | 10 | 1C-12-11 | |
| | 11 | 1C-12-12 | |
| | 12 | 1C-22-7 | |
| | 13 | 1C-12-13 | |
| | 14 | 1C-12-14 | |
| | 15 | 1C-12-15 | |
| | 16 | 1C-12-16 | |
| 5/29 | 1 | 1C-12-3 | |
| | 2 | 1C-12-5 | |
| | 3 | 1C-22-8 | |
| | 4 | 1C-12-8 | |
| | 5 | 1C-11-2 | |
| | 6 | 1C-11-6 | |
| | 7 | 1C-12-6 | |
| | 8 | 1C-21-7 | |
| 5/30 | 1 | 1C-11-3 | not on tape |
| | 2 | 1C-21-6 | ″ |
| | 3 | 1C-21-6 | ″ |
| | 4 | 1C-11-6 | ″ |
| | 5 | 1C-11-3 | ″ |
| | 6 | 1C-12-6 | ″ |
| | 7 | 1C-22-5 | ″ |
| | 8 | 1C-21-7 | ″ |
| | 9 | 1C-11-7 | ″ |
| 5/31 | 1 | 1C-11-1 | |
| | 2 | 1C-11-7 | |
| | 3 | 1C-12-7 | |
| | 4 | 1C-22-6 | |
| | 5 | 2C-11-1 | |
| | 6 | 2C-11-2 | |
| | 7 | 2C-11-3 | |
| | 8 | 2C-11-4 | |

# Appendix 5
## Experimental Summary Sheets

The complete set of summary sheets for the simulation experiment are presented in this appendix. The summary sheets provide basic information about each simulation run that was made. This basic information consists of the case number, run number, pilot identifier and dynamic parameters associated with each run. The summary sheets also provide statistical performance data which includes the mean errors, $\varepsilon_{long.}$ and $\varepsilon_{lat.}$, and standard deviations, $\sigma_{long.}$ and $\sigma_{lat.}$, of the tracking errors. The longitudinal axis values correspond to pitch errors for the pitch/roll tracking task and flight-path errors for the flight-path/heading task. The lateral axis values correspond to roll errors for the pitch/roll tracking task and heading angle errors for the flight-path/heading task.

Probably the most important items recorded on the summary sheets are the subjective pilot ratings and pilot/evaluator comments. The pilot ratings indicate the level of handling qualities associated with each run measured on the Cooper-Harper scale. The comments consist of pilot opinions and recommendations regarding the vehicle dynamics and evaluator comments that document significant observations made by the engineer/evaluator during the experiment.

Table A.8 - Data Summary Sheets

| CASE NO. | SPECS : | | |
|---|---|---|---|
| 1A-11-1 | $\eta_y$ : OFF $\quad \omega_y = -$ $\qquad$ SCAS : ON $\quad K_q = 2.0$<br><br>$\eta_z$ : OFF $\quad \omega_z = -$ $\qquad$ SPEED HOLD ; OFF<br><br>OLD CASE NO. : 4 | | |
| RUN/PILOT<br><br>5-2-1 / B | SCORES :<br><br>$\varepsilon_{long} = .155 \qquad \sigma_{long} = 1.02$<br><br>$\varepsilon_{lat} = .373 \qquad \sigma_{lat} = .492$ | | COOPER-<br>HARPER<br>RATING<br><br>N/A |
| COMMENTS : | | | |

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1A-11-1 | SPECS :<br><br>$\eta_y$ : OFF   $\omega_y = -$      SCAS : ON    $K_q = 2.0$<br><br>$\eta_z$ : OFF   $\omega_z = -$      SPEED HOLD ; OFF<br><br>OLD CASE NO. : 4 | |
|---|---|---|
| RUN/PILOT<br><br>5-2-4 /<br><br>/ B | SCORES :<br><br>$\varepsilon_{long} = .155$      $\sigma_{long} = 1.02$<br><br>$\varepsilon_{lat} = .373$      $\sigma_{lat} = .492$ | COOPER-<br>HARPER<br>RATING<br><br>N/A |
| COMMENTS : | | |

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1A-11-2 | SPECS :<br><br>$\eta_y$ : OFF    $\omega_y = 2.0$    SCAS : ON    $K_\bullet = 2.0$<br><br>$\eta_z$ : ON    $\omega_z = 2.0$    SPEED HOLD ; OFF<br><br>OLD CASE NO. :  10 | |
|---|---|---|
| RUN/PILOT<br><br>5-3-6 /<br>/ B | SCORES :<br><br>$\varepsilon_{long} = .048$    $\sigma_{long} = 1.40$<br><br>$\varepsilon_{lat} = -.056$    $\sigma_{lat} = .387$ | COOPER-<br>HARPER<br>RATING<br><br>N/A |

COMMENTS :


- MOTION TASK HARDER AND MORE DIFFICULT



- WORSE THAN NO MOTION ( THE SENSATION NOT
NECESSARILY THE PERFORMANCE )

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1A-11-2 | $\eta_y$ : OFF $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$ $\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD ; OFF OLD CASE NO. : 10 | |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| S-7-2 / B | $\varepsilon_{long} = .15 \qquad \sigma_{long} = 1.37$ $\varepsilon_{lat} = .10 \qquad \sigma_{lat} = .58$ | N/A |

COMMENTS :


- DEFINITELY MORE COMPENSATION THAN
  PREVIOUS RUN

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1A-11-3 | $\eta_y$ : OFF  $\omega_y$ = 2.0    SCAS : ON    $K_q$ = 2.0<br><br>$\eta_z$ : ON    $\omega_z$ = 1.75   SPEED HOLD : ON<br><br>OLD CASE NO. : 16 | |

| RUN/PILOT | SCORES : | COOPER-<br>HARPER<br>RATING |
|---|---|---|
| 5-8-4 / B | $\varepsilon_{long}$ = .152      $\sigma_{long}$ = 1.39<br><br>$\varepsilon_{lat}$ = -.129      $\sigma_{lat}$ = .71 | N/A |

COMMENTS :

   - FLEW AGGRESSIVELY

   - OBVIOUSLY MORE JUMPY THAN BEFORE

Table A.8 - Data Summary Sheets continued

| CASE NO. 1A-11-3 | SPECS : |
|---|---|
| | $\eta_y$ : OFF   $\omega_y$ = 2.0   SCAS : ON   $K_q$ = 2.0 |
| | $\eta_z$ : ON   $\omega_z$ = 1.75   SPEED HOLD : ON |
| | OLD CASE NO. : 16 |

| RUN/PILOT | SCORES : | | COOPER-HARPER RATING |
|---|---|---|---|
| 5-8-5 / B | $\varepsilon_{long}$ = .175   $\sigma_{long}$ = 1.87 | | N/A |
| | $\varepsilon_{lat}$ = -.35   $\sigma_{lat}$ = .468 | | |

COMMENTS :

- FELT THAT WAS THE BEST HE COULD DO WITHOUT EXCITING THE STRUCTURAL MODES

- ACCEPTING WIDER TOLERANCE AND EXCURSION

- LEARNED TO COMPENSATE FOR JUMP WITH SMOOTHER TECHNIQUE

- CAN KEEP FROM EXCITING THE MODES BUT WITH LOWER FTEQUENCIES PERFORMANCE IS DEGRADED, WHERE BEFORE IS WAS NOT DEGRADED MUCH AT ALL

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1A-11-4 | SPECS :<br><br>$\eta_y$ : OFF    $\omega_y$ = 2.0    SCAS : ON    $K_\alpha$ = 2.0<br><br>$\eta_z$ : ON    $\omega_z$ = 1.5    SPEED HOLD ; ON<br><br>OLD CASE NO. :   22 | |
|---|---|---|
| RUN/PILOT<br><br>5-10-8 /<br><br>/ B | SCORES :<br><br>$\varepsilon_{long}$ = .012      $\sigma_{long}$ = 1.56<br><br>$\varepsilon_{lat}$ = -.055    $\sigma_{lat}$ = .365 | COOPER-<br>HARPER<br>RATING<br><br>N/A |
| COMMENTS :<br><br>- MUCH LARGER AMPLITUDE OF OSCILLATION<br><br>- ADEQUATE PERFORMANCE NOT ACHIEVABLE<br><br>- PITCH OVERSHOOT, PIO AND LAG<br><br>- HAVE TO HOLD STICK INTIL ■SPRING■ CATCHES UP<br><br>- HAD TO REDUCE GAINS OR THINGS GOT BAD | | |

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1A-11-4 | $\eta_y$ : OFF $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$ <br><br> $\eta_z$ : ON $\quad \omega_z = 1.5 \quad$ SPEED HOLD ; ON <br><br> OLD CASE NO. : 22 | |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 5-14-2 / B | $\varepsilon_{long} = .167 \qquad \sigma_{long} = 1.7$ <br><br> $\varepsilon_{lat} = .14 \qquad \sigma_{lat} = .415$ | 7 |

COMMENTS :

- CAN IDENTIFY FLEX OSCILLATIONS EASIER WITH MOTION


- CUES HELP; WITHOUT MOTION IT IS HARD TO TELL WHETHER A VISUAL ■ATTITUDE■ CHANGE IN THE DISPLAY IS DUE TO ACTUAL ATTITUDE CHANGE OR FLEX

- TASK A LITTLE EASIER THAN CASE 1A-21-1; CAN KEEP MEAN ERROR AROUND ZERO AND LET OSCILLATIONS DIE OUT

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1A-21-1 | $\eta_y$ : OFF $\omega_y$ = - SCAS : ON $K_\eta$ = 1.6 <br><br> $\eta_z$ : OFF $\omega_z$ = - SPEED HOLD : OFF <br><br> OLD CASE NO. : 1* | |

| RUN/PILOT | SCORES : | | COOPER-<br>HARPER<br>RATING |
|---|---|---|---|
| 4-30-1 <br> / <br> / A | $\mathcal{E}_{long}$ = N/A $\sigma_{long}$ = N/A <br><br> $\mathcal{E}_{lat}$ = N/A $\sigma_{lat}$ = N/A | | N/A |

COMMENTS :

- ZERO CROSSINGS BOBBLE

- SMALL PIO■S WITH NOMINAL TRACKING

- EARLY IN RUN, TARGET REVERSED

- HIGH GAIN

- SIGMA(P)**2 = 0.77

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1A-21-2 | SPECS :<br><br>$\eta_y$ : OFF  $\omega_y$ = -    SCAS : ON    $K_q$ = 2.0<br><br>$\eta_z$ : OFF  $\omega_z$ = -    SPEED HOLD : OFF<br><br>OLD CASE NO. :  1 | |
|---|---|---|
| RUN/PILOT<br><br>4-30-4<br><br>A | SCORES :<br><br>$\varepsilon_{long}$ = N/A        $\sigma_{long}$ = N/A<br><br>$\varepsilon_{lot}$ = N/A        $\sigma_{lot}$ = N/A | COOPER-<br>HARPER<br>RATING<br><br>N/A |

COMMENTS :

  - WELL DAMPED, KQ=2.0 APPEARS TO BE AN
    IMPROVEMENT OVER 1.6


  - SIGMA(P)**2 = 0.77

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1A-21-2 | $\eta_y$ : OFF $\omega_y$ = -   SCAS : ON   $K_q$ = 2.0 <br><br> $\eta_z$ : OFF $\omega_z$ = -   SPEED HOLD ; OFF <br><br> OLD CASE NO. : 1 | |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 4-30-5 / / A | $\varepsilon_{long}$ = N/A   $\sigma_{long}$ = N/A <br><br> $\varepsilon_{lat}$ = N/A   $\sigma_{lat}$ = N/A | N/A |

COMMENTS :

- SIGMA(P)**2 = 0.77 ; KG = 5.0 (RATHER THAN NOMINAL 4.5)

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1A-21-3 | SPECS :<br><br>$\eta_y$ : OFF    $\omega_y$ = 2.0    SCAS : ON    $K_q$ = 2.0<br><br>$\eta_z$ : ON    $\omega_z$ = 2.0    SPEED HOLD ; OFF<br><br>OLD CASE NO. : 7 | |
|---|---|---|
| RUN/PILOT<br><br>5-3-3 /<br>/ B | SCORES :<br><br>$\varepsilon_{long}$ = .240        $\sigma_{long}$ = 1.23<br><br>$\varepsilon_{lat}$ = -.051        $\sigma_{lat}$ = .345 | COOPER-<br>HARPER<br>RATING<br><br>N/A |
| COMMENTS :<br><br>  - PITCH MORE DIFFICULT<br><br><br>  - MORE COMPENSATION REQUIRED | | |

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1A-21-3 | SPECS :<br><br>$\eta_y$ : OFF $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$<br><br>$\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD : OFF<br><br>OLD CASE NO. : 7 | | |
|---|---|---|---|
| RUN/PILOT<br><br>5-7-5 /<br>/ B | SCORES :<br><br>$\varepsilon_{long} = .035 \qquad \sigma_{long} = 1.65$<br><br>$\varepsilon_{lat} = .173 \qquad \sigma_{lat} = .458$ | | COOPER-<br>HARPER<br>RATING<br><br>N/A |

COMMENTS :

- MOTION GAVE PERFORMANCE CUES, IN THE
  SENSE THAT IT WAS AN AID

- CAN TELL THE DEFFIERENCE BETWEEN HIS
  PIO S AND THE FLEX MODE AND HE KNOWS
  NOT TO FIGHT IT

- WITH NO MOTION, PERHAPS IT S HARDER TO
  TELL THE DIFFERENCE

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1A-21-4 | SPECS : <br><br>$\eta_y$ : OFF  $\omega_y = 2.0$  SCAS : ON  $K_a = 2.0$ <br><br>$\eta_z$ : ON  $\omega_z = 1.5$  SPEED HOLD ; ON <br><br>OLD CASE NO. :  21 | |
|---|---|---|
| RUN/PILOT<br><br>S-3-11 /<br><br>/ B | SCORES : <br><br>$\varepsilon_{long} = .513$  $\sigma_{long} = 2.02$ <br><br>$\varepsilon_{lat} = -1.16$  $\sigma_{lat} = 1.32$ | COOPER-<br>HARPER<br>RATING<br><br>N/A |
| COMMENTS : <br><br>- ALMOST IMPOSSIBLE WITH AND PRECISION <br><br><br>- DOESN■T THINK THERE IS A LAG PROBLEM, BUT DID PERCEIVE A LAG <br><br><br>- OBVIOUS VISUAL OVERSHOOTS | | |

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1A-21-4 | SPECS :<br><br>$\eta_y$ : OFF  $\omega_y$ = 2.0    SCAS : ON    $K_q$ = 2.0<br><br>$\eta_z$ : ON  $\omega_z$ = 1.5    SPEED HOLD : ON<br><br>OLD CASE NO. : 21 | |
|---|---|---|
| RUN/PILOT<br><br>5-10-7 / B | SCORES :<br><br>$\varepsilon_{long}$ = .348    $\sigma_{long}$ = 1.49<br><br>$\varepsilon_{lat}$ = -.041    $\sigma_{lat}$ = .574 | COOPER-<br>HARPER<br>RATING<br><br>N/A |

COMMENTS :

  - TENDENCY TO PITCH OVERSHOOT AND PIO

  - LOWER INTENSITY DUE TO NOT
    OVERCONTROLLING

  - BARELY ADEQUATE PERFORMANCE, DUE TO PIO
    TENDENCY

  - APPARENT LAG (LIKE A SPRING), NOSE DOWN
    AT FIRST

Table A.8 - Data Summary Sheets continued

| CASE NO.

1A-21-4 | SPECS :

$\eta_y$ : OFF  $\omega_y = 2.0$    SCAS : ON    $K_q = 2.0$

$\eta_z$ : ON  $\omega_z = 1.5$    SPEED HOLD : ON

OLD CASE NO. : 21 | |
|---|---|---|
| RUN/PILOT

5-14-1 /

/ B | SCORES :

$\varepsilon_{long} = .605$        $\sigma_{long} = 1.63$

$\varepsilon_{lat} = .18$        $\sigma_{lat} = .51$ | COOPER-
HARPER
RATING

7+ |

COMMENTS :

- CONTROLLABILITY OF TASK IN DOUBT

- LAG EFFECTS NOTICABLE AND A VARIABLE
  FUNCTION OF THE MAGNITUDE OF INPUT

- LOWER GAINS AND SMOOTHING INPUTS

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1B-11-1 | SPECS :<br><br>$\eta_y$ : OFF   $\omega_y$ = -        SCAS : ON     $K_\bullet$ = 2.0<br><br>$\eta_z$ : OFF   $\omega_z$ = -        SPEED HOLD ; OFF<br><br>OLD CASE NO. : 5 | |
|---|---|---|
| RUN/PILOT<br><br>S-2-5<br><br>B | SCORES :<br><br>$\varepsilon_{long}$ = -.007     $\sigma_{long}$ = .228<br><br>$\varepsilon_{lat}$ = .291     $\sigma_{lat}$ = 1.57 | COOPER-<br>HARPER<br>RATING<br><br>N/A |
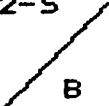
COMMENTS :

- PILOTS ARE TRAINED TO IGNORE MOTION AND
BELIEVE THIER EYES, THEREFORE MOTION AND
NO MOTION RESULTS SHOULD BE CLOSE

- SIGMA(P)**2 = 0.77

## Table A.8 - Data Summary Sheets continued

| CASE NO.  1B-11-2 | SPECS : $\eta_y$ : ON   $\omega_y = 2.0$   SCAS : ON   $K_q = 2.0$  $\eta_z$ : OFF   $\omega_z = 2.0$   SPEED HOLD : OFF  OLD CASE NO. : 11 | |
|---|---|---|
| RUN/PILOT  S-3-7 / B | SCORES :  $\varepsilon_{long} = -.063$   $\sigma_{long} = .298$  $\varepsilon_{lat} = -.034$   $\sigma_{lat} = 2.18$ | COOPER-HARPER RATING  N/A |

COMMENTS :

- PILOT COMMENTED THAT IN GENERAL, ROLL
  ALWAYS OVERSHOOTS

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | | |
|---|---|---|---|
| 1B-11-3 | $\eta_y$ : ON  $\omega_y = 1.5$  SCAS : ON  $K_\theta = 2.0$ <br><br> $\eta_z$ : OFF  $\omega_z = 2.0$  SPEED HOLD ; ON <br><br> OLD CASE NO. : 32 | | |

| RUN/PILOT | SCORES : | | COOPER-HARPER RATING |
|---|---|---|---|
| 5-17-8 / B | $\mathcal{E}_{long} = .84$  $\sigma_{long} = .236$ <br><br> $\mathcal{E}_{lat} = .222$  $\sigma_{lat} = 1.19$ | | 3.5 |

COMMENTS :

    - MODERATE PILOT COMPENSATION


    - TENDENCY TO OVERSHOOT

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1B-21-1 | $\eta_y$ : OFF $\omega_y$ = – $\quad$ SCAS : ON $\quad$ K$_e$ = 1.6<br><br>$\eta_z$ : OFF $\omega_z$ = – $\quad$ SPEED HOLD ; OFF<br><br>OLD CASE NO. : 2* | |

| RUN/PILOT | SCORES : | COOPER–HARPER RATING |
|---|---|---|
| 4-30-2 / A | $\varepsilon_{long}$ = N/A $\qquad$ $\sigma_{long}$ = N/A<br><br>$\varepsilon_{lat}$ = N/A $\qquad$ $\sigma_{lat}$ = N/A | N/A |

COMMENTS :

- BREAKOUTS AND GRADIENTS IN HARMONY

- SIGMA(P)**2 = 0.77

Table A.8 - Data Summary Sheets  continued

| CASE NO.  1B-21-2 | SPECS : <br><br> $\eta_y$ : OFF $\omega_y$ = -     SCAS : ON    $K_q$ = 2.0 <br><br> $\eta_z$ : OFF $\omega_z$ = -     SPEED HOLD : OFF <br><br> OLD CASE NO. : 2 | |
|---|---|---|
| RUN/PILOT <br><br> S-2-2 / B | SCORES : <br><br> $\varepsilon_{long}$ = .044    $\sigma_{long}$ = .229 <br><br> $\varepsilon_{lat}$ = -.059    $\sigma_{lat}$ = 1.83 | COOPER-HARPER RATING <br><br> N/A |

COMMENTS :

    - TENDENCY TO CREATE COMPENSATION IN ROLL

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1B-21-3 | SPECS :<br><br>$\eta_y$ : ON  $\omega_y = 2.0$   SCAS : ON   $K_q = 2.0$<br><br>$\eta_x$ : OFF  $\omega_x = 2.0$   SPEED HOLD : OFF<br><br>OLD CASE NO. : 8 | |
|---|---|---|
| RUN/PILOT<br><br>5-3-4 /<br><br>/ B | SCORES :<br><br>$\varepsilon_{long} = -.233$    $\sigma_{long} = .361$<br><br>$\varepsilon_{lat} = -.432$    $\sigma_{lat} = 2.71$ | COOPER-<br>HARPER<br>RATING<br><br>N/A |
| COMMENTS :<br><br>  - LAG IN ROLL | | |

Table A.8 - Data Summary Sheets continued

| CASE NO.  1B-21-3 | SPECS : $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_\phi = 2.0$ <br> $\eta_x$ : OFF $\quad \omega_x = 2.0 \quad$ SPEED HOLD ; OFF <br> OLD CASE NO. : 8 | |
|---|---|---|
| RUN/PILOT <br> 5-7-6 / B | SCORES : $\varepsilon_{long} = .346 \qquad \sigma_{long} = .343$ <br> $\varepsilon_{lat} = -.137 \qquad \sigma_{lat} = 1.40$ | COOPER- HARPER RATING <br> N/A |
| COMMENTS : | | |

Table A.8 - Data Summary Sheets  continued

| CASE NO.<br><br>1B-21-4 | SPECS :<br><br>$\eta_y$ : ON  $\omega_y = 1.5$  SCAS : ON  $K_q = 2.0$<br><br>$\eta_z$ : OFF  $\omega_z = 2.0$  SPEED HOLD : ON<br><br>OLD CASE NO. : 31 | |
|---|---|---|
| RUN/PILOT<br><br>5-17-7 / B | SCORES :<br><br>$\varepsilon_{long} = .085$  $\sigma_{long} = .265$<br><br>$\varepsilon_{lat} = -.302$  $\sigma_{lat} = 1.33$ | COOPER-<br>HARPER<br>RATING<br><br>3 |

COMMENTS :


- SENSITIVE TO ROLL



- BE CAREFUL NOT TO OVERSHOOT

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-11-1 | SPECS :<br><br>$\eta_y$ : OFF  $\omega_y$ = -  SCAS : ON  $K_q$ = 2.0<br><br>$\eta_z$ : OFF  $\omega_z$ = -  SPEED HOLD : OFF<br><br>OLD CASE NO. : 6 | |
|---|---|---|
| RUN/PILOT<br><br>5-2-6 /<br><br>/ B | SCORES :<br><br>$\varepsilon_{long}$ = -.035  $\sigma_{long}$ = .325<br><br>$\varepsilon_{lat}$ = 1.04  $\sigma_{lat}$ = 1.89 | COOPER-<br>HARPER<br>RATING<br><br>N/A |

COMMENTS :


- RELUCTANCE TO DIVE - AMPLIFIES BY ■DOWN■
  MOTION


- SIGMA(P)**2 = 0.77

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-11-1 | SPECS :<br><br>$\eta_y$ : OFF $\omega_y$ = –      SCAS : ON    $K_q$ = 2.0<br><br>$\eta_z$ : OFF $\omega_z$ = –      SPEED HOLD ; OFF<br><br>OLD CASE NO. : 6 | |
|---|---|---|
| RUN/PILOT<br><br>5-3-1 ╱<br>╱ B | SCORES :<br><br>$\varepsilon_{long}$ = –.069    $\sigma_{long}$ = .202<br><br>$\varepsilon_{lat}$ = .927    $\sigma_{lat}$ = 2.19 | COOPER–<br>HARPER<br>RATING<br><br>2.5 |
| COMMENTS :<br><br>– NOT TOO MUCH PITCH COMPENSATION REQUIRED<br><br><br>– ROLL MAY TAKE A LITTLE (COMPENSATION TO COMPLETE TESK)<br><br><br>– TAU(3) = 0.0 | | |

Table A.8 - Data Summary Sheets  continued

| CASE NO.<br><br>1C-11-1 | SPECS :<br><br>$\eta_y$ : OFF  $\omega_y$ = -  SCAS : ON  $K_e$ = 2.0<br><br>$\eta_z$ : OFF  $\omega_z$ = -  SPEED HOLD : OFF<br><br>OLD CASE NO. : 6 | |
|---|---|---|
| RUN/PILOT<br><br>5-3-2 / <br>/ B | SCORES :<br><br>$\varepsilon_{long}$ = .167  $\sigma_{long}$ = 1.05<br><br>$\varepsilon_{lat}$ = .171  $\sigma_{lat}$ = 1.99 | COOPER-<br>HARPER<br>RATING<br><br>N/A |
| | COMMENTS :<br><br>- ROLL MORE NOTICEABLE | |

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | | |
|---|---|---|---|
| 1C-11-1 | $\eta_y$ : OFF $\quad \omega_y = -$ <br><br> $\eta_z$ : OFF $\quad \omega_z = -$ <br><br> OLD CASE NO. : 6 | SCAS : ON $\quad K = 2.0$ <br><br> SPEED HOLD : OFF | |

| RUN/PILOT | SCORES : | | COOPER-HARPER RATING |
|---|---|---|---|
| S-7-1 <br><br> B | $\varepsilon_{long} = -.071$ <br><br> $\varepsilon_{lat} = .152$ | $\sigma_{long} = .91$ <br><br> $\sigma_{lat} = 1.32$ | 2.5 |

COMMENTS :

- SLIGHT TENDENCY TO BOBBLE IN PITCH AND ROLL


- C(L(DELTA(S))) MULT = 0.5

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-11-1 | SPECS :<br><br>$\eta_y$ : OFF $\quad \omega_y = -$ $\quad\quad$ SCAS : ON $\quad\quad$ K$_\blacksquare$ = 2.0<br><br>$\eta_x$ : OFF $\quad \omega_x = -$ $\quad\quad$ SPEED HOLD ; OFF<br><br>$\quad\quad$ OLD CASE NO. : 6 | | |
|---|---|---|---|
| RUN/PILOT<br><br>S-8-1 / <br>/ B | SCORES :<br><br>$\mathcal{E}_{long} = .026$ $\quad\quad\quad$ $\sigma_{long} = 1.01$<br><br>$\mathcal{E}_{lat} = .051$ $\quad\quad\quad$ $\sigma_{lat} = 1.36$ | | COOPER-<br>HARPER<br>RATING<br><br>2.5 |

COMMENTS :

- COULD PERFORM TASK EASILY

- TECHNIQUE : LIKE AIR-TO-AIR HUD, DON■T
  FIXATE ON DOT BUT ■LOOK THROUGH■ THE
  DISLAY SO AS TO SEE ROLL TOO

- TRIED TO BE MORE AGGRESSIVE, LED TO
  DIMINISHING RETURNS, POSSIBLY IN WORSE
  LONGITUDINAL SCORES

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | | |
|---|---|---|---|
| 1C-11-1 | $\eta_y$ : OFF $\omega_y = -$ SCAS : ON $K_e = 2.0$ $\eta_z$ : OFF $\omega_z = -$ SPEED HOLD : OFF OLD CASE NO. : 6 | | |

| RUN/PILOT | SCORES : | | COOPER-HARPER RATING |
|---|---|---|---|
| S-31-1 / C | $\varepsilon_{long} = .154$ $\varepsilon_{lat} = -.105$ | $\sigma_{long} = .953$ $\sigma_{lat} = 1.19$ | 3 |

COMMENTS :

- HAD TO WORK A LITTLE

- NOTICED PITCH SENSITVITY

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-11-2 | SPECS :<br><br>$\eta_y$ : ON   $\omega_y$ = 2.0   SCAS : ON   $K_q$ = 2.0<br><br>$\eta_z$ : ON   $\omega_z$ = 2.0   SPEED HOLD ; OFF<br><br>OLD CASE NO. : 12 | |
|---|---|---|
| RUN/PILOT<br><br>5-3-8<br><br>8 | SCORES :<br><br>$\varepsilon_{long}$ = .01   $\sigma_{long}$ = 1.24<br><br>$\varepsilon_{lat}$ = .217   $\sigma_{lat}$ = 2.61 | COOPER-<br>HARPER<br>RATING<br><br>5 |

COMMENTS :

- DEFINITELY COMPENSATING ON BANK ERROR

- TWO AXIS TASK LEADS TO WORSE ROLL SCORE

- NOT SATISFACTORY PERFORMANCE

- LURCHING AND DISPLAY JUMPING

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : |
|---|---|
| 1C-11-2 | $\eta_y$ : ON  $\omega_y = 2.0$  SCAS : ON  $K_q = 2.0$<br><br>$\eta_z$ : ON  $\omega_z = 2.0$  SPEED HOLD ; OFF<br><br>OLD CASE NO. :  12 |

| RUN/PILOT | SCORES : | COOPER-<br>HARPER<br>RATING |
|---|---|---|
| 5-7-3 / B | $\mathcal{E}_{long} = .183$   $\sigma_{long} = 1.34$<br><br>$\mathcal{E}_{lat} = -.056$   $\sigma_{lat} = 1.62$ | 5 |

COMMENTS :

- HAVE TO REST RIGHT ARM ON RIGHT LEG FOR PRECISE INPUTS


- LET OSCILLATIONS DIE OUT, BUT COULD BE AGGRESSIVE

Table A.8 - Data Summary Sheets continued

| CASE NO.

1C-11-2 | SPECS :

$\eta_y$ : ON   $\omega_y = 2.0$   SCAS : ON   $K_q = 2.0$

$\eta_z$ : ON   $\omega_z = 2.0$   SPEED HOLD ; OFF

OLD CASE NO. : 12 | | |
|---|---|---|---|
| RUN/PILOT

5-29-5 /

/ B | SCORES :

$\varepsilon_{long} = .07$   $\sigma_{long} = 1.33$

$\varepsilon_{lat} = .01$   $\sigma_{lat} = 1.19$ | | COOPER-
HARPER
RATING

7-8 |

COMMENTS :

- NOT PUTTING SMOOTH INPUTS IN

- REALLY AGGRESSIVE (NOTICEABLY MORE
  AGGRESSIVE INPUTS)

- ACQUISITION EASY; FINE TRACKING HARD

- HARD TO CONTROL THIS DISPLAY

- NOT AS TUNED UP TODAY REFERING TO HIS
  TECHNIQUE

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-11-3 | SPECS :<br><br>$\eta_y$ : ON    $\omega_y = 2.0$    SCAS : ON    $K_q = 2.0$<br><br>$\eta_z$ : ON    $\omega_z = 2.0$    SPEED HOLD : ON<br><br>OLD CASE NO. : 13 | | |
|---|---|---|---|
| RUN/PILOT<br><br>5-3-9<br><br>B | SCORES :<br><br>$\varepsilon_{long} = .166$    $\sigma_{long} = 1.12$<br><br>$\varepsilon_{lat} = -.077$    $\sigma_{lat} = 2.07$ | | COOPER-<br>HARPER<br>RATING<br><br>4 |

COMMENTS :

  - BANK ANGLE STILL ANNOYING

  - TASK EASIER, RESPONSIVE, POOR RATING DUE
    TO ROLL (A RIGID-BODY PROBLEM PERHAPS)

  - NOT CONFUSING DISPLAY, MOTION FELT (PER-
    CEIVED) BUT DISPLAY AS GOOD AS BASILINE

  - TWO DISCRETE TASKS (NOT COUPLED)

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : |
|---|---|
| 1C-11-3 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_s = 2.0$ <br><br> $\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD ; ON <br><br> OLD CASE NO. : 13 |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 5-7-4 / B | $\varepsilon_{long} = .097 \qquad \sigma_{long} = 1.24$ <br><br> $\varepsilon_{lat} = .163 \qquad \sigma_{lat} = 1.63$ | N/A |

COMMENTS :

  - FREE ARM FED BY MOTION

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-11-3 | SPECS :<br><br>$\eta_y$ : ON    $\omega_y = 2.0$    SCAS : ON    $K_q = 2.0$<br><br>$\eta_x$ : ON    $\omega_x = 2.0$    SPEED HOLD : ON<br><br>OLD CASE NO. : 13 | |
|---|---|---|
| RUN/PILOT<br><br>5-7-8 /<br>    / B | SCORES :<br><br>$\varepsilon_{long} = .276$     $\sigma_{long} = 1.58$<br><br>$\varepsilon_{lat} = .011$     $\sigma_{lat} = 1.65$ | COOPER-<br>HARPER<br>RATING<br><br>5 |
| COMMENTS :<br><br>  - MOTION MAY PROVIDE A ■DAMPING CUE■ FROM<br>    SOUND AND MOTION | | |

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : |
|---|---|
| 1C-11-3 | $\eta_y$ : ON  $\omega_y$ = 2.0  SCAS : ON  $K_q$ = 2.0<br><br>$\eta_z$ : ON  $\omega_z$ = 2.0  SPEED HOLD : ON<br><br>OLD CASE NO. : 13 |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 5-8-2 / B | $\varepsilon_{long}$ = .182  $\sigma_{long}$ = 1.13<br><br>$\varepsilon_{lat}$ = -.07  $\sigma_{lat}$ = 1.28 | 4 |

COMMENTS :

- APPLIED LEARNED TECHNIQUE. PART OF HIS
  COMPENSATION


- INVESTIGATOR THOUGHT IT WAS CASE 1C-21-1
  (BY OBSERVING TASK)


- FLYING AGGRESSIVELY BUT SMOOTHLY. DID
  NOT LET DOT COMPLETELY VIBRATE FREELY
  BY ■SMOOTHING■


- THE PERFORMANCE WAS AS GOOD AS PREVIOUS
  RUN BUT CONSIDERABLE COMPENSATION
  REQUIRED

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : |
|---|---|
| 1C-11-3 | $\eta_y$ : ON   $\omega_y$ = 2.0   SCAS : ON   $K_\star$ = 2.0<br><br>$\eta_z$ : ON   $\omega_z$ = 2.0   SPEED HOLD ; ON<br><br>OLD CASE NO. : 13 |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 5-10-2 / B | $\varepsilon_{long}$ = .079    $\sigma_{long}$ = 1.17<br><br>$\varepsilon_{lat}$ = -.10    $\sigma_{lat}$ = 1.14 | 5 |

COMMENTS :

- PILOT CAN CONTROL THE SITUATION AND RIDE
  IS MUCH SMOOTHER

- VISUAL CUES AID IN CONTROL OF THE
  SITUATION

- QUALITATIVELY DISCONCERTING THAT SCORES
  ARE NOT HIGHER (WORSE) SINCE NOTED MORE
  ERROR

- THE PILOT PERCIEVED WORSE PERFORMANCE
  AND HIGH WORK LOAD

- NOTE : NO DIGITAL DATA

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-11-3 | SPECS :<br><br>$\eta_y$ : ON    $\omega_y = 2.0$    SCAS : ON    $K_\bullet = 2.0$<br><br>$\eta_z$ : ON    $\omega_z = 2.0$    SPEED HOLD : ON<br><br>OLD CASE NO. : 13 | |
|---|---|---|
| RUN/PILOT<br><br>5-21-8 /<br>/ A | SCORES :<br><br>$\mathcal{E}_{long} = .213$    $\sigma_{long} = 1.26$<br><br>$\mathcal{E}_{lat} = .215$    $\sigma_{lat} = 1.49$ | COOPER-<br>HARPER<br>RATING<br><br>4-5 |

COMMENTS :

Table A.8 - Data Summary Sheets continued

| CASE NO.

1C-11-3 | SPECS :

$\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_\theta = 2.0$

$\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD ; ON

OLD CASE NO. : 13 | |
|---|---|---|
| RUN/PILOT

5-30-1 / C | SCORES :

$\varepsilon_{long} = -.008 \qquad \sigma_{long} = 1.58$

$\varepsilon_{lat} = .868 \qquad \sigma_{lat} = 2.34$ | COOPER-
HARPER
RATING

N/A |
| COMMENTS :

   - ( ON LEARNING CURVE ) | | |

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-11-3 | SPECS :<br><br>$\eta_y$ : ON     $\omega_y = 2.0$     SCAS : ON     $K_\theta = 2.0$<br><br>$\eta_x$ : ON     $\omega_x = 2.0$     SPEED HOLD : ON<br><br>OLD CASE NO. : 13 | | |
|---|---|---|---|
| RUN/PILOT<br><br>5-30-5<br><br>C | SCORES :<br><br>$\varepsilon_{long} = -.085$     $\sigma_{long} = 1.35$<br><br>$\varepsilon_{lat} = -.49$     $\sigma_{lat} = 1.79$ | | COOPER-<br>HARPER<br>RATING<br><br>5 |
| COMMENTS : | | | |

Table A.8 - Data Summary Sheets continued

| CASE NO. 1C-11-4 | SPECS : $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_\theta = 2.0$ <br><br> $\eta_z$ : ON $\quad \omega_z = 1.75 \quad$ SPEED HOLD : ON <br><br> OLD CASE NO. : 18 | |
|---|---|---|
| **RUN/PILOT** <br><br> 5-8-8 / <br><br> / B | **SCORES :** <br><br> $\varepsilon_{long} = .347 \qquad \sigma_{long} = 1.69$ <br><br> $\varepsilon_{lat} = .103 \qquad \sigma_{lat} = 1.55$ | **COOPER- HARPER RATING** <br><br> 6-7 |

COMMENTS :

- TRIED TO FLY WITH ■OPTIMAIZED■ TECHNIQUE

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-11-4 | SPECS :<br><br>$\eta_y$ : ON $\omega_y = 2.0$ SCAS : ON $K_q = 2.0$<br><br>$\eta_x$ : ON $\omega_x = 1.75$ SPEED HOLD ; ON<br><br>OLD CASE NO. : 18 | |
|---|---|---|
| RUN/PILOT<br><br>5-10-3 /<br><br>/ B | SCORES :<br><br>$\varepsilon_{long} = .13$ $\sigma_{long} = 1.42$<br><br>$\varepsilon_{lat} = -.036$ $\sigma_{lat} = 1.26$ | COOPER-<br>HARPER<br>RATING<br><br>6.5 |

COMMENTS :

- NOT QUITE ADEQUATE PERFORMANCE (WORSE THAN COOPER-HARPER 6)

- ON FRINGES OF ADEQUATE TASK PERFORMANCE; HIGH INTENSE EFFORT

- NOTE : NO DIGITAL DATA

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-11-4 | SPECS :<br><br>$\eta_y$ : ON  $\omega_y$ = 2.0  SCAS : ON  $K_q$ = 2.0<br><br>$\eta_z$ : ON  $\omega_z$ = 1.75  SPEED HOLD : ON<br><br>OLD CASE NO. : 18 | |
|---|---|---|
| RUN/PILOT<br><br>5-10-6 /<br>/ B | SCORES :<br><br>$\varepsilon_{long}$ = .173  $\sigma_{long}$ = 1.39<br><br>$\varepsilon_{lat}$ = -.079  $\sigma_{lat}$ = 1.26 | COOPER-<br>HARPER<br>RATING<br><br>6.5 |

COMMENTS :

- BARLEY OBTAINED ADEQUATE PERFORMANCE

- INTENSE CONCENTRATION REQUIRED

- FIGHT TENDENCY TO PIO

- NOTE : NO DIGITAL DATA

Table A.8 - Data Summary Sheets continued

| CASE NO.  1C-11-5 | SPECS : $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$ $\eta_z$ : ON $\quad \omega_z = 1.5 \quad$ SPEED HOLD : ON  OLD CASE NO. : 24 | |
|---|---|---|
| RUN/PILOT  5-10-9 / / B | SCORES :  $\varepsilon_{long} = .33 \qquad \sigma_{long} = 1.74$  $\varepsilon_{lat} = .283 \qquad \sigma_{lat} = 1.52$ | COOPER- HARPER RATING  7+ |

COMMENTS :

- CAN POINT THE NOSE WITH RIGID-BODY AND IT STAYS THERE; IN THIS CASE HE CAN■T LET GO

- COMMENTS FOR PREVIOUS RUN APPLY (I.E. RUN NO. 5-10-8)

- CONTROLLABILITY NOT A QUESTION BUT PER- FORMANCE IS TERRIBLE; CAN■T DO TASK

- NOTE : NO DIGITAL DATA

| CASE NO. | SPECS : |
|---|---|
| 1C-11-5 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K = 2.0$ <br><br> $\eta_z$ : ON $\quad \omega_z = 1.5 \quad$ SPEED HOLD ; ON <br><br> OLD CASE NO. : 24 |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 5-14-4 / B | $\varepsilon_{long} = .224 \qquad \sigma_{long} = 1.60$ <br><br> $\varepsilon_{lat} = -.044 \qquad \sigma_{lat} = 1.61$ | N/A |

COMMENTS :

- MOTION CUES HELPFUL

- THOUGH PERFORMANCE WAS BETTER THAN PRE-
  VIOUS RUN (I.E. RUN NO. 5-14-3), GAINS
  WERE HIGHER; CAN GET INTO OSCILLATIONS
  AND HAVE TO FIGHT NOT FEED THEM

- MOTION HELPS SORT OUT FLEX MOTION SUCH
  THAT LAGS WERE NOT SO APPARENT

- EASIER TO CONTROL TIGHTER

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : |
|---|---|
| 1C-11-5 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$<br><br>$\eta_z$ : ON $\quad \omega_z = 1.5 \quad$ SPEED HOLD : ON<br><br>OLD CASE NO. : 24 |

| RUN/PILOT | SCORES : | | COOPER-<br>HARPER<br>RATING |
|---|---|---|---|
| 5-21-9 / A | $\varepsilon_{long} = .34$<br><br>$\varepsilon_{lat} = -.102$ | $\sigma_{long} = 1.71$<br><br>$\sigma_{lat} = 2.02$ | 7 |

COMMENTS :

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-11-6 | SPECS :<br><br>$\eta_y$ : ON  $\omega_y = 1.5$  SCAS : ON  $K_{\eta} = 2.0$<br><br>$\eta_z$ : ON  $\omega_z = 2.0$  SPEED HOLD ; ON<br><br>OLD CASE NO. : 34 | |
|---|---|---|
| RUN/PILOT<br><br>5-17-10<br><br>B | SCORES :<br><br>$\varepsilon_{long} = .112$  $\sigma_{long} = 1.06$<br><br>$\varepsilon_{lat} = -.12$  $\sigma_{lat} = 1.15$ | COOPER-<br>HARPER<br>RATING<br><br>4.5 |

COMMENTS :

- MOTION HELPS DETERMINE WHAT TO CHASE AND WHAT NOT TO

- SOME WING FLEXING NOTICED

- DISPLAY JITTER NOT AS APPEARENT AS IT WAS WHEN WE TESTED LOW FREQUENCY IN LONGITUDINAL AXIS

- HIGH COMPENSATION REQUIRED

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-11-6 | SPECS :<br><br>$\eta_y$ : ON   $\omega_y = 1.5$   SCAS : ON   $K_q = 2.0$<br><br>$\eta_z$ : ON   $\omega_z = 2.0$   SPEED HOLD ; ON<br><br>OLD CASE NO. :   34 | |
|---|---|---|
| RUN/PILOT<br><br>5-29-6 /<br>/ B | SCORES :<br><br>$\mathcal{E}_{long} = .17$   $\sigma_{long} = 1.24$<br><br>$\mathcal{E}_{lat} = -.143$   $\sigma_{lat} = 1.49$ | COOPER-<br>HARPER<br>RATING<br><br>7-8 |

COMMENTS :


- NOT EXCITING STRUCTURAL MODE



- PITCH AND ROLL RESPONSE BOTH MORE SENSI-
  TIVE THAN LAST RUN (I.E. RUN NO. 5-29-5)



- THOUGHT AT FIRST IT WAS NO DIFFERENT
  THAN LAST RUN



- COPPER-HARPER RATING WAS PRIMARILY DUE
  TO PITCH

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : |
|----------|---------|
| 1C-11-6 | $\eta_y$ : ON $\quad \omega_y = 1.5 \quad$ SCAS : ON $\quad K_{\bullet} = 2.0$ <br><br> $\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD ; ON <br><br> OLD CASE NO. : 34 |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|-----------|----------|----------------------|
| 5-30-4 / C | $\varepsilon_{long} = -.044 \qquad \sigma_{long} = 1.42$ <br><br> $\varepsilon_{lat} = -.251 \qquad \sigma_{lat} = 2.10$ | 5 |

COMMENTS :

— PIO TENDENCY IN PITCH AND ROLL

Table A.8 - Data Summary Sheets continued

| CASE NO.  1C-11-7 | SPECS : $\eta_y$ : ON $\quad \omega_y = 1.0 \quad$ SCAS : ON $\quad K_q = 2.0$ <br> $\eta_x$ : ON $\quad \omega_x = 2.0 \quad$ SPEED HOLD ; ON <br> OLD CASE NO. : 40 | |
|---|---|---|
| RUN/PILOT  S-30-9 / <br> / C | SCORES : <br> $\mathcal{E}_{long} = .192 \qquad \sigma_{long} = 1.38$ <br> $\mathcal{E}_{lat} = .152 \qquad \sigma_{lat} = 1.80$ | COOPER-HARPER RATING <br><br> 4 |
| COMMENTS : <br><br>     - NOT SURE IF MOTION HELPED IN THIS CASE | | |

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : |
|---|---|
| 1C-11-7 | $\eta_y$ : ON $\omega_y = 1.0$ SCAS : ON $K_q = 2.0$ <br><br> $\eta_z$ : ON $\omega_z = 2.0$ SPEED HOLD ; ON <br><br> OLD CASE NO. : 40 |

| RUN/PILOT | SCORES : | | COOPER-HARPER RATING |
|---|---|---|---|
| 5-31-2 / C | $\varepsilon_{long} = .126$ <br><br> $\varepsilon_{lat} = -.112$ | $\sigma_{long} = 1.34$ <br><br> $\sigma_{lat} = 1.46$ | 5 |

COMMENTS :

- JUDGES ADEQUATE PERFORMANCE BUT NOT
DESIRED PERFORMANCE ACHIEVED

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1C-11-8 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$ <br><br> $\eta_z$ : ON $\quad \omega_z = 1.0 \quad$ SPEED HOLD ; ON <br><br> OLD CASE NO. : 49 | |
| RUN/PILOT | SCORES : | COOPER-<br>HARPER<br>RATING |
| 5-21-10 <br><br> A | $\varepsilon_{long} = .41 \qquad \sigma_{long} = 2.88$ <br><br> $\varepsilon_{lat} = -.021 \qquad \sigma_{lat} = 1.97$ | N/A |
| COMMENTS : | | |

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1C-12-1 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_\theta = 2.0$ <br><br> $\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD : ON <br><br> OLD CASE NO. : 14. | |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 5-3-10 / <br><br> / B | $\varepsilon_{long} = .015 \qquad \sigma_{long} = 1.16$ <br><br> $\varepsilon_{lat} = .396 \qquad \sigma_{lat} = 2.12$ | 4 |

COMMENTS :

- PITCH RESPONSE SLIGHTLY WORSE THAN RIGID
  -BODY


- RATING PRIMARILY DUE TO ROLL PERFORMANCE
  RATING WOULD HAVE BEEN 3 IF NOT FOR ROLL

| CASE NO. | SPECS : | |
|---|---|---|
| 1C-12-1 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad$ K$_{\bullet}$ = 2.0<br><br>$\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD ; ON<br><br>OLD CASE NO. : 14. | |

| RUN/PILOT | SCORES : | COOPER-<br>HARPER<br>RATING |
|---|---|---|
| 5-7-9<br>B | $\varepsilon_{long}$ = .279 $\qquad \sigma_{long}$ = 1.02<br><br>$\varepsilon_{lat}$ = .058 $\qquad \sigma_{lat}$ = 1.56 | 3 |

COMMENTS :

- BETTER PERFORMANCE


- COMPENSATION IN LEARNING NOT TO PAY
  ATTENTION TO MOTION


- PREVIOUSLY (WITH FLEXIBLE DISPLAY) COULD
  USE MOTION TO IDENTIFY BENDING MODE AND
  IGNORE IT


- PRETTY RESPONSIVE IN PITCH. TASK WAS ~~ONE~~
  CLEARLY EASIER THAN WITH FLEXIBLE
  DISPLAY


- IN THIS CASE, TRIED TO IGNORE THE MOTION

C-2

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-12-1 | SPECS :<br><br>$\eta_y$ : ON  $\omega_y = 2.0$  SCAS : ON  $K_q = 2.0$<br><br>$\eta_x$ : ON  $\omega_x = 2.0$  SPEED HOLD ; ON<br><br>OLD CASE NO. : 14. | |
|---|---|---|
| RUN/PILOT<br><br>5-8-3 /<br><br>/ B | SCORES :<br><br>$\mathcal{E}_{long} = .130$  $\sigma_{long} = 1.09$<br><br>$\mathcal{E}_{lat} = .016$  $\sigma_{lat} = 1.38$ | COOPER-<br>HARPER<br>RATING<br><br>5 |
| COMMENTS :<br><br>- HAD TO UNLEARN TECHNIQUE USED FOR CASE 1C-11-3. PERHAPS OVERCONTROL AS A RESULT<br><br>- COMPENSATION LIGHTER. HAD TO MOVE THE STICK SLOWLY<br><br>- FELT TASK WAS HARDER. FELT THE MOTION AND NEW IT WAS FLEXIBLE BUT DIFFERENT FROM CASE 1C-11-3<br><br>- FELT PERFORMANCE WAS WORSE | | |

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | | |
|---|---|---|---|
| 1C-12-1 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$<br><br>$\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD : ON<br><br>OLD CASE NO. : 14. | | |

| RUN/PILOT | SCORES : | | COOPER-HARPER RATING |
|---|---|---|---|
| S-10-1<br><br>B | $\mathcal{E}_{long} = .18$<br><br>$\mathcal{E}_{lat} = -.118$ | $\sigma_{long} = 1.00$<br><br>$\sigma_{lat} = 1.13$ | 4.5 |

COMMENTS :

- IDENTIFIED THIS CASE

- QUALITATIVE PERFORMANCE A LITTLE WORSE:
  HAVE TO SUPPRESS THE MOTION CUES, MOTION
  IS A DISTRACTION: AWARE OF UNDULATION
  AND POSSIBLY MOTION FEEDING BACK THROUGH

- DESIRED PERFORMANCE BUT EXCESSIVE WORK
  LOAD

- MUCH MORE EFFORT, INTENSE CONCENTRATION
  NEEDED TO OVERCOME THE MOTION SENSATION
  AND GRIPPING STICK HARD

- NOTE : NO DIGITAL DATA

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-12-1 | SPECS :<br><br>$\eta_y$ : ON  $\omega_y = 2.0$  SCAS : ON  $K_\bullet = 2.0$<br><br>$\eta_z$ : ON  $\omega'_z = 2.0$  SPEED HOLD : ON<br><br>OLD CASE NO. : 14. | |
|---|---|---|
| RUN/PILOT<br><br>5-21-7 / A | SCORES :<br><br>$\mathcal{E}_{long} = .219$  $\sigma_{long} = .906$<br><br>$\mathcal{E}_{lat} = -.018$  $\sigma_{lat} = 1.35$ | COOPER-<br>HARPER<br>RATING<br><br>N/A |

COMMENTS :

- AS SYMMETRIC BENDING FREQUENCY DECREASES
  THE TOTAL RESPONSE DECREASES; THEREFORE
  THE AEROELASTIC MODE RESPONSE IS NOT AS
  DRAMATIC

- AEROELASTIC MODE RESPONSE IS NOTICEABLE
  WITH ABRUPT INPUTS

- TWO PHASE TASK; THERE IS A DIFFERENCE
  BETWEEN FINE-TRACKING AND TARGET
  ACQUISITION

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1C-12-1 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$ <br><br> $\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD ; ON <br><br> OLD CASE NO. : 14. | |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 5-22-1 / A | $\varepsilon_{long} = -.05 \qquad \sigma_{long} = 1.07$ <br><br> $\varepsilon_{lat} = .08 \qquad \sigma_{lat} = 1.64$ | 2-3 |

COMMENTS :

- PERHAPS SLIGHT LAG. PITCH FAIRLY
  RESPONSIVE AND PREDICTABLE


- NOTE : NO STRIP CHARTS AVAILABLE BUT
  DIGITAL DATA IS AVAILABLE

## Table A.8 - Data Summary Sheets  continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1C-12-1 | $\eta_y$ : ON $\quad \omega_y$ = 2.0 $\quad$ SCAS : ON $\quad K_q$ = 2.0 <br> $\eta_z$ : ON $\quad \omega_z$ = 2.0 $\quad$ SPEED HOLD ; ON <br> OLD CASE NO. : 14. | |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| S-24-1 / A | $\varepsilon_{long}$ = -.203 $\qquad \sigma_{long}$ = .954 <br> $\varepsilon_{lat}$ = -.01 $\qquad \sigma_{lat}$ = 1.28 | 2-3 |

COMMENTS :

Table A.8 - Data Summary Sheets continued

| CASE NO. 1C-12-2 | SPECS : $\eta_y$ : ON  $\omega_y = 2.0$  SCAS : ON  $K_s = 2.0$ $\eta_z$ : ON  $\omega_z = 1.75$  SPEED HOLD : ON  OLD CASE NO. : 19 | |
|---|---|---|
| RUN/PILOT 5-10-4 / B | SCORES : $\varepsilon_{long} = .081$  $\sigma_{long} = .92$ $\varepsilon_{lat} = -.124$  $\sigma_{lat} = 1.17$ | COOPER- HARPER RATING 4.5 |

COMMENTS :

- DELUSION OF REDUCTION IN PITCH-DAMPING: TENDENCY TO OVERSHOOT

- NEARLY OBTAINED DESIRED PERFORMANCE, BUT STILL INTENSE CONCENTRATION NECESSARY

- HARDER THAN CASE 1C-12-1

- NOTE : NO DIGITAL DATA

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-12-3 | SPECS :<br><br>$\eta_y$ : ON    $\omega_y = 2.0$    SCAS : ON    $K_\eta = 2.0$<br><br>$\eta_z$ : ON    $\omega_z = 1.5$    SPEED HOLD : ON<br><br>OLD CASE NO. : 25. | | |
|---|---|---|---|
| RUN/PILOT<br><br>5-14-5 /<br><br>/ B | SCORES :<br><br>$\varepsilon_{long} = .205$    $\sigma_{long} = .959$<br><br>$\varepsilon_{lat} = .111$    $\sigma_{lat} = 1.29$ | | COOPER-<br>HARPER<br>RATING<br><br>2.5 |

COMMENTS :

- VERY CLOSE TO DESIRED PERFORMANCE

- PIECE OF CAKE

- BASED ON PREVIOUS RUNS OF 5-14 THIS CASE
  IS PRETTY EASY

- EVALUATOR COMMENT - I COULD SURE FEEL
  THE VIBRATION MOTION

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-12-3 | SPECS :<br><br>$\eta_y$ : ON    $\omega_y$ = 2.0    SCAS : ON    $K_{\blacksquare}$ = 2.0<br><br>$\eta_z$ : ON    $\omega_z$ = 1.5    SPEED HOLD : ON<br><br>OLD CASE NO. : 25. | |
|---|---|---|
| RUN/PILOT<br><br>S-21-6  /<br><br>/ A | SCORES :<br><br>$\varepsilon_{long}$ = .20      $\sigma_{long}$ = .953<br><br>$\varepsilon_{lat}$ = -.066      $\sigma_{lat}$ = 1.40 | COOPER-<br>HARPER<br>RATING<br><br>N/A |
| COMMENTS : | | |

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : |  |
|---|---|---|
| 1C-12-3 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$ <br><br> $\eta_z$ : ON $\quad \omega_z = 1.5 \quad$ SPEED HOLD : ON <br><br> OLD CASE NO. : 25. | |

| RUN/PILOT | SCORES : |  | COOPER-HARPER RATING |
|---|---|---|---|
| 5-29-1 / A | $\varepsilon_{long} = .23$ <br><br> $\varepsilon_{lat} = .15$ | $\sigma_{long} = .952$ <br><br> $\sigma_{lat} = 1.34$ | 4 |

COMMENTS :

Table A.8 - Data Summary Sheets continued

| CASE NO. 1C-12-3 | SPECS : $\eta_y$ : ON $\omega_y = 2.0$ SCAS : ON $K_\theta = 2.0$ <br> $\eta_z$ : ON $\omega'_z = 1.5$ SPEED HOLD ; ON <br> OLD CASE NO. : 25. | | |
|---|---|---|---|
| RUN/PILOT <br> 5-24-2 / <br> / A | SCORES : <br> $\varepsilon_{long} = .028$ $\sigma_{long} = 1.01$ <br> $\varepsilon_{lat.} = -.065$ $\sigma_{lat} = 1.36$ | | COOPER- <br> HARPER <br> RATING <br> 2-3 |

COMMENTS :

  - GOOD RESPONSE

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1C-12-4 | $\eta_y$ : ON  $\omega_y = 2.0$  SCAS : ON  $K_q = 2.0$<br><br>$\eta_z$ : ON  $\omega_z = 1.25$  SPEED HOLD : ON<br><br>OLD CASE NO. : 27 | |

| RUN/PILOT | SCORES : | COOPER-<br>HARPER<br>RATING |
|---|---|---|
| S-17-1<br><br>B | $\varepsilon_{long} = .153$   $\sigma_{long} = 1.02$<br><br>$\varepsilon_{lat} = .044$   $\sigma_{lat} = 1.18$ | 3 |

COMMENTS :

- THOUGHT PERFORMANCE WAS BETTER, PERHAPS
  PEAK DEVIATION LESS THAN PREVIOUS RUN


- RIDE IS STILL ROUGH

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-12-5 | SPECS :<br><br>$\eta_y$ : ON  $\omega_y = 2.0$  SCAS : ON  $K_q = 2.0$<br><br>$\eta_z$ : ON  $\omega_z = 1.0$  SPEED HOLD : ON<br><br>OLD CASE NO. :  29. | |
|---|---|---|
| RUN/PILOT<br><br>5-17-3 /<br><br>/ B | SCORES :<br><br>$\varepsilon_{long} = .27$  $\sigma_{long} = 1.00$<br><br>$\varepsilon_{lat} = .15$  $\sigma_{lat} = 1.2$ | COOPER-<br>HARPER<br>RATING<br><br>3.5 |
| COMMENTS :<br><br>- DISTRACTION TO FEEL VIBRATION<br><br><br>- CLOSE TO DESIRED PERFORMANCE | | |

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-12-5 | SPECS :<br><br>$\eta_y$ : ON    $\omega_y = 2.0$    SCAS : ON    $K_q = 2.0$<br><br>$\eta_z$ : ON    $\omega_z = 1.0$    SPEED HOLD ; ON<br><br>OLD CASE NO. : 29 . | |
|---|---|---|
| RUN/PILOT<br><br>5-21-4<br><br>A | SCORES :<br><br>$\mathcal{E}_{long} = .262$        $\sigma_{long} = 1.05$<br><br>$\mathcal{E}_{lat} = -.084$      $\sigma_{lat} = 1.51$ | COOPER-<br>HARPER<br>RATING<br><br>N/A |
| COMMENTS : | | |

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-12-5 | SPECS :<br><br>$\eta_y$ : ON $\omega_y = 2.0$ SCAS : ON $K_q = 2.0$<br><br>$\eta_z$ : ON $\omega_z = 1.0$ SPEED HOLD : ON<br><br>OLD CASE NO. : 29. | |
|---|---|---|
| RUN/PILOT<br><br>5-24-3 / A | SCORES :<br><br>$\varepsilon_{long} = -.035$ $\sigma_{long} = 1.04$<br><br>$\varepsilon_{lat} = -.16$ $\sigma_{lat} = 1.36$ | COOPER-<br>HARPER<br>RATING<br><br>N/A |
| COMMENTS :<br><br>— LOW FREQUENCY NORMAL (PLUNGE) UNDULATION NOTICEABLE | | |

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-12-5 | SPECS :<br><br>$\eta_y$ : ON  $\omega_y$ = 2.0  SCAS : ON  $K_q$ = 2.0<br><br>$\eta_z$ : ON  $\omega_z$ = 1.0  SPEED HOLD ; ON<br><br>OLD CASE NO. : 29. | |
|---|---|---|
| RUN/PILOT<br><br>5-29-2 /<br><br>/ A | SCORES :<br><br>$\varepsilon_{long}$ = .32  $\sigma_{long}$ = 1.07<br><br>$\varepsilon_{lat}$ = .066  $\sigma_{lat}$ = 1.43 | COOPER-<br>HARPER<br>RATING<br><br>4 |
| COMMENTS :<br><br>    - LOW FREQUENCY PLUNGE SENSATION | | |

Table A.8 - Data Summary Sheets  continued

| CASE NO.

1C-12-6 | SPECS :

$\eta_y$ : ON $\quad \omega_y = 1.5 \quad$ SCAS : ON $\quad K_q = 2.0$

$\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD ; ON

OLD CASE NO. : 35 | |
|---|---|---|
| RUN/PILOT

5-17-11/

/B | SCORES :

$\varepsilon_{long} = .131 \qquad \sigma_{long} = .797$

$\varepsilon_{lat} = -.038 \qquad \sigma_{lat} = 1.15$ | COOPER-
HARPER
RATING

3.5 |

COMMENTS :

- CONSISTENT WITH PREVIOUS RESULTS

- PERFORMANCE BECOMES SOMEWHAT INDEPENDENT
  FROM CASE TO CASE

- VARIATION WITH MOTION CAN BE FELT

- IN ROLL: TENDENCY TO OVERSHOOT

- CAN EXCITE LATERAL MODE LEADING TO PIO

Table A.8 - Data Summary Sheets  continued

| CASE NO.<br><br>1C-12-6 | SPECS :<br><br>$\eta_y$ : ON $\quad \omega_y = 1.5 \quad$ SCAS : ON $\quad K_q = 2.0$<br><br>$\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD ; ON<br><br>OLD CASE NO. : 35 | |
|---|---|---|
| RUN/PILOT<br><br>5-29-7 /<br><br>/ B | SCORES :<br><br>$\varepsilon_{long} = .12 \quad\quad \sigma_{long} = .86$<br><br>$\varepsilon_{lat} = -.06 \quad\quad \sigma_{lat} = 1.29$ | COOPER-<br>HARPER<br>RATING<br><br>4 |

COMMENTS :


- ROLL DIFFICULTIES WERE MORE APPEARENT;
  ROLL RESPONSE HAD LESS DAMPING AND WAS
  HARDER TO CONTROL


- HAD TO FIGHT TO KEEP PITCH PERFORMANCE
  UP


- HAD TO CONDENTRATE ON ROLL TASK, WHERE
  AS IN BASELINE ROLL TASK WAS ALMOST
  AUTOMATIC


- INCREASED ROLL SENSITIVITY, OR REDUCED
  ROLL DAMPING; OVERHSOOT AND 2-3 ROLL
  CORRECTIONS REQUIRED


- PIO TENDENCY IN ROLL

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-12-6 | SPECS :<br><br>$\eta_y$ : ON $\quad \omega_y = 1.5 \quad$ SCAS : ON $\quad K_q = 2.0$<br><br>$\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD ; ON<br><br>OLD CASE NO. : 35 | |
|---|---|---|
| RUN/PILOT<br><br>5-30-6<br><br>C | SCORES :<br><br>$\varepsilon_{long} = .070 \qquad \sigma_{long} = 1.00$<br><br>$\varepsilon_{lat} = -.362 \qquad \sigma_{lat} = 1.51$ | COOPER-<br>HARPER<br>RATING<br><br>3-4 |
| COMMENTS :<br><br>    - MUCH EASIER TASK THAN LAST TWO (I.E. RUN<br>      NO. 5-30-4 AND 5-30-5)<br><br><br>    - HAD TO WORK HARDER THAN WOULD LIKE TO | | |

Table A.8 - Data Summary Sheets  continued

| CASE NO.<br><br>1C-12-7 | SPECS :<br><br>$\eta_y$ : ON $\omega_y = 1.0$ SCAS : ON $K_q = 2.0$<br><br>$\eta_z$ : ON $\omega_z = 2.0$ SPEED HOLD : ON<br><br>OLD CASE NO. : 41 | |
|---|---|---|
| RUN/PILOT<br><br>5-31-3<br><br>C | SCORES :<br><br>$\varepsilon_{long} = .049$ $\sigma_{long} = .985$<br><br>$\varepsilon_{lat} = -.516$ $\sigma_{lat} = 1.64$ | COOPER-<br>HARPER<br>RATING<br><br>4-5 |

COMMENTS :

- TASK EASIER THAN LAST RUN BUT STILL WORK
  ING HARD

- MOTION MIGHT NOT HAVE HELPED

- MODERATE TO HEAVY COMPENSATION REQUIRED

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1C-12-8 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$ <br><br> $\eta_z$ : ON $\quad \omega_z = 0.8 \quad$ SPEED HOLD ; ON <br><br> OLD CASE NO. : 45. | |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 5-21-1 / <br> / A | $\varepsilon_{long} = -.24 \qquad \sigma_{long} = 1.64$ <br><br> $\varepsilon_{lat} = -.25 \qquad \sigma_{lat} = 1.70$ | RATING <br><br> N/A |

COMMENTS :

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1C-12-8 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$ <br><br> $\eta_z$ : ON $\quad \omega_z = 0.8 \quad$ SPEED HOLD : ON <br><br> OLD CASE NO. : 45. | |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 5-21-3 / A | $\varepsilon_{long} = .006 \qquad \sigma_{long} = 1.48$ <br><br> $\varepsilon_{lat} = -.143 \qquad \sigma_{lat} = 1.79$ | N/A |

COMMENTS :

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | | |
|---|---|---|---|
| 1C-12-8 | $\eta_y$ : ON    $\omega_y = 2.0$    SCAS : ON    $K_q = 2.0$ <br><br> $\eta_z$ : ON    $\omega_z = 0.8$    SPEED HOLD ; ON <br><br> OLD CASE NO. : 45. | | |

| RUN/PILOT | SCORES : | | COOPER-HARPER RATING |
|---|---|---|---|
| S-24-4 / A | $\varepsilon_{long} = -.25$    $\sigma_{long} = 1.37$ <br><br> $\varepsilon_{lat} = -.077$    $\sigma_{lat} = 1.57$ | | 4-5 |

COMMENTS :

- LOW FREQUENCY LIGHTLY DAMPED


- PERHAPS FLEW A LITTLE TENTATIVELY
  BECAUSE OF ODD (LOW FREQUENCY) MOTION
  AND WAS APPREHENSIVE AS A RESULT

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-12-8 | SPECS :<br><br>$\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$<br><br>$\eta_z$ : ON $\quad \omega_z = 0.8 \quad$ SPEED HOLD ; ON<br><br>OLD CASE NO. : 45. | |
|---|---|---|
| RUN/PILOT<br><br>5-29-4<br><br>A | SCORES :<br><br>$\varepsilon_{long} = -.24 \qquad \sigma_{long} = 1.30$<br><br>$\varepsilon_{lat} = .15 \qquad \sigma_{lat} = 1.36$ | COOPER-<br>HARPER<br>RATING<br><br>5 |

COMMENTS :

- HEAVIER FORCES

- LESS PREDICTABLE

- UNSTABLE PHUGOID NOTED BUT NOT
  CONTROLLED

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-12-9 | SPECS :<br><br>$\eta_y$ : ON   $\omega_y$ = 2.0   SCAS : ON   $K_q$ = 2.0<br><br>$\eta_z$ : ON   $\omega_z$ = 0.9   SPEED HOLD : ON<br><br>OLD CASE NO. : 46 | |
|---|---|---|
| RUN/PILOT<br><br>5-21-2 /<br><br>/ A | SCORES :<br><br>$\varepsilon_{long}$ = .287   $\sigma_{long}$ = 1.05<br><br>$\varepsilon_{lot}$ = .058   $\sigma_{lot}$ = 1.40 | COOPER-<br>HARPER<br>RATING<br><br>N/A |
| COMMENTS : | | |

**Table A.8 - Data Summary Sheets continued**

| CASE NO.<br><br>1C-12-10 | SPECS :<br><br>$\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 1.6$<br><br>$\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD : ON<br><br>OLD CASE NO. : 54 | | |
|---|---|---|---|
| RUN/PILOT<br><br>5-24-5<br><br>A | SCORES :<br><br>$\varepsilon_{long} = .281 \qquad \sigma_{long} = .995$<br><br>$\varepsilon_{lat} = -.227 \qquad \sigma_{lat} = 1.08$ | | COOPER-<br>HARPER<br>RATING<br><br>3 |

COMMENTS :


- LITTLE OSCILLATORY TENDENCY



- STICK MORE SENSITIVE ( THAN PREVIOUS RUNS
  I.E. RUNS 5-24-1 - 5-24-4)

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | | | |
|---|---|---|---|---|
| 1C-12-10 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 1.6$ <br> $\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD ; ON <br><br> OLD CASE NO. : 54 | | | |

| RUN/PILOT. | SCORES : | | COOPER-HARPER RATING |
|---|---|---|---|
| 5-24-9 / B | $\varepsilon_{long} = .080$ $\qquad \sigma_{long} = .839$ <br><br> $\varepsilon_{lat} = -.130$ $\qquad \sigma_{lat} = 1.08$ | | 3 |

COMMENTS :

    - LITTLE OVERSHOOT

    - MUST BE CAREFUL NOT TO OVERCONTROL

    - FREQUENCY OF VIBRATION NOT DISTRACTING

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1C-12-11 | $\eta_y$ : ON  $\omega_y = 2.0$  SCAS : ON  $K_\bullet = 1.6$ <br><br> $\eta_z$ : ON  $\omega_z = 1.5$  SPEED HOLD : ON <br><br> OLD CASE NO. : 55 | |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 5-24-6 / A | $\varepsilon_{long} = -.034$  $\sigma_{long} = 1.00$ <br><br> $\varepsilon_{lat} = -.038$  $\sigma_{lat} = 1.18$ | 2.5 |

COMMENTS :

- PRETTY GOOD RESPONSE


- NOT TOO SENSITIVE

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-12-11 | SPECS :<br><br>$\eta_y$ : ON    $\omega_y = 2.0$    SCAS : ON    $K_q = 1.6$<br><br>$\eta_z$ : ON    $\omega_z = 1.5$    SPEED HOLD ; ON<br><br>OLD CASE NO. : 55 | |
|---|---|---|
| RUN/PILOT<br><br>5-24-10 /<br><br>/ B | SCORES :<br><br>$\varepsilon_{long} = .13$    $\sigma_{long} = 1.03$<br><br>$\varepsilon_{lat} = .054$    $\sigma_{lat} = .895$ | COOPER-<br>HARPER<br>RATING<br><br>3+ |

COMMENTS :

- ACQUISITION NOMINAL

- OSCILLATIONS TEND TO BE ANNOYING

- HAD TO MENTALLY SUPRESS THE ANNOYANCE
  ( SENSATION )

Table A.8 - Data Summary Sheets continued

| CASE NO.

1C-12-12 | SPECS :<br><br>$\eta_y$ : ON    $\omega_y = 2.0$    SCAS : ON    $K_q = 1.6$<br><br>$\eta_z$ : ON    $\omega_z = 1.0$    SPEED HOLD ; ON<br><br>OLD CASE NO. : 56 | |
|---|---|---|
| RUN/PILOT<br><br>5-24-7<br><br>A | SCORES :<br><br>$\varepsilon_{long} = -.040$    $\sigma_{long} = 1.0$<br><br>$\varepsilon_{lat} = -.074$    $\sigma_{lat} = 1.37$ | COOPER-<br>HARPER<br>RATING<br><br>3.5 |

COMMENTS :

   - MORE DIFFICULT TO CONTROL (THAN PREVIOUS
     RUN)


   - SICKENING MOTION

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-12-12 | SPECS :<br><br>$\eta_y$ : ON   $\omega_y$ = 2.0   SCAS : ON   $K_q$ = 1.6<br><br>$\eta_z$ : ON   $\omega_z$ = 1.0   SPEED HOLD ; ON<br><br>OLD CASE NO. : 56 | |
|---|---|---|
| RUN/PILOT<br><br>5-24-11<br><br>B | SCORES :<br><br>$\varepsilon_{long}$ = .054   $\sigma_{long}$ = .895<br><br>$\varepsilon_{lat}$ = -.004   $\sigma_{lat}$ = 1.10 | COOPER-<br>HARPER<br>RATING<br><br>N/A |

COMMENTS :

- TASK SEEMED A LITTLE TOUGHER (THAN PREVIOUS RUNS)

- NOT SURE IF ENTIRELY DUE TO MOTION

Table A.8 - Data Summary Sheets continued

| CASE NO.

1C-12-13 | SPECS :<br><br>$\eta_y$ : ON $\omega_y$ = 2.0 SCAS : ON $K_q$ = 1.6<br><br>$\eta_z$ : ON $\omega_z$ = 0.8 SPEED HOLD : ON<br><br>OLD CASE NO. : 57 | |
|---|---|---|
| RUN/PILOT<br><br>5-24-8 /<br><br>/ A | SCORES :<br><br>$\varepsilon_{long}$ = -.145 $\sigma_{long}$ = 1.27<br><br>$\varepsilon_{lat}$ = -.017 $\sigma_{lat}$ = 1.32 | COOPER-<br>HARPER<br>RATING<br><br>5 |
| COMMENTS :<br><br>- MUCH HARDER ( THAN PREVIOUS RUNS )<br><br><br>- WEIRD MOTION | | |

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | | |
|---|---|---|---|
| 1C-12-13 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 1.6$ <br><br> $\eta_z$ : ON $\quad \omega_z = 0.8 \quad$ SPEED HOLD : ON <br><br> OLD CASE NO. : 57 | | |

| RUN/PILOT | SCORES : | | COOPER-HARPER RATING |
|---|---|---|---|
| 5-24-13 <br><br> B | $\varepsilon_{long} = .058$ <br><br> $\varepsilon_{lat} = -.66$ | $\sigma_{long} = 1.21$ <br><br> $\sigma_{lat} = 1.11$ | 5 |

COMMENTS :

- SIGNIFICANT DEGREDATION IN PERFORMANCE

- MORE DIFFICULT TO ACQUIRE TARGET

- SLUGGISH

- MORE STICK DEFLECTION REQUIRED

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-12-14 | SPECS :<br><br>$\eta_y$ : ON $\quad \omega_y$ = 2.0 $\quad$ SCAS : OFF $\quad$ K$_q$ = —<br><br>$\eta_z$ : ON $\quad \omega_z$ = 2.0 $\quad$ SPEED HOLD ; ON<br><br>OLD CASE NO. : 58 | |
|---|---|---|
| RUN/PILOT<br><br>5-24-14<br><br>/ B | SCORES :<br><br>$\varepsilon_{long}$ = .023 $\qquad \sigma_{long}$ = 1.18<br><br>$\varepsilon_{lat}$ = -.12 $\qquad \sigma_{lat}$ = 1.32 | COOPER-<br>HARPER<br>RATING<br><br>5 |

COMMENTS :


- SLUGGISH



- HEAVY, LARGE STICK DISPLACEMENTS

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1C-12-15 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : OFF $\quad K_e = -$ <br><br> $\eta_z$ : ON $\quad \omega_z = 1.5 \quad$ SPEED HOLD : ON <br><br> OLD CASE NO. : 59 | |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 5-24-15 / B | $\varepsilon_{long} = -.014 \qquad \sigma_{long} = 1.35$ <br><br> $\varepsilon_{lat} = -.016 \qquad \sigma_{lat} = 1.30$ | 6 |

COMMENTS :

- SLUGGISH

- HEAVY, LARGE STICK DISPLACEMENTS

- LESS PREDICTABLE

- LARGER OVERSHOOT IN CORRECTIONS

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-12-16 | SPECS :<br><br>$\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : OFF $\quad K_q = -$<br><br>$\eta_z$ : ON $\quad \omega_z = 1.0 \quad$ SPEED HOLD : ON<br><br>OLD CASE NO. : 60 | |
|---|---|---|
| RUN/PILOT<br><br>5-24-16 / B | SCORES :<br><br>$\varepsilon_{long} = .059 \qquad \sigma_{long} = 1.35$<br><br>$\varepsilon_{lat} = -.20 \qquad \sigma_{lat} = 1.21$ | COOPER-<br>HARPER<br>RATING<br><br>6 |

COMMENTS :

- SIMILAR TO LAST RUN

- DID NOT SEEM TO BE JUMPING QUITE AS BAD

- LARGE FORCES AND DISPLACEMENTS

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-12-17 | SPECS :<br><br>$\eta_y$ : OFF   $\omega_y$ = -      SCAS : ON      $K_q$ = 2.0<br><br>$\eta_z$ : OFF   $\omega_z$ = -      SPEED HOLD ; ON<br><br>OLD CASE NO. :  29* | |
|---|---|---|
| RUN/PILOT<br><br>5-17-4<br><br>/  8 | SCORES :<br><br>$\varepsilon_{long}$ = .08        $\sigma_{long}$ = .84<br><br>$\varepsilon_{lat}$ = .033      $\sigma_{lat}$ = 1.15 | COOPER-<br>HARPER<br>RATING<br><br>2.5 |

COMMENTS :

- MOTION A DISTRACTION BECAUSE FELT SURGE
  (U) IN DIVE; PILOTS ARE WARY


- DESIRED PERFORMANCE ACHIEVED


- PITCH A LITTLE LIGHTER IN RESPONSE SO
  MAY BE TENDENCY TO OVERSHOOT

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-21-1 | SPECS :<br><br>$\eta_y$ : OFF  $\omega_y = -$    SCAS : ON    $K_q = 1.6$<br><br>$\eta_z$ : OFF  $\omega_z = -$    SPEED HOLD ; OFF<br><br>OLD CASE NO. : 3* | |
|---|---|---|
| RUN/PILOT<br><br>4-30-3 /<br><br>/ A | SCORES :<br><br>$\varepsilon_{long}$ = N/A        $\sigma_{long}$ = N/A<br><br>$\varepsilon_{lat}$ = N/A        $\sigma_{lat}$ = N/A | COOPER-<br>HARPER<br>RATING<br><br>5 |

COMMENTS :

- INTERESTING THING IS AN OSCILLATION IS
  SET UP WHEN TRYING TO RECOVER BOTH AXES
  THAT DID NOT OCCUR IN CASE 1B-21-2


- CAN NOT DIVERT ATTENTION OR ELSE A FEW
  OVERSHOOTS


- WILL TRY TO ADJUST KQ IN PITCH SCAS TO
  ELIMINATE BOBBLE


- NOTE : SIGMA(P)**2 = 0.77 FOR THIS RUN

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1C-21-2 | $\eta_y$ : OFF $\quad \omega_y = -$ $\quad$ SCAS : ON $\quad$ K$_s$ = 2.0 <br><br> $\eta_z$ : OFF $\quad \omega_z = -$ $\quad$ SPEED HOLD ; OFF <br><br> OLD CASE NO. : 3 | |

| RUN/PILOT | SCORES : | | COOPER-HARPER RATING |
|---|---|---|---|
| 5-2-3 / <br> / B | $\mathcal{E}_{long}$ = .114 <br><br> $\mathcal{E}_{lat}$ = .046 | $\sigma_{long}$ = 1.00 <br><br> $\sigma_{lat}$ = 1.84 | 4 |

COMMENTS :

- NOTE : SIGMA(P)**2 = 0.77 FOR THIS RUN

Table A.8 - Data Summary Sheets  continued

| CASE NO.<br><br>1C-21-3 | SPECS :<br><br>$\eta_y$ : ON   $\omega_y = 2.0$   SCAS : ON   $K_q = 2.0$<br><br>$\eta_z$ : ON   $\omega_z = 2.0$   SPEED HOLD ; OFF<br><br>OLD CASE NO. : 9.1 | |
|---|---|---|
| RUN/PILOT<br><br>5-3-5 / <br>/ B | SCORES :<br><br>$\varepsilon_{long} = .315$   $\sigma_{long} = 1.36$<br><br>$\varepsilon_{lat} = -5.25$   $\sigma_{lat} = 2.53$ | COOPER-<br>HARPER<br>RATING<br><br>N/A |

COMMENTS :


- OSCILLATIONS STAY WITHIN CIRCLE



- JUST LET IT DAMPEN OUT SINCE CAN NOT
CONTROL IT

Table A.8 - Data Summary Sheets continued

| CASE NO.  1C-21-3 | SPECS : $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_\varsigma = 2.0$ $\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD ; OFF OLD CASE NO. : 9.1 | |
|---|---|---|
| RUN/PILOT  5-7-7 / B | SCORES : $\varepsilon_{long} = .565 \qquad \sigma_{long} = 1.62$ $\varepsilon_{lat} = .308 \qquad \sigma_{lat} = 1.92$ | COOPER- HARPER RATING  N/A |
| COMMENTS : | | |

| CASE NO. | SPECS : | |
|---|---|---|
| 1C-21-3 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$ <br><br> $\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD : OFF <br><br> OLD CASE NO. : 9.1 | |

| RUN/PILOT | SCORES : | | COOPER-HARPER RATING |
|---|---|---|---|
| 6-11-3 / D | $\varepsilon_{long} = .419 \qquad \sigma_{long} = 1.53$ <br><br> $\varepsilon_{lat} = -.57 \qquad \sigma_{lat} = 2.25$ | | N/A |

COMMENTS :

- MORE OSCILLATION IS DISPLAY COMPARED TO TWO PREVIOUS RUNS


- DEGRADED PERFORMANCE COMPARED TO TWO PREVIOUS RUNS


- ROLL OVERSHOOT

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1C-21-4 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K = 2.0$<br><br>$\eta_z$ : ON $\quad \omega_z = 1.75 \quad$ SPEED HOLD : ON<br><br>OLD CASE NO. : 17 | |

| RUN/PILOT | SCORES : | COOPER-<br>HARPER<br>RATING |
|---|---|---|
| S-8-6 / B | $\varepsilon_{long} = .162 \qquad \sigma_{long} = 1.69$<br><br>$\varepsilon_{lat} = -.11 \qquad \sigma_{lat} = 1.41$ | N/A |

COMMENTS :

- TRIED TO BE AS AGGRESSIVE AS POSSIBLE


- TRYING TO STAY CENTERED ON TARGET WITH
OSCILLATIONS ON EITHER SIDE OF THE DOT.
OBVIOUS DUE TO VIBRATION


- ROLL STILL NOT A PROBLEM - CONCENTRATE
ON PITCH


- USED MECHANICAL TECHNIQUE

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-21-4 | SPECS :<br><br>$\eta_y$ : ON   $\omega_y = 2.0$   SCAS : ON   $K_q = 2.0$<br><br>$\eta_z$ : ON   $\omega_z = 1.75$  SPEED HOLD : ON<br><br>OLD CASE NO. : 17 | |
|---|---|---|
| RUN/PILOT<br><br>5-8-7 /<br><br>/ B | SCORES :<br><br>$\varepsilon_{long} = .429$   $\sigma_{long} = 1.53$<br><br>$\varepsilon_{lat} = -.25$   $\sigma_{lat} = 1.51$ | COOPER-<br>HARPER<br>RATING<br><br>N/A |
| COMMENTS :<br><br>  - ATTEMPTED TO FLY AS SMOOTHLY AS POSSIBLE<br>    TO AVOID EXCITATION OF MODES | | |

## Table A.8 - Data Summary Sheets continued

| CASE NO.  1C-21-5 | SPECS : $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_{\theta} = 2.0$ $\eta_z$ : ON $\quad \omega_z = 1.5 \quad$ SPEED HOLD ; ON OLD CASE NO. : 23 | |
|---|---|---|
| RUN/PILOT  5-14-3 /  / B | SCORES :  $\varepsilon_{long} = .474 \qquad \sigma_{long} = 1.82$  $\varepsilon_{lat} = .364 \qquad \sigma_{lat} = 1.64$ | COOPER- HARPER RATING  7+ |

COMMENTS :

- APPARENT LAG VERY ANNOYING

- EXTREME STICK DISPLACEMENTS REQUIRED TO GET NOSE MOVING

- TENDS TO PIO

- ROLL DOES NOT SEEM TO AFFECT MY PERFORMANCE OR THE TASK

| CASE NO. | SPECS : | | |
|---|---|---|---|
| 1C-21-6 | $\eta_y$ : ON $\quad\omega_y = 1.5 \quad$ SCAS : ON $\quad K_q = 2.0$<br><br>$\eta_z$ : ON $\quad\omega_z = 2.0 \quad$ SPEED HOLD ; ON<br><br>OLD CASE NO. : 33 | | |

| RUN/PILOT | SCORES : | COOPER-<br>HARPER<br>RATING |
|---|---|---|
| 5-17-9 / <br> / B | $\varepsilon_{long} = .12 \qquad \sigma_{long} = 1.39$<br><br>$\varepsilon_{lat} = -.167 \qquad \sigma_{lat} = 1.68$ | 7 |

COMMENTS :

- HARD TO ROLL: ROLL OBVIOUSLY DEGRADED

- HARD TO FLY INSTINCTIVELY (AS BEFORE)

- PERFORMANCE VERY BAD

| CASE NO. | SPECS : | |
|---|---|---|
| 1C-21-6 | $\eta_y$ : ON $\quad \omega_y = 1.5 \quad$ SCAS : ON $\quad K_q = 2.0$ <br><br> $\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD : ON <br><br> OLD CASE NO. : 33 | |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 5-30-2 / C | $\varepsilon_{long} = .224 \qquad \sigma_{long} = 1.49$ <br><br> $\varepsilon_{lat} = .32 \qquad \sigma_{lat} = 2.08$ | N/A |

COMMENTS :

     - (ON LEARNING CURVE)

     - MENTALLY TRIED HARDER THAN PREVIOULY

     - FELT PERFOMANCE WAS BETTER THAN PREVIOUS
        RUN

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-21-6 | SPECS :<br><br>$\eta_y$ : ON $\quad \omega_y = 1.5 \quad$ SCAS : ON $\quad K_s = 2.0$<br><br>$\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD : ON<br><br>OLD CASE NO. : 33 | |
|---|---|---|
| RUN/PILOT<br><br>S-30-3 /<br><br>/ C | SCORES :<br><br>$\varepsilon_{long} = .244 \quad\quad \sigma_{long} = 1.45$<br><br>$\varepsilon_{lat} = .751 \quad\quad \sigma_{lat} = 1.95$ | COOPER-<br>HARPER<br>RATING<br><br>N/A |

COMMENTS :

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1C-21-7 | $\eta_y$ : ON $\omega_y$ = 1.0 SCAS : ON $K_q$ = 2.0 <br><br> $\eta_z$ : ON $\omega_z$ = 2.0 SPEED HOLD : ON <br><br> OLD CASE NO. : 39 | |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 5-29-8 / B | $\varepsilon_{long}$ = .227 $\sigma_{long}$ = 1.42 <br><br> $\varepsilon_{lat}$ = -.264 $\sigma_{lat}$ = 1.74 | 7.5 |

COMMENTS :

- HARD TO TELL WHETHER PITCH OR ROLL IS THE PREBLEM WITH SIMULTANEOUS TASKS BEING FLOWN

- DIFFICULT CONFIGURATION TO CONTROL

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-21-7 | SPECS : <br><br>$\eta_y$ : ON $\omega_y = 1.0$ SCAS : ON $K_q = 2.0$<br><br>$\eta_z$ : ON $\omega_z = 2.0$ SPEED HOLD : ON<br><br>OLD CASE NO. : 39 | |
|---|---|---|
| RUN/PILOT<br><br>5-30-8<br><br>C | SCORES : <br><br>$\mathcal{E}_{long} = .18$ $\sigma_{long} = 1.31$<br><br>$\mathcal{E}_{lat} = .156$ $\sigma_{lat} = 1.76$ | COOPER-<br>HARPER<br>RATING<br><br>5 |

COMMENTS :

- A LITTLE TOUGHER THAN LAST RUN

- FELT LIKE MORE RUDDER EFFECTIVENESS

- AILERON FELT THE SAME

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-21-8 | SPECS : <br><br>$\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q =$ ESC<br><br>$\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD ; OFF<br><br>OLD CASE NO. : 113 | |
|---|---|---|
| RUN/PILOT<br><br>6-11-4<br><br>D | SCORES :<br><br>$\varepsilon_{long} = -.049 \qquad \sigma_{long} = 2.63$<br><br>$\varepsilon_{lat} = -.323 \qquad \sigma_{lat} = 2.94$ | COOPER-<br>HARPER<br>RATING<br><br>N/A |
| COMMENTS :<br><br>   - TASK WAS VERY DIFFICULT<br><br><br>   - PERFORMANCE UNACCEPTABLE<br><br><br>   - LARGE STICK DISPLACEMENTS REQUIRED | | |

## Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1C-21-8 | $\eta_y$ : ON $\quad \omega_y$ = 2.0 $\quad$ SCAS : ON $\quad$ $K_q$ = ESC<br><br>$\eta_z$ : ON $\quad \omega_z$ = 2.0 $\quad$ SPEED HOLD : OFF<br><br>OLD CASE NO. : 113 | |
| RUN/PILOT<br><br>6-11-5 /<br>/ D | SCORES :<br><br>$\varepsilon_{long}$ = -.161 $\qquad \sigma_{long}$ = 2.05<br><br>$\varepsilon_{lat}$ = .592 $\qquad \sigma_{lat}$ = 3.34 | COOPER-<br>HARPER<br>RATING<br><br>N/A |

COMMENTS :

- UNACCEPTABLE PERFORMANCE

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-21-8 | SPECS :<br><br>$\eta_y$ : ON   $\omega_y = 2.0$   SCAS : ON   $K_q = $ ESC<br><br>$\eta_z$ : ON   $\omega_z = 2.0$   SPEED HOLD : OFF<br><br>OLD CASE NO. : 113 | |
|---|---|---|
| RUN/PILOT<br><br>6-11-9<br><br>C | SCORES :<br><br>$\varepsilon_{long} = -.027$   $\sigma_{long} = 2.85$<br><br>$\varepsilon_{lat} = -.704$   $\sigma_{lat} = 2.19$ | COOPER-<br>HARPER<br>RATING<br><br>8+ |
| COMMENTS :<br><br>- LARGE STICK INPUTS<br><br><br>- OVERSHOOT PROBLEM<br><br><br>- SLUGGISH RESPONSE<br><br><br>- VERY HARD TASK; UNACCEPTABLE PERFORMANCE | | |

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-22-1 | SPECS :<br><br>$\eta_y$ : ON    $\omega_y$ = 2.0    SCAS : ON    $K_q$ = 2.0<br><br>$\eta_z$ : ON    $\omega_z$ = 2.0    SPEED HOLD : ON<br><br>OLD CASE NO. : 20 | |
|---|---|---|
| RUN/PILOT<br><br>5-10-5 /<br><br>/ B | SCORES :<br><br>$\varepsilon_{long}$ = .11     $\sigma_{long}$ = 1.04<br><br>$\varepsilon_{lat}$ = -.179    $\sigma_{lat}$ = 1.29 | COOPER-<br>HARPER<br>RATING<br><br>3.5 |
| COMMENTS :<br><br>  - DESIRED PERFORMANCE OBTAINED WITH<br>    COMFORTABLE WORKLOAD<br><br><br>  - ONLY SLIGHT TENDENCY TO OVERCONTROL IN<br>    PITCH<br><br><br>  - NOTE :  NO DIGITAL DATA | | |

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1C-22-2 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$ <br><br> $\eta_z$ : ON $\quad \omega_z = 1.5 \quad$ SPEED HOLD : ON <br><br> OLD CASE NO. : 26 | |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 5-14-6 / B | $\mathcal{E}_{long} = .201 \qquad \sigma_{long} = .904$ <br><br> $\mathcal{E}_{lat} = -.131 \qquad \sigma_{lat} = 1.32$ | 2.5 |

COMMENTS :

- PERFORMANCE ABOUT THE SAME AS CASE
  1C-12-3 (PREVIOUS RUN) BUT MUCH MORE
  PLEASANT TASK

- NO BOUNCING

- PERHAPS SUBTLE LAGS

- NOT QUITE DESIRED PERFORMANCE, BUT
  PRETTY CLOSE

Table A.8 - Data Summary Sheets  continued

| CASE NO.<br><br>1C-22-3 | SPECS :<br><br>$\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$<br><br>$\eta_z$ : ON $\quad \omega_z = 1.25 \quad$ SPEED HOLD : ON<br><br>OLD CASE NO. : 28 | | |
|---|---|---|---|
| RUN/PILOT<br><br>5-17-2<br><br>B | SCORES :<br><br>$\varepsilon_{long} = .144 \qquad \sigma_{long} = .82$<br><br>$\varepsilon_{lat} = .044 \qquad \sigma_{lat} = 1.10$ | | COOPER-<br>HARPER<br>RATING<br><br>2.5 |
| COMMENTS :<br><br>- HINT OF PIO TENDENCY<br><br><br>- KEPT GAINS HIGH BUT REALLY CLOSE TO BASELINE | | | |

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-22-3 | SPECS :<br><br>$\eta_y$ : ON    $\omega_y$ = 2.0    SCAS : ON    $K_q$ = 2.0<br><br>$\eta_z$ : ON    $\omega_z$ = 1.25    SPEED HOLD : ON<br><br>OLD CASE NO. : 28 | |
|---|---|---|
| RUN/PILOT<br><br>S-17-5 /<br>/ B | SCORES :<br><br>$\varepsilon_{long}$ = .313     $\sigma_{long}$ = 1.11<br><br>$\varepsilon_{lat}$ = -.032     $\sigma_{lat}$ = 1.31 | COOPER-<br>HARPER<br>RATING<br><br>3.5 |

COMMENTS :

- SENSITIVITY: MORE OF A TENDENCY TO
OVERSHOOT


- FELT HE DID NOT GET IN A GROOVE


- HAD SOME TROUBLE OSCILLATING ABOUT
TARGET


- NO MOTION PUTS YOU TO SLEEP

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-22-4 | SPECS :<br><br>$\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$<br><br>$\eta_z$ : ON $\quad \omega_z = 1.0 \quad$ SPEED HOLD : ON<br><br>OLD CASE NO. : 30 | | |
|---|---|---|---|
| RUN/PILOT<br><br>5-17-6 /<br><br>/ B | SCORES :<br><br>$\varepsilon_{long} = .16 \qquad \sigma_{long} = .86$<br><br>$\varepsilon_{lat} = .18 \qquad \sigma_{lat} = 1.12$ | | COOPER-<br>HARPER<br>RATING<br><br>3.5 |

COMMENTS :

- HAD TO BE SMOOTH TO GET HIGH GAINS, TO BE TIGHT

- INTENT ON KEEPING GAINS HIGH BUT STILL BE SMOOTH

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : |
|----------|---------|
| 1C-22-5 | $\eta_y$ : ON $\quad \omega_y = 1.5 \quad$ SCAS : ON $\quad K_\theta = 2.0$ <br><br> $\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD : ON <br><br> OLD CASE NO. : 36 |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|-----------|----------|----------------------|
| 5-17-12 / B | $\varepsilon_{long} = .127 \qquad \sigma_{long} = .822$ <br><br> $\varepsilon_{lat} = -.278 \qquad \sigma_{lat} = 1.11$ | 4 |

COMMENTS :

- HARD TO STAY AGGRESSIVE; WANT TO GO TO SLEEP WITH NO MOTION


- INTENSE CONCENTRATION NEEDE TO GET DESIRED PERFORMANCE


- LIGHT FORCES IN ROLL; HAD TO CONCENTRATE TO KEEP SMOOTH

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-22-5 | SPECS :<br><br>$\eta_y$ : ON $\quad \omega_y = 1.5 \quad$ SCAS : ON $\quad K_q = 2.0$<br><br>$\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD : ON<br><br>OLD CASE NO. : 36 | | |
|---|---|---|---|
| RUN/PILOT<br><br>5-30-7 /<br><br>/ C | SCORES :<br><br>$\varepsilon_{long} = .085 \qquad \sigma_{long} = 1.04$<br><br>$\varepsilon_{lat} = -.157 \qquad \sigma_{lat} = 1.46$ | | COOPER-<br>HARPER<br>RATING<br><br>3.5 |
| COMMENTS :<br><br>  - LIKES THE MOTION. IT HELPS (REFERING TO<br>    COMPARISON WITH PREVIOUS RUNS) | | | |

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1C-22-6 | $\eta_y$ : ON $\quad \omega_y = 1.0 \quad$ SCAS : ON $\quad K_q = 2.0$ <br> $\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD : ON <br> OLD CASE NO. : 42 | |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| S-31-4 / C | $\mathcal{E}_{long} = .107 \qquad \sigma_{long} = .980$ <br> $\mathcal{E}_{lat} = -.570 \qquad \sigma_{lat} = 1.47$ | 4 |

COMMENTS :

- LITTLE HARDER THAN CONFIG. 1C-11-1

- LESS PREDICTABLE IN ROLL

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1C-22-7 | $\eta_y$ : ON   $\omega_y = 2.0$   SCAS : ON   $K_q = 1.6$<br><br>$\eta_z$ : ON   $\omega_z = 1.0$   SPEED HOLD : ON<br><br>OLD CASE NO. : 56B | |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 5-24-12 / B | $\varepsilon_{long} = .41$   $\sigma_{long} = 1.5$<br><br>$\varepsilon_{lat} = -.299$   $\sigma_{lat} = 1.49$ | 4 |

COMMENTS :

- PITCH WAS NOT WELL BEHAVED ( AS PREVIOUS RUNS )

- NOT ENTIRELY DUE TO MOTION ( REFERING TO COMMENTS FOR PREVIOUS RUN )

Table A.8 - Data Summary Sheets  continued

| CASE NO.<br><br>1C-22-8 | SPECS :<br><br>$\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_\cdot = 2.0$<br><br>$\eta_z$ : ON $\quad \omega_z = 0.8 \quad$ SPEED HOLD ; ON<br><br>OLD CASE NO. : 45B | |
|---|---|---|
| RUN/PILOT<br><br>5-29-3 /<br><br>/ A | SCORES :<br><br>$\varepsilon_{long} = -.23 \qquad \sigma_{long} = 1.33$<br><br>$\varepsilon_{lat} = .19 \qquad \sigma_{lat} = 1.50$ | COOPER-<br>HARPER<br>RATING<br><br>5 |
| COMMENTS : | | |

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-22-9 | SPECS :<br><br>$\eta_y$ : ON    $\omega_y$ = 2.0    SCAS : ON    $K_q$ = ESC<br><br>$\eta_x$ : ON    $\omega_x$ = 1.5    SPEED HOLD ; OFF<br><br>OLD CASE NO. : 75 | |
|---|---|---|
| RUN/PILOT<br><br>6-3-1 / A | SCORES :<br><br>$\varepsilon_{long}$ = .38      $\sigma_{long}$ = 1.29<br><br>$\varepsilon_{lat}$ = -.32      $\sigma_{lat}$ = 2.04 | COOPER-<br>HARPER<br>RATING<br><br>N/A |

COMMENTS :

   - STICK: SEEMS TO RUN OUT OF CONTROL POWER

   - GOOD RESPONSE OTHERWISE

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-22-9 | SPECS :<br><br>$\eta_y$ : ON $\omega_y = 2.0$ SCAS : ON $K_q$ = ESC<br><br>$\eta_x$ : ON $\omega_x = 1.5$ SPEED HOLD ; OFF<br><br>OLD CASE NO. : 75 | |
|---|---|---|
| RUN/PILOT<br><br>6-4-1 /<br><br>/ A | SCORES :<br><br>$\varepsilon_{long}$ = .203 $\sigma_{long}$ = 1.05<br><br>$\varepsilon_{lat}$ = -.082 $\sigma_{lat}$ = 1.77 | COOPER-<br>HARPER<br>RATING<br><br>N/A |
| COMMENTS : | | |

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-22-9 | SPECS :<br><br>$\eta_y$ : ON  $\omega_y$ = 2.0   SCAS : ON   $K_s$ = ESC<br><br>$\eta_z$ : ON  $\omega_z$ = 1.5   SPEED HOLD : OFF<br><br>OLD CASE NO. : 75 | |
|---|---|---|
| RUN/PILOT<br><br>6-4-3 /<br><br>/ A | SCORES :<br><br>$\varepsilon_{long}$ = 1.81   $\sigma_{long}$ = 1.02<br><br>$\varepsilon_{lat}$ = -.275   $\sigma_{lat}$ = 1.48 | COOPER-<br>HARPER<br>RATING<br><br>N/A |
| COMMENTS : | | |

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1C-22-10 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$ <br> $\eta_z$ : ON $\quad \omega_z = 1.5 \quad$ SPEED HOLD : OFF <br><br> OLD CASE NO. : 76 | |
| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
| 6-3-2 / A | $\varepsilon_{long} = -.39 \qquad \sigma_{long} = 1.15$ <br><br> $\varepsilon_{lat} = .258 \qquad \sigma_{lat} = 1.57$ | N/A |

COMMENTS :

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-22-10 | SPECS :<br><br>$\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$<br><br>$\eta_z$ : ON $\quad \omega_z = 1.5 \quad$ SPEED HOLD : OFF<br><br>OLD CASE NO. : 76 | |
|---|---|---|
| RUN/PILOT<br><br>6-4-2 / <br>/ A | SCORES :<br><br>$\varepsilon_{long} = -.047 \qquad \sigma_{long} = .91$<br><br>$\varepsilon_{lat} = .023 \qquad \sigma_{lat} = 1.47$ | COOPER-<br>HARPER<br>RATING<br><br>N/A |

COMMENTS :

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-22-11 | SPECS :<br><br>$\eta_y$ : ON  $\omega_y$ = 2.0   SCAS : ON   $K_q$ = 2.0<br><br>$\eta_z$ : ON  $\omega_z$ = 2.0    SPEED HOLD ; OFF<br><br>OLD CASE NO. : 77. | |
|---|---|---|
| RUN/PILOT<br><br>6-3-3<br><br>A | SCORES :<br><br>$\varepsilon_{long}$ = -.001   $\sigma_{long}$ = .88<br><br>$\varepsilon_{lat}$ = .098   $\sigma_{lat}$ = 1.41 | COOPER-<br>HARPER<br>RATING<br><br>N/A |
| COMMENTS : | | |

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1C-22-11 | $\eta_y$ : ON  $\omega_y = 2.0$  SCAS : ON  $K_q = 2.0$<br><br>$\eta_z$ : ON  $\omega_z = 2.0$  SPEED HOLD : OFF<br><br>OLD CASE NO. : 77. | |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 6-4-4 / A | $\varepsilon_{long} = .013$  $\sigma_{long} = .96$<br><br>$\varepsilon_{lat} = -.066$  $\sigma_{lat} = 1.41$ | N/A |

COMMENTS :

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1C-22-11 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$ <br><br> $\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD : OFF <br><br> OLD CASE NO. : 77. | |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 6-11-2 / / D | $\varepsilon_{long} = .068 \qquad \sigma_{long} = 1.30$ <br><br> $\varepsilon_{lat} = -.495 \qquad \sigma_{lat} = 2.22$ | N/A |

COMMENTS :


- NO DISCERNNABLE DIFFERENCE IN
  PERFORMANCE COMPARED TO PREVIOUS RUN



- SAME SLIGHT ROLL OVERSHOOT

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-22-11 | SPECS :<br><br>$\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$<br><br>$\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD ; OFF<br><br>OLD CASE NO. : 77. | |
|---|---|---|
| RUN/PILOT<br><br>6-11-7<br><br>C | SCORES :<br><br>$\mathcal{E}_{long} = .399 \qquad \sigma_{long} = 1.15$<br><br>$\mathcal{E}_{lat} = -.423 \qquad \sigma_{lat} = 1.94$ | COOPER-<br>HARPER<br>RATING<br><br>N/A |
| | COMMENTS :<br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br> | |

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>1C-22-12 | SPECS :<br><br>$\eta_y$ : ON $\omega_y = 2.0$ SCAS : ON $K_q = $ ESC<br><br>$\eta_z$ : ON $\omega_z = 2.0$ SPEED HOLD ; OFF<br><br>OLD CASE NO. : 112 | |
|---|---|---|
| RUN/PILOT<br><br>6-11-1 /<br>/ D | SCORES :<br><br>$\varepsilon_{long} = .087$ $\sigma_{long} = 1.34$<br><br>$\varepsilon_{lat} = -.09$ $\sigma_{lat} = 2.85$ | COOPER-<br>HARPER<br>RATING<br><br>N/A |

COMMENTS :

- SLIGHT ROLL OVERSHOOT

- PERFORMANCE ACCEPTABLE

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | | |
|---|---|---|---|
| | $\eta_y$ : ON $\quad \omega_y = 2.0$ $\quad$ SCAS : ON $\quad$ $K_q$ = ESC | | |
| 1C-22-12 | $\eta_z$ : ON $\quad \omega_z = 2.0$ $\quad$ SPEED HOLD : OFF | | |
| | OLD CASE NO. : 112 | | |

| RUN/PILOT | SCORES : | | COOPER-HARPER RATING |
|---|---|---|---|
| 6-11-6 / | $\varepsilon_{long} = .196$ | $\sigma_{long} = 1.29$ | |
| / D | $\varepsilon_{lat} = -.20$ | $\sigma_{lat} = 2.35$ | N/A |

COMMENTS :

Table A.8 - Data Summary Sheets  continued

| CASE NO. | SPECS : | |
|---|---|---|
| 1C-22-12 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_a =$ ESC<br>$\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD ; OFF<br><br>OLD CASE NO. :  112 | |
| RUN/PILOT<br><br>6-11-8 /<br><br>/ C | SCORES :<br><br>$\varepsilon_{long} = .257 \qquad \sigma_{long} = 1.17$<br><br>$\varepsilon_{lat} = -.229 \qquad \sigma_{lat} = 1.85$ | COOPER-<br>HARPER<br>RATING<br><br>N/A |

COMMENTS :

    - NO OBVIOUS DIFFERENCE FROM LAST RUN

    - THIS RUN MIGHT BE LESS SQUIRRELY

| CASE NO. | SPECS : | | |
|---|---|---|---|
| 2C-11-1 | $\eta_y$ : OFF  $\omega_y$ = −<br><br>$\eta_z$ : OFF  $\omega_z$ = −<br><br>OLD CASE NO. : 61 | SCAS : ON<br><br>SPEED HOLD ; ON | $K_q$ = 1.6 |

| RUN/PILOT | SCORES : | | COOPER-HARPER RATING |
|---|---|---|---|
| S-31-5 / C | $\varepsilon_{long}$ = .066<br><br>$\varepsilon_{lat}$ = −.270 | $\sigma_{long}$ = .513<br><br>$\sigma_{lat}$ = .205 | 2 |

COMMENTS :

‑  ACHIEVED DESIRED PERFORMANCE

‑  NOTE :  SIGMA(P)**2 = 0.1 ; OMEGA(R) = OMEGA(P) = 0.5

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | | |
|---|---|---|---|
| 2C-11-2 | $\eta_y$ : ON  $\omega_y = 2.0$  SCAS : ON  $K_q = 1.6$<br><br>$\eta_z$ : ON  $\omega_z = 2.0$  SPEED HOLD : ON<br><br>OLD CASE NO. : 62 | | |

| RUN/PILOT | SCORES : | | COOPER-HARPER RATING |
|---|---|---|---|
| 5-31-6 /<br><br>/ C | $\varepsilon_{long} = .066$<br><br>$\varepsilon_{lat} = -.213$ | $\sigma_{long} = .456$<br><br>$\sigma_{lat} = .210$ | N/A |

COMMENTS :


- TARGET VIBRATES WITH A/C SYMBOL; NO REAL
  CONFUSION


- NOTE : SIGMA(P)**2 = 0.1 ; OMEGA(R) =
  OMEGA(P) = 0.5

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 2C-11-3 | $\eta_y$ : ON  $\omega_y$ = 2.0    SCAS : ON    $K_q$ = 1.6<br><br>$\eta_z$ : ON  $\omega_z$ = 2.0    SPEED HOLD : ON<br><br>OLD CASE NO. : 63 | |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 5-31-7 / C | $\varepsilon_{long}$ = .017    $\sigma_{long}$ = .60<br><br>$\varepsilon_{lat}$ = -.172    $\sigma_{lat}$ = .311 | N/A |

COMMENTS :

- NOTE : SIGMA(P)**2 = 0.2 ; OMEGA(R) = OMEGA(P) = 0.5

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>2C-11-4 | SPECS :<br><br>$\eta_y$ : ON    $\omega_y$ = 2.0    SCAS : ON    $K_q$ = 1.6<br><br>$\eta_z$ : ON    $\omega_z$ = 2.0    SPEED HOLD : ON<br><br>OLD CASE NO. : 64 | |
|---|---|---|
| RUN/PILOT<br><br>5-31-8 /<br><br>/ C | SCORES :<br><br>$\mathcal{E}_{long}$ = -.111    $\sigma_{long}$ = .735<br><br>$\mathcal{E}_{lat}$ = -.181    $\sigma_{lat}$ = .298 | COOPER-<br>HARPER<br>RATING<br><br>4 |

COMMENTS :

- HAD TO BE CAREFUL

- NOTE : SIGMA(P)**2 = 0.3 ; OMEGA(R) = OMEGA(P) = 0.5

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>2C-11-5 | SPECS :<br><br>$\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$<br><br>$\eta_x$ : ON $\quad \omega_x = 2.0 \quad$ SPEED HOLD : ON<br><br>OLD CASE NO. : 78 | |
|---|---|---|
| RUN/PILOT<br><br>6-3-4<br><br>/ C | SCORES :<br><br>$\varepsilon_{long} = .013 \qquad \sigma_{long} = .702$<br><br>$\varepsilon_{lat} = -.036 \qquad \sigma_{lat} = .291$ | COOPER-<br>HARPER<br>RATING<br><br>4.5 |

COMMENTS :

- STICK FORCES ARE A LITTLE HEAVY

- GOOD TRACKING PERFORMANCE WITHOUT MUCH
  DIFFICULTY

- MOTION IS A DISTRACTION; BUT DOES NOT
  SEEM TO AFFECT PERFORMANCE

- ROLL OSCILLATIONS; MODERATELY OBJECTION-
  ABLE; CAUSES TENTATIVE USE OF AILERON,
  USE RUDDER TO COMPENSATE

## Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 2C-11-5 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$ <br><br> $\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD ; ON <br><br> OLD CASE NO. : 78 | |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 6-4-7 / / C | $\varepsilon_{long} = .061 \qquad \sigma_{long} = .58$ <br><br> $\varepsilon_{lat} = -.112 \qquad \sigma_{lat} = .203$ | 4 |

COMMENTS :

- FINE TUNES HEADING ERROR WITH RUDDER;
  GROSS CORRECTION WITH AILERON
  (MINIMIZES ROLL OSCILLATIONS)


- DEFINITE INCREASE IN PERFORMANCE (OVER
  PREVIOUS RUN)


- WORKED AS HARD WITH BETTER RESULTS


- ROLL MOTION IS BOTHERSOME, JERKY

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : |
|----------|---------|
| 2C-11-6 | $\eta_y$ : ON   $\omega_y = 2.0$   SCAS : ON   $K_q = 2.0$ <br><br> $\eta_z$ : ON   $\omega_z = 1.5$   SPEED HOLD : ON <br><br> OLD CASE NO. : 79. |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|-----------|----------|----------------------|
| 6-3-5 / / C | $\varepsilon_{long} = .26$   $\sigma_{long} = 1.21$ <br><br> $\varepsilon_{lat} = -.332$   $\sigma_{lat} = .270$ | 5 |

COMMENTS :

- STICK FORCES SAME AS LAST RUN

- FELT PERFORMANCE WAS WORSE THAN SCORES INDICATE

- MOTION IS DISTRACTING; EFFECT ON PERFORM1ANCE IS QUESTIONABLE

- AWARE OF ROLL OSCILLATIONS AND SO AVOIDS EXCITING THEM

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>2C-11-6 | SPECS :<br><br>$\eta_y$ : ON   $\omega_y$ = 2.0   SCAS : ON   $K_q$ = 2.0<br><br>$\eta_z$ : ON   $\omega_z$ = 1.5   SPEED HOLD : ON<br><br>OLD CASE NO. : 79 | |
|---|---|---|
| RUN/PILOT<br><br>6-4-11 /<br><br>    / C | SCORES :<br><br>$\mathcal{E}_{long}$ = .058    $\sigma_{long}$ = .650<br><br>$\mathcal{E}_{lat}$ = -.172    $\sigma_{lat}$ = .279 | COOPER-<br>HARPER<br>RATING<br><br>4.5 |

COMMENTS :

    - LOW RUDDER RESPONSE

    - CAN NOT SEEM TO OBTAIN PERFORMANCE THAT
    SEEMS TO BE ACHIEVABLE

    - ANNOYING LONGITUDINAL VIBRATION

## Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | | |
|---|---|---|---|
| 2C-11-7 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$ <br> $\eta_z$ : ON $\quad \omega_z = 1.0 \quad$ SPEED HOLD ; ON <br><br> OLD CASE NO. : 80 | | |

| RUN/PILOT | SCORES : | | COOPER-HARPER RATING |
|---|---|---|---|
| 6-3-6 <br><br> C | $\mathcal{E}_{long} = -.017$ <br><br> $\mathcal{E}_{lat} = -.406$ | $\sigma_{long} = .785$ <br><br> $\sigma_{lat} = .427$ | 5 |

COMMENTS :

- STICK FORCES SEEMED HEAVIER; MORE PITCH, AILERON AND RUDDER ACTIVITY WERE REQUIRED TO OBTAIN PERFORMANCE

- MOTION IS ANNOYING

- ROLL OSCILLATIONS LESS NOTICEABLE

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>2C-11-7 | SPECS :<br><br>$\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_{\P} = 2.0$<br><br>$\eta_z$ : ON $\quad \omega_z = 1.0 \quad$ SPEED HOLD : ON<br><br>OLD CASE NO. : 80 | |
|---|---|---|
| RUN/PILOT<br><br>6-4-6<br><br>C | SCORES :<br><br>$\mathcal{E}_{\text{long}} = -.113 \qquad \sigma_{\text{long}} = .709$<br><br>$\mathcal{E}_{\text{lat}} = -.153 \qquad \sigma_{\text{lat}} = .339$ | COOPER-<br>HARPER<br>RATING<br><br>5 |

COMMENTS :

- TASK WAS DO-ABLE

- USED MOTION CUES BUT DID NOT CONSCIOUSLY
  KEY ON IT

- IGNORE HORIZON MOTION IN DISPLAY

- SLIGHT RESPONSE LAG

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | | |
|---|---|---|---|
| 2C-11-8 | $\eta_y$ : ON    $\omega_y$ = 2.0    SCAS : ON    $K_q$ = 2.0<br><br>$\eta_z$ : ON    $\omega_z$ = 2.0    SPEED HOLD ; OFF<br><br>OLD CASE NO. : 91 | | |

| RUN/PILOT | SCORES : | | COOPER-HARPER RATING |
|---|---|---|---|
| 6-6-2 / C | $\varepsilon_{long}$ = .006    $\sigma_{long}$ = .59<br><br>$\varepsilon_{lat}$ = -.143    $\sigma_{lat}$ = .198 | | 4.5 |

COMMENTS :

- NO MAJOR DEFICIENCIES

- FELT LATERAL MOTION ANNOYING; UNREALISTIC

- SLIGHTLY MORE DIFFICULT THAN PREVIOUS RUN

- FLEX MODE SEEMS SLIGHTLY DIFFERENT

- FELT HE WAS WORKING HARDER

| CASE NO.<br><br>2C-11-9 | SPECS :<br><br>$\eta_y$ : ON    $\omega_y$ = 2.0    SCAS : ON    $K_s$ = 2.0<br><br>$\eta_z$ : ON    $\omega_z$ = 1.5    SPEED HOLD ; OFF<br><br>OLD CASE NO. : 92 | |
|---|---|---|
| RUN/PILOT<br><br>6-6-3 /<br><br>/ C | SCORES :<br><br>$\varepsilon_{long}$ = -.12        $\sigma_{long}$ = .654<br><br>$\varepsilon_{lat}$ = -.176        $\sigma_{lat}$ = .264 | COOPER-<br>HARPER<br>RATING<br><br>5 |

COMMENTS :

- DECREASE IN RESPONSIVENESS TO STICK
  (COMPARED TO PREVIOUS RUN)


- FELT PERFORMANCE WAS WORSE FOR THIS RUN
  (COMPARED TO PREVIOUS RUN)


- IGNORING HORIZON MOTION IN DISPLAY

Table A.8 - Data Summary Sheets  continued

| CASE NO. | SPECS : |
|---|---|
| 2C-11-10 | $\eta_y$ : ON    $\omega_y = 2.0$    SCAS : ON    $K_q = 2.0$<br><br>$\eta_z$ : ON    $\omega_z = 1.0$    SPEED HOLD : OFF<br><br>OLD CASE NO. : 93 |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 6-6-4 / C | $\mathcal{E}_{long} = -.031$    $\sigma_{long} = .785$<br><br>$\mathcal{E}_{lat} = -.236$    $\sigma_{lat} = .258$ | 6 |

COMMENTS :

- VERY OBJECTIONABLE, SLUGGISH BEHAVIOR

- COULD COMPENSATE FOR DEFICIENCIES, FELT HE COULD DO BETTER WITH PRACTICE

- NOT AS RESPONSIVE TO STICK, MORE LEAD REQUIRED DUE TO INCREASED SLUGGISHNESS (COMPARED TO LAST FEW PREVIOUS RUNS)

- IGNORING HORIZON DISPLAY MOTION

- HAD TO BE MORE AGGRESSIVE

| CASE NO.

2C-11-11 | SPECS :

$\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$

$\eta_z$ : ON $\quad \omega_z = 1.0 \quad$ SPEED HOLD : ON

OLD CASE NO. : 93B | |

| RUN/PILOT

6-6-6 / C | SCORES :

$\mathcal{E}_{long} = .122 \quad\quad \sigma_{long} = .722$

$\mathcal{E}_{lat} = -.28 \quad\quad \sigma_{lat} = .25$ | COOPER-HARPER RATING

6 |

COMMENTS :

- EXTENSIVE PILOT COMPENSATION REQUIRED

- PIO TENDENCIES; TRIED TO PUT IN SMOOTH INPUTS TO NOT EXCITE OSCILLATIONS (IN BOTH AXES)

- TASK REQUIRED MORE STICK ACTIVITY

- IF TARGET GETS AWAY, A LARGER INPUT CAUSES A CHASING GAME

- SPEED HOLD EFFECTS NOTICED

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | | |
|---|---|---|---|
| 2C-11-12 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_e = 2.0$ <br><br> $\eta_z$ : ON $\quad \omega_z = 0.8 \quad$ SPEED HOLD : OFF <br><br> OLD CASE NO. : 94 | | |

| RUN/PILOT | SCORES : | | COOPER-HARPER RATING |
|---|---|---|---|
| 6-6-5 / C | $\mathcal{E}_{long} = -.031 \qquad \sigma_{long} = .78$ <br><br> $\mathcal{E}_{lat} = -.21 \qquad \sigma_{lat} = .264$ | | 6 |

COMMENTS :

- TRYING TO PUT IN SMOOTH INPUTS IN
  LATERAL STICK TO NOT EXCITE
  OSCILLATIONS

- IF HE STAYS CLOSE TO TARGET - OK, BUT IF
  IT GETS AWAY FROM HIM HE HAS TROUBLE
  GETTING BACK TO IT

- MORE DIFFICULT THAN PREVIOUS RUN

- CONTROL EFFECTIVENESS ABOUT THE SAME AS
  LAST RUN

- LEAD REQUIRED IN BOTH AXES

| CASE NO. | SPECS : | |
|---|---|---|
| 2C-11-13 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$ <br><br> $\eta_z$ : ON $\quad \omega_z = 0.8 \quad$ SPEED HOLD : ON <br><br> OLD CASE NO. : 94B | |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 6-6-7 / C | $\varepsilon_{long} = .012 \qquad \sigma_{long} = .765$ <br><br> $\varepsilon_{lat} = -.204 \qquad \sigma_{lat} = .292$ | 6 |

COMMENTS :

- TASK REQUIRED SIGNIFICANT PILOT WORKLOAD

- NO NOTICE OF SPEED HOLD EFFECTS

- IGNORING HORIZON DISPLAY MOTION

- SOMETIMES FEELS COMBINATION OF CAB
  MOTION AND HORIZON MOTION CONFUSING

- THINKS MOTION IS CONFUSING

## Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | | | |
|---|---|---|---|---|
| 2C-12-1 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$ <br> $\eta_z$ : ON $\quad \omega_z = 2.0 \quad$ SPEED HOLD ; ON <br><br> OLD CASE NO. : 82 | | | |

| RUN/PILOT | SCORES : | | COOPER-<br>HARPER<br>RATING |
|---|---|---|---|
| 6-4-8 / C | $\varepsilon_{long} = .033 \qquad \sigma_{long} = .61$ <br><br> $\varepsilon_{lat} = -.118 \qquad \sigma_{lat} = .173$ | | 4 |

COMMENTS :

- DID NOT NOTICE ANY DIFFERENCE OVER
  PREVIOUS RUN


- COMMENTS FROM PREVIOUS RUN APPLY IN THIS
  RUN TOO

| CASE NO.  2C-12-2 | SPECS :  $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$  $\eta_z$ : ON $\quad \omega_z = 1.0 \quad$ SPEED HOLD ; ON  OLD CASE NO. : 83 | |
|---|---|---|
| RUN/PILOT  6-4-9 / C | SCORES :  $\varepsilon_{long} = .031 \qquad \sigma_{long} = .634$  $\varepsilon_{lat} = -.127 \qquad \sigma_{lat} = .294$ | COOPER-HARPER RATING  5 |

COMMENTS :

- MORE COMPENSATION THAN PREVIOUS RUN

- HARDER TO OBTAIN DESIRED PERFORMANCE

- RESPONSE LAG

- WORSE THAN PREVIOUS RUN ( I.E. CASE 2C-12-1)

| CASE NO.<br><br>2C-12-3 | SPECS :<br><br>$\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$<br><br>$\eta_z$ : ON $\quad \omega_z = 1.5 \quad$ SPEED HOLD ; ON<br><br>OLD CASE NO. : 84 | |
|---|---|---|
| RUN/PILOT<br><br>6-4-10 /<br><br>/ C | SCORES :<br><br>$\varepsilon_{long} = .063 \qquad \sigma_{long} = .636$<br><br>$\varepsilon_{lat} = -.180 \qquad \sigma_{lat} = .194$ | COOPER-<br>HARPER<br>RATING<br><br>4.5 |

COMMENTS :

- MORES RESPONSIVE THAN PREVIOUS RUN (I.E.
  CASE 2C-12-2)


- PROMINANT ANNOYING LONGITUDINAL
  VIBRATION


- DID NOT FEEL HE DID AS WELL AS HE COULD
  HAVE


- DID NOT CAPITALIZE ON IMPROVED
  RESPONSIVENESS

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>2C-12-4 | SPECS :<br><br>$\eta_y$ : OFF $\quad \omega_y = -$ $\quad$ SCAS : ON $\quad K_q = 2.0$<br><br>$\eta_z$ : OFF $\quad \omega_z = -$ $\quad$ SPEED HOLD ; OFF<br><br>OLD CASE NO. : 90 | |
|---|---|---|
| RUN/PILOT<br><br>6-6-1 /<br>/ C | SCORES :<br><br>$\varepsilon_{long} = .045 \qquad \sigma_{long} = .70$<br><br>$\varepsilon_{lat} = -.15 \qquad \sigma_{lat} = .169$ | COOPER-<br>HARPER<br>RATING<br><br>4 |

COMMENTS :

- MINOR DEFICIENCES BUT CAN COMPLETE TASK

- HAD TO WORK HARD

- HAD TO LEAD TARGET

- FELT HE COULD DO BETTER THAN HE DID

Table A.8 - Data Summary Sheets continued

| CASE NO.<br><br>2C-12-5 | SPECS :<br><br>$\eta_y$ : OFF $\omega_y$ = -      SCAS : ON    $K_q$ = 2.0<br><br>$\eta_z$ : OFF $\omega_z$ = -      SPEED HOLD ; ON<br><br>OLD CASE NO. : 90B | | |
|---|---|---|---|
| RUN/PILOT<br><br>6-6-11<br><br>C | SCORES :<br><br>$\varepsilon_{long}$ = -.019      $\sigma_{long}$ = .53<br><br>$\varepsilon_{lat}$ = -.030      $\sigma_{lat}$ = .153 | | COOPER-<br>HARPER<br>RATING<br><br>4 |

COMMENTS :

- HAD TO WORK SOME

- THIS CASE ALLOWS PILOT TO BE MORE
  AGGRESSIVE IN BOTH AXES

- CAN INPUT SHARPER INPUTS WITHOUT
  EXCITING PIO

- CAN LOCK ON TARGET BETTER

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Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 2C-12-6 | $\eta_y$ : ON $\omega_y = 2.0$ SCAS : OFF $K_q = -$ <br> $\eta_z$ : ON $\omega_z = 2.0$ SPEED HOLD : OFF <br> OLD CASE NO. : 114 | |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 6-11-10 / C | $\varepsilon_{long} = N/A$ $\sigma_{long} = N/A$ <br> $\varepsilon_{lat} = N/A$ $\sigma_{lat} = N/A$ | N/A |

COMMENTS :

- PILOT INPUT CAUSES INSTABILITY; OBVIOUS PIO

- VERY LIGHT STICK FORCES REQUIRED TO MAINTAIN STABILITY

- NOTE : NO TAPED DATA ; NO STRIP CHARTS

## Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : |
|---|---|
| 2C-21-1 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_a = 2.0$ <br><br> $\eta_x$ : ON $\quad \omega_x = 1.0 \quad$ SPEED HOLD : ON <br><br> OLD CASE NO. : 81 |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 6-3-7 / C | $\varepsilon_{long} = -.042 \qquad \sigma_{long} = .744$ <br><br> $\varepsilon_{lat} = -.385 \qquad \sigma_{lat} = .269$ | 4 |

COMMENTS :

    - WAS MORE AGGRESSIVE THAN PREVIOUS RUN

    - NOTICED OVERSHOOT IN PITCH

    - MORE AGGRESSIVE IN AILERON INPUTS

    - IGNORED DISPLAY MOTION OF HORIZON.
      DID NOT AFFECT PERFORMANCE

C - 3

**Table A.8 - Data Summary Sheets continued**

| CASE NO. | SPECS : | | |
|---|---|---|---|
| 2C-21-1 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$ <br><br> $\eta_z$ : ON $\quad \omega_z = 1.0 \quad$ SPEED HOLD ; ON <br><br> OLD CASE NO. : 81 | | |

| RUN/PILOT | SCORES : | | COOPER-HARPER RATING |
|---|---|---|---|
| 6-6-10 / <br> / C | $\varepsilon_{long} = .024$ <br><br> $\varepsilon_{lat} = -.17$ | $\sigma_{long} = .64$ <br><br> $\sigma_{lat} = .275$ | 6 |

COMMENTS :

    - FELT MOTION HELPED IN THIS CASE

    - NO MOTION ALLOWS STEADIER STICK INPUTS

    - FELT HE COULD BE MORE AGGRESSIVE.
    BUT STILL TRIED TO STAY SMOOTH

Table A.8 - Data Summary Sheets continued

| CASE NO. | SPECS : | |
|---|---|---|
| 2C-21-2 | $\eta_y$ : ON $\omega_y = 2.0$ SCAS : ON $K_q = 2.0$ <br> $\eta_z$ : ON $\omega_z = 2.0$ SPEED HOLD : ON <br><br> OLD CASE NO. : 99 | |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 6-6-8 / C | $\varepsilon_{long} = .142$ $\sigma_{long} = .544$ <br><br> $\varepsilon_{lat} = -.096$ $\sigma_{lat} = .21$ | 4 |

COMMENTS :

- CAN GET AGGRESSIVE AND THINGS DO NOT GET
  OUT OF CONTROL


- NO PIO TENDENCY


- CAN NOT TELL IF MOTION AFFECTS
  PERFORMANCE


- FELT SCORES MAY NOT REFLECT PERFORMANCE


- HAD TO SUPPLY SOME LEAD

Table A.8 - Data Summary Sheets continued

| CASE NO. 2C-21-3 | SPECS : $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$ <br><br> $\eta_z$ : ON $\quad \omega_z = 1.5 \quad$ SPEED HOLD : ON <br><br> OLD CASE NO. : 100 | |
|---|---|---|
| RUN/PILOT <br> 6-6-9 <br><br> C | SCORES : <br><br> $\varepsilon_{long} = .061 \qquad \sigma_{long} = .60$ <br><br> $\varepsilon_{lat} = -.17 \qquad \sigma_{lat} = .185$ | COOPER-HARPER RATING <br><br> 5 |

COMMENTS :


- MORE SQUIRRELY IN ROLL THAN IN PREVIOUS RUN



- NOTICED OVERSHOOTS IN PITCH AND ROLL (MORE NOTICEABLE IN ROLL)



- CAN NOT TELL THE EFFECT OF MOTION ON PERFORMANCE

## Table A.8 - Data Summary Sheets concluded

| CASE NO. | SPECS : | |
|---|---|---|
| 2C-21-4 | $\eta_y$ : ON $\quad \omega_y = 2.0 \quad$ SCAS : ON $\quad K_q = 2.0$ <br><br> $\eta_z$ : ON $\quad \omega_z = 1.0 \quad$ SPEED HOLD : OFF <br><br> OLD CASE NO. : 93C | |

| RUN/PILOT | SCORES : | COOPER-HARPER RATING |
|---|---|---|
| 6-4-5 / <br> / A | $\varepsilon_{long} = .015 \qquad \sigma_{long} = .968$ <br><br> $\varepsilon_{lat} = -.244 \qquad \sigma_{lat} = .259$ | N/A |

| COMMENTS : |
|---|
| |

# Appendix 6
## Simulator Frequency Response Data


This appendix presents frequency response data of the simulation facility that was used to conduct the simulation experiment, i.e. the Langley VMS simulator. This data was obtained experimentally using several sets of vehicle dynamics that correspond to varying degrees of structural flexibility. The following tables describe the experimental conditions and the data that was recorded. The units for the frequency response plots are indicated as well as a description of the parameters that were measured and their units. The values of the symmetric and antisymmetric mode vibration frequencies are also indicated, these define the configurations associated with each set of frequency response data. This data was used to produce the frequency response plots of the simulator presented in Figures 16 through 20, which correspond to the baseline configuration, i.e. Configuration 1.

# Tabulated Simulator Frequency Response Data

- Input Amplitude : 20 lbs (both axes).

- Magnitudes tabulated in decibels (dB).

- Phases tabulated in degrees.

- Frequencies are tabulated in Hz.

The table below indicates the units for the various parameters—

Table A.9 - Simulator Data : Symbol Definition

| Symbol | Meaning | Units |
|--------|---------|-------|
| F | pitch and roll axes input force | lbs |
| $\delta$ | pitch and roll axes stick deflections | in |
| nz | normal acceleration | g's |
| ny | lateral acceleration | g's |
| $\dot{\theta}$ | attitude rate | $\frac{rad}{sec}$ |
| q,p | pitch and roll rates | $\frac{rad}{sec}$ |

subscripts : cp - cockpit location

cmd - command to motion base

other symbols: $\hat{(\cdot)}$ - measured at motion base

$\dot{(\cdot)}$ - time derivative

Table A.10 - Simulator Data : Configuration Definition

| | CONFIGURATION | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| $\omega_z$ (Hz) | 2.0 | 1.5 | 1.0 | 2.0 | 0 |
| $\omega_y$ (Hz) | 2.0 | 2.0 | 2.0 | 1.5 | 0 |

# Table A.11 - Simulator Data : Frequency Responses

CONFIGURATION 1 : Magnitudes

| freq | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|------|------|------|------|------|------|------|------|------|
| 0.25 | -14.130 | -38.400 | -12.850 | -11.830 | -30.240 | -64.360 | -57.220 | -22.190 | -28.990 |
| 0.50 | -13.210 | -40.330 | -14.890 | -11.430 | -27.150 | -64.960 | -55.250 | -22.910 | -30.090 |
| 0.75 | -12.600 | -38.370 | -17.360 | -12.200 | -24.420 | -63.160 | -54.380 | -21.050 | -30.940 |
| 1.00 | -13.470 | -37.230 | -18.870 | -12.370 | -21.910 | -63.070 | -54.250 | -20.630 | -31.940 |
| 1.25 | -14.860 | -35.910 | -20.030 | -12.550 | -20.675 | -63.310 | -55.560 | -20.480 | -33.670 |
| 1.50 | -16.430 | -34.270 | -21.220 | -12.790 | -19.310 | -63.480 | -56.960 | -20.430 | -35.470 |
| 1.75 | -18.000 | -31.820 | -22.480 | -13.080 | -17.220 | -62.890 | -57.710 | -19.916 | -37.160 |
| 2.00 | -19.690 | -27.170 | -30.490 | -13.710 | -7.570 | -60.550 | -57.750 | -18.360 | -39.420 |

key :   All longitudinal axis parameters

1) delta / F

2) $n_{z_{cp}}$ / delta      3) $\dot{\theta}$ / delta

4) $\hat{n}_{z_{cp}}$ / $n_z$      5) $\hat{\dot{q}}$ / $\dot{\theta}$

6) $\hat{n}_{z_{cp}}$ / F      7) $\hat{\dot{q}}$ / F

8) $\hat{n}_{z_{cmd}}$ / F      9) $\hat{\dot{q}}_{cmd}$ / F

the data below is for easy reading into fortran programs

data

```
0.25   -14.130 -38.400 -12.850 -11.830 -30.240 -64.360 -57.220 -22.190 -28.990
0.50   -13.210 -40.330 -14.890 -11.430 -27.150 -64.960 -55.250 -22.910 -30.090
0.75   -12.600 -38.370 -17.360 -12.200 -24.420 -63.160 -54.380 -21.050 -30.940
1.00   -13.470 -37.230 -18.870 -12.370 -21.910 -63.070 -54.250 -20.630 -31.940
1.25   -14.860 -35.910 -20.030 -12.550 -20.675 -63.310 -55.560 -20.480 -33.670
1.50   -16.430 -34.270 -21.220 -12.790 -19.310 -63.480 -56.960 -20.430 -35.470
1.75   -18.000 -31.820 -22.480 -13.080 -17.220 -62.890 -57.710 -19.916 -37.160
2.00   -19.690 -27.170 -30.490 -13.710  -7.570 -60.550 -57.750 -18.360 -39.420
```

Table A.11 - Simulator Data : Frequency Responses  continued

CONFIGURATION 1 : Phases

| freq | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|------|------|------|------|------|------|------|------|------|
| 0.25 | -78.27 | -60.75 | -167.74 | 47.62 | -287.10 | -91.41 | -173.09 | -88.82 | -257.60 |
| 0.50 | -60.53 | 31.13 | -244.31 | 20.56 | -319.48 | -8.83 | -264.32 | -3.44 | -337.62 |
| 0.75 | -98.01 | 14.62 | -258.10 | 14.29 | -341.61 | -69.09 | -337.72 | -61.68 | -43.27 |
| 1.00 | -140.16 | 7.69 | -262.58 | 6.67 | -2.49 | -125.70 | -45.24 | -116.11 | -99.42 |
| 1.25 | -176.81 | 3.00 | -267.58 | 0.26 | -22.38 | -173.55 | -106.43 | -163.85 | -144.26 |
| 1.50 | -205.62 | -1.71 | -270.14 | -5.05 | -39.64 | -212.38 | -155.40 | -198.85 | -180.14 |
| 1.75 | -229.06 | -7.13 | -277.31 | -8.10 | -57.38 | -244.28 | -203.74 | -229.00 | -209.62 |
| 2.00 | -243.89 | -28.03 | -28.67 | -8.58 | -359.14 | -280.51 | -271.70 | -265.76 | -241.76 |

key :  All longitudinal axis parameters

1)  delta / F

2)  $n_{z_{cp}}$ / delta        3)  $\dot{theta}$ / delta

4)  $\hat{n_{z_{cp}}}$ / $n_z$        5)  $\dot{q}$ / theta

6)  $\hat{n_{z_{cp}}}$ / F        7)  $\dot{q}$ / F

8)  $\hat{n_{z_{cmd}}}$ / F        9)  $\dot{q}_{cmd}$ / F

the data below is for easy reading into fortran programs

data

```
0.25   -78.27   -60.75   -167.74    47.62   -287.10    -91.41   -173.09    -88.82   -257.60
0.50   -60.53    31.13   -244.31    20.56   -319.48     -8.83   -264.32     -3.44   -337.62
0.75   -98.01    14.62   -258.10    14.29   -341.61    -69.09   -337.72    -61.68    -43.27
1.00  -140.16     7.69   -262.58     6.67     -2.49   -125.70    -45.24   -116.11    -99.42
1.25  -176.81     3.00   -267.58     0.26    -22.38   -173.55   -106.43   -163.85   -144.26
1.50  -205.62    -1.71   -270.14    -5.05    -39.64   -212.38   -155.40   -198.85   -180.14
1.75  -229.06    -7.13   -277.31    -8.10    -57.38   -244.28   -203.74   -229.00   -209.62
2.00  -243.89   -28.03    -28.67    -8.58   -359.14   -280.51   -271.70   -265.76   -241.76
```

Table A.11 - Simulator Data : Frequency Responses  continued

CONFIGURATION 1 : Magnitudes

| freq | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0.25 | -6.390 | -57.180 | -12.080 | 2.790 | -43.080 | -60.770 | -61.560 | -18.480 | -26.090 |
| 0.50 | -10.900 | -51.700 | -15.290 | -7.010 | -36.858 | -69.600 | -63.050 | -25.970 | -30.860 |
| 0.75 | -24.260 | -51.990 | -16.850 | -4.780 | -40.610 | -81.020 | -81.720 | -41.810 | -45.540 |

key :  All lateral-directional axes parameters

    1)  delta / F

    2)  $n_{y_{cp}}$ / delta    3)  p / delta

    4)  $\hat{n}_{y_{cp}}$ / $n_y$    5)  $\hat{\dot{p}}$ / $\dot{p}$

    6)  $\hat{n}_{y_{cp}}$ / F    7)  $\dot{p}$ / F

    8)  $\hat{n}_{y_{cmd}}$ / F    9)  $\hat{p}_{cmd}$ / F

the data below is for easy reading into fortran programs

data

```
0.25    -6.390 -57.180 -12.080    2.790 -43.080 -60.770 -61.560 -18.480 -26.090
0.50   -10.900 -51.700 -15.290   -7.010 -36.858 -69.600 -63.050 -25.970 -30.860
0.75   -24.260 -51.990 -16.850   -4.780 -40.610 -81.020 -81.720 -41.810 -45.540
```

Table A.11 - Simulator Data : Frequency Responses continued

CONFIGURATION 1 : Phases

| freq | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| 0.25 | -195.18 | -339.67 | -99.08 | -186.43 | -65.80 | -1.27 | -0.06 | -179.38 | -261.50 |
| 0.50 | -267.56 | -337.96 | -83.28 | -215.34 | -107.36 | -100.85 | -98.19 | -260.58 | -351.90 |
| 0.75 | -306.44 | -338.28 | -76.03 | -238.83 | -163.54 | -163.54 | -186.01 | -296.97 | -38.54 |

key :  All lateral-directional axes parameters

1)  delta / F

2)  ny   / delta        3)  p / delta
      cp

    ^                      .
4)  ny   / ny           5)  p / p
      cp

    ^                      .
6)  ny   / F            7)  p / F
      cp

    ^                      .
8)  ny   / F            9)  p   / F
      cmd                    cmd


the data below is for easy reading into fortran programs

data

| 0.25 | -195.18 | -339.67 | -99.08 | -186.43 | -65.80 | -1.27 | -0.06 | -179.38 | -261.50 |
|---|---|---|---|---|---|---|---|---|---|
| 0.50 | -267.56 | -337.96 | -83.28 | -215.34 | -107.36 | -100.85 | -98.19 | -260.58 | -351.90 |
| 0.75 | -306.44 | -338.28 | -76.03 | -238.83 | -163.54 | -163.54 | -136.01 | -296.97 | -38.54 |

## Table A.11 - Simulator Data : Frequency Responses continued

CONFIGURATION 2 : Magnitudes

| freq | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|------|------|------|------|------|------|------|------|------|
| 0.25 | -14.050 | -38.841 | -12.960 | -12.600 | -31.910 | -65.480 | -58.920 | -23.350 | -30.570 |
| 0.50 | -12.660 | -39.600 | -15.520 | -13.420 | -29.550 | -65.670 | -57.730 | -23.350 | -32.110 |
| 0.75 | -12.460 | -37.380 | -18.120 | -12.360 | -25.710 | -62.200 | -56.290 | -20.010 | -32.640 |
| 1.00 | -13.720 | -35.380 | -20.010 | -12.970 | -22.146 | -62.070 | -55.880 | -19.630 | -33.650 |
| 1.25 | -15.700 | -32.380 | -22.880 | -13.580 | -18.293 | -61.650 | -56.870 | -19.060 | -35.400 |
| 1.50 | -18.290 | -26.720 | -18.880 | -13.870 | -22.210 | -58.870 | -59.370 | -17.260 | -39.980 |
| 1.75 | -16.820 | -30.940 | -19.070 | -13.270 | -21.370 | -60.960 | -57.250 | -18.840 | -37.330 |
| 2.00 | -18.570 | -33.600 | -20.530 | -13.960 | -19.602 | -66.120 | -58.710 | -21.550 | -38.680 |

key :   All longitudinal axis parameters

1) $\delta / F$

2) $n_{z_{cp}} / \delta$          3) $\theta / \delta$

4) $\hat{n}_{z_{cp}} / n_z$       5) $\dot{\hat{q}} / \theta$

6) $\hat{n}_{z_{cp}} / F$         7) $\dot{\hat{q}} / F$

8) $\hat{n}_{z_{cmd}} / F$        9) $\dot{\hat{q}}_{cmd} / F$

the data below is for easy reading into fortran programs

data

```
0.25   -14.050 -38.841 -12.960 -12.600 -31.910 -65.480 -58.920 -23.350 -30.570
0.50   -12.660 -39.600 -15.520 -13.420 -29.550 -65.670 -57.730 -23.350 -32.110
0.75   -12.460 -37.380 -18.120 -12.360 -25.710 -62.200 -56.290 -20.010 -32.640
1.00   -13.720 -35.380 -20.010 -12.970 -22.146 -62.070 -55.880 -19.630 -33.650
1.25   -15.700 -32.380 -22.880 -13.580 -18.293 -61.650 -56.870 -19.060 -35.400
1.50   -18.290 -26.720 -18.880 -13.870 -22.210 -58.870 -59.370 -17.260 -39.980
1.75   -16.820 -30.940 -19.070 -13.270 -21.370 -60.960 -57.250 -18.840 -37.330
2.00   -18.570 -33.600 -20.530 -13.960 -19.602 -66.120 -58.710 -21.550 -38.680
```

Table A.11 - Simulator Data : Frequency Responses continued

CONFIGURATION 2 : Phases

| freq | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| 0.25 | -75.06 | -64.14 | -172.70 | 43.61 | -281.75 | -95.58 | -169.51 | -89.74 | -254.74 |
| 0.50 | -63.16 | 24.81 | -248.13 | 26.38 | -310.74 | -11.97 | -262.02 | -7.65 | -322.98 |
| 0.75 | -105.87 | 8.79 | -261.48 | 14.57 | -337.36 | -82.51 | -344.71 | -76.02 | -48.15 |
| 1.00 | -149.02 | 0.38 | -267.63 | 2.13 | -1.56 | -146.51 | -58.21 | -136.56 | -109.61 |
| 1.25 | -182.76 | -10.24 | -279.90 | 0.61 | -27.12 | -192.39 | -129.78 | -183.42 | -157.89 |
| 1.50 | -190.12 | -68.17 | -152.98 | -1.19 | -246.96 | -259.49 | -230.06 | -250.32 | -205.32 |
| 1.75 | -220.04 | -158.54 | -244.36 | -10.83 | -15.51 | -29.41 | -119.91 | -11.72 | -181.11 |
| 2.00 | -246.23 | -170.34 | -255.57 | -11.81 | -47.52 | -68.38 | -189.32 | -50.28 | -217.28 |

key :   All longitudinal axis parameters

  1)   delta / F

  2)   $n_{z_{cp}}$ / delta      3)   $\dot{theta}$ / delta

  4)   $\hat{n}_z$ / $n_{z_{cp}}$      5)   $\hat{q}$ / $\dot{theta}$

  6)   $\hat{n}_{z_{cp}}$ / F      7)   $\hat{\dot{q}}$ / F

  8)   $\hat{n}_{z_{cmd}}$ / F      9)   $\hat{\dot{q}}_{cmd}$ / F

the data below is for easy reading into fortran programs

data

```
0.25  -75.06   -64.14  -172.70   43.61  -281.75   -95.58  -169.51   -89.74  -254.74
0.50  -63.16    24.81  -248.13   26.38  -310.74   -11.97  -262.02    -7.65  -322.98
0.75 -105.87     8.79  -261.48   14.57  -337.36   -82.51  -344.71   -76.02   -48.15
1.00 -149.02     0.38  -267.63    2.13    -1.56  -146.51   -58.21  -136.56  -109.61
1.25 -182.76   -10.24  -279.90    0.61   -27.12  -192.39  -129.78  -183.42  -157.89
1.50 -190.12   -68.17  -152.98   -1.19  -246.96  -259.49  -230.06  -250.32  -205.32
1.75 -220.04  -158.54  -244.36  -10.83   -15.51   -29.41  -119.91   -11.72  -181.11
2.00 -246.23  -170.34  -255.57  -11.81   -47.52   -68.38  -189.32   -50.28  -217.28
```

Table A.11 - Simulator Data : Frequency Responses continued

CONFIGURATION 2 : Magnitudes

| freq | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0.25 | -6.420 | -56.620 | -12.150 | 2.480 | -42.870 | -60.550 | -61.440 | -18.420 | -25.970 |
| 0.50 | -11.190 | -51.510 | -15.290 | -7.330 | -36.800 | -70.030 | -63.280 | -26.180 | -31.050 |
| 0.75 | -26.920 | -51.980 | -16.760 | -4.170 | -36.200 | -83.070 | -79.890 | -44.580 | -48.160 |

```
    key :   All lateral-directional axes parameters

            1)  delta / F

            2)  ny    / delta       3)  p / delta
                  cp

                  ^                     .
            4)  ny    / ny          5)  p / p
                  cp

                  ^                     .
            6)  ny    / F           7)  p / F
                  cp

                  ^                     .
            8)  ny    / F           9)  p   / F
                  cmd                     cmd
```

the data below is for easy reading into fortran programs

data

```
    0.25   -6.420 -56.620 -12.150   2.480 -42.870 -60.550 -61.440 -18.420 -25.970
    0.50  -11.190 -51.510 -15.290  -7.330 -36.800 -70.030 -63.280 -26.180 -31.050
    0.75  -26.920 -51.980 -16.760  -4.170 -36.200 -83.070 -79.890 -44.580 -48.160
```

Table A.11 - Simulator Data : Frequency Responses continued

CONFIGURATION 2 : Phases

| freq | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|---|---|---|---|---|---|---|---|---|
| 0.25 | -197.24 | -311.52 | -97.72 | -211.87 | -63.64 | -0.63 | -385.59 | -178.42 | -260.96 |
| 0.50 | -267.60 | -335.59 | -82.72 | -212.49 | -108.35 | -95.08 | -98.67 | -260.23 | -351.70 |
| 0.75 | -305.26 | -337.88 | -75.03 | -304.80 | -149.45 | -227.94 | -169.73 | -292.81 | -36.68 |

```
key :   All lateral-directional axes parameters

        1)  delta / F

        2)  ny    / delta      3)  p / delta
              cp

              ^                     ^
        4)  ny    / ny         5)  p / p
              cp

              ^                     ^
        6)  ny    / F          7)  p / F
              cp

              ^                     ^
        8)  ny    / F          9)  p    / F
              cmd                     cmd
```

the data below is for easy reading into fortran programs

data
```
0.25  -197.24  -311.52  -97.72  -211.87  -63.64   -0.63  -385.59  -178.42  -260.96
0.50  -267.60  -335.59  -82.72  -212.49  -108.35  -95.08  -98.67  -260.23  -351.70
0.75  -305.26  -337.88  -75.03  -304.80  -149.45  -227.94  -169.73  -292.81  -36.68
```

Table A.11 - Simulator Data : Frequency Responses continued

CONFIGURATION 3 : Magnitudes

| freq | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|------|------|------|------|------|------|------|------|------|
| 0.25 | -13.290 | -41.210 | -13.920 | -10.570 | -35.230 | -65.060 | -62.440 | -24.210 | -34.500 |
| 0.50 | -11.150 | -37.600 | -18.670 | -12.810 | -26.740 | -61.560 | -56.560 | -19.410 | -31.440 |
| 0.75 | -13.570 | -33.750 | -26.700 | -13.440 | -15.630 | -60.750 | -55.900 | -18.640 | -32.830 |
| 1.00 | -18.100 | -28.890 | -14.000 | -13.590 | -26.530 | -60.560 | -58.620 | -18.450 | -40.280 |
| 1.25 | -14.590 | -33.450 | -17.300 | -12.860 | -24.120 | -60.890 | -56.010 | -19.010 | -34.740 |
| 1.50 | -15.750 | -35.560 | -18.990 | -13.130 | -22.100 | -64.430 | -56.850 | -20.790 | -35.490 |
| 1.75 | -17.310 | -36.670 | -19.960 | -13.350 | -20.141 | -67.310 | -57.410 | -22.930 | -36.870 |
| 2.00 | -18.780 | -37.380 | -20.910 | -12.080 | -17.830 | -68.240 | -57.520 | -25.110 | -38.290 |

key :   All longitudinal axis parameters

   1)   delta / F

   2)   $n_{z_{cp}}$ / delta        3)   $\dot{theta}$ / delta

   4)   $\hat{n_{z_{cp}}}$ / $n_z$       5)   q / $\dot{theta}$

   6)   $\hat{n_{z_{cp}}}$ / F        7)   $\hat{q}$ / F

   8)   $\hat{n_{z_{cmd}}}$ / F       9)   $\hat{q_{cmd}}$ / F

   the data below is for easy reading into fortran programs

data

```
0.25   -13.290  -41.210  -13.920  -10.570  -35.230  -65.060  -62.440  -24.210  -34.500
0.50   -11.150  -37.600  -18.670  -12.810  -26.740  -61.560  -56.560  -19.410  -31.440
0.75   -13.570  -33.750  -26.700  -13.440  -15.630  -60.750  -55.900  -18.640  -32.830
1.00   -18.100  -28.890  -14.000  -13.590  -26.530  -60.560  -58.620  -18.450  -40.280
1.25   -14.590  -33.450  -17.300  -12.860  -24.120  -60.890  -56.010  -19.010  -34.740
1.50   -15.750  -35.560  -18.990  -13.130  -22.100  -64.430  -56.850  -20.790  -35.490
1.75   -17.310  -36.670  -19.960  -13.350  -20.141  -67.310  -57.410  -22.930  -36.870
2.00   -18.780  -37.380  -20.910  -12.080  -17.830  -68.240  -57.520  -25.110  -38.290
```

Table A.11 - Simulator Data : Frequency Responses continued

CONFIGURATION 3 : Phases

| freq | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|------|------|------|------|------|------|------|------|------|
| 0.25 | -61.82 | -63.38 | -193.91 | 56.17 | -153.85 | -69.03 | -49.58 | -73.41 | -138.11 |
| 0.50 | -85.72 | 5.73 | -260.82 | 25.70 | -319.17 | -54.29 | -305.71 | -52.22 | -22.98 |
| 0.75 | -144.06 | -14.24 | -64.04 | 11.72 | -210.88 | -146.58 | -58.97 | -142.86 | -126.11 |
| 1.00 | -123.52 | -104.57 | -184.68 | 4.72 | -265.84 | -223.38 | -214.04 | -216.20 | -271.01 |
| 1.25 | -150.11 | -162.19 | -243.65 | -5.53 | -345.78 | -317.82 | -19.54 | -303.09 | -92.03 |
| 1.50 | -196.80 | -171.39 | -252.57 | -12.64 | -24.98 | -20.82 | -114.35 | -0.19 | -156.89 |
| 1.75 | -225.14 | -174.54 | -257.67 | -5.63 | -51.63 | -45.30 | -174.44 | -32.91 | -192.89 |
| 2.00 | -247.38 | -177.21 | -360.08 | -16.10 | -69.01 | -80.70 | -216.47 | -58.18 | -220.52 |

key :   All longitudinal axis parameters

1)  delta / F

2)  $n_{z_{cp}}$ / delta       3)  $\dot{theta}$ / delta

4)  $\hat{n}_{z_{cp}}$ / $n_z$       5)  $\hat{q}$ / $\dot{theta}$

6)  $\hat{n}_{z_{cp}}$ / F       7)  $\dot{q}$ / F

8)  $\hat{n}_{z_{cmd}}$ / F       9)  $\hat{q}_{cmd}$ / F

the data below is for easy reading into fortran programs

data

| | | | | | | | | | |
|------|------|------|------|------|------|------|------|------|------|
| 0.25 | -61.82 | -63.38 | -193.91 | 56.17 | -153.85 | -69.03 | -49.58 | -73.41 | -138.11 |
| 0.50 | -85.72 | 5.73 | -260.82 | 25.70 | -319.17 | -54.29 | -305.71 | -52.22 | -22.98 |
| 0.75 | -144.06 | -14.24 | -64.04 | 11.72 | -210.88 | -146.58 | -58.97 | -142.86 | -126.11 |
| 1.00 | -123.52 | -104.57 | -184.68 | 4.72 | -265.84 | -223.38 | -214.04 | -216.20 | -271.01 |
| 1.25 | -150.11 | -162.19 | -243.65 | -5.53 | -345.78 | -317.82 | -19.54 | -303.09 | -92.03 |
| 1.50 | -196.80 | -171.39 | -252.57 | -12.64 | -24.98 | -20.82 | -114.35 | -0.19 | -156.89 |
| 1.75 | -225.14 | -174.54 | -257.67 | -5.63 | -51.63 | -45.30 | -174.44 | -32.91 | -192.89 |
| 2.00 | -247.38 | -177.21 | -360.08 | -16.10 | -69.01 | -80.70 | -216.47 | -58.18 | -220.52 |

## Table A.11 - Simulator Data : Frequency Responses continued

CONFIGURATION 3 : Magnitudes

| freq | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|---|---|---|---|---|---|---|---|---|
| 0.25 | -6.940 | -51.600 | -11.510 | -2.110 | -42.500 | -60.640 | -60.950 | -18.270 | -25.450 |
| 0.50 | -11.590 | -50.390 | -14.650 | -5.410 | -36.300 | -67.380 | -62.540 | -25.690 | -30.360 |
| 0.75 | -26.080 | -50.740 | -15.995 | -2.460 | -34.980 | -79.270 | -77.060 | -42.830 | -46.200 |

key :   All lateral-directional axes parameters

1)   delta / F

2)   $n y_{cp}$  / delta          3)   p / delta

4)   $\hat{ny}_{cp}$  / ny          5)   $\hat{p}$ / p

6)   $\hat{ny}_{cp}$  / F          7)   $\hat{p}$ / F

8)   $\hat{ny}_{cmd}$  / F          9)   $\hat{p}_{cmd}$  / F

the data below is for easy reading into fortran programs

data

```
0.25    -6.940 -51.600 -11.510    -2.110 -42.500 -60.640 -60.950 -18.270 -25.450
0.50   -11.590 -50.390 -14.650    -5.410 -36.300 -67.380 -62.540 -25.690 -30.360
0.75   -26.080 -50.740 -15.995    -2.460 -34.980 -79.270 -77.060 -42.830 -46.200
```

Table A.11 - Simulator Data : Frequency Responses continued

CONFIGURATION 3 : Phases

| freq | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|---|---|---|---|---|---|---|---|---|
| 0.25 | -192.34 | -245.02 | -98.60 | -266.85 | -52.32 | -344.21 | -343.26 | -162.79 | -246.90 |
| 0.50 | -260.04 | -323.78 | -84.97 | -222.31 | -105.50 | -86.14 | -90.52 | -251.72 | -344.30 |
| 0.75 | -299.88 | -331.70 | -77.60 | -219.85 | -146.28 | -131.43 | -163.76 | -283.39 | -34.54 |

```
key :  All lateral-directional axes parameters

       1)  delta / F

       2)  ny    / delta      3)  p / delta
             cp
                               .
             ^                 ^
       4)  ny    / ny          5)  p / p
             cp
                               .
             ^                 ^
       6)  ny    / F           7)  p / F
             cp
                               .
             ^                 ^
       8)  ny    / F           9)  p    / F
             cmd                    cmd


       the data below is for easy reading into fortran programs

data

  0.25  -192.34  -245.02   -98.60  -266.85   -52.32  -344.21  -343.26  -162.79  -246.90
  0.50  -260.04  -323.78   -84.97  -222.31  -105.50   -86.14   -90.52  -251.72  -344.30
  0.75  -299.88  -331.70   -77.60  -219.85  -146.28  -131.43  -163.76  -283.39   -34.54
```

## Table A.11 - Simulator Data : Frequency Responses continued

CONFIGURATION 4 : Magnitudes

| freq | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|------|------|------|------|------|------|------|------|------|
| 0.25 | -14.070 | -38.500 | -12.950 | -12.080 | -28.800 | -64.640 | -55.820 | -22.590 | -27.590 |
| 0.50 | -13.230 | -40.540 | -14.960 | -10.990 | -25.330 | -64.760 | -53.530 | -22.950 | -28.410 |
| 0.75 | -12.550 | -38.460 | -17.490 | -11.240 | -23.110 | -62.230 | -53.140 | -20.890 | -29.800 |
| 1.00 | -13.470 | -37.300 | -18.990 | -12.270 | -21.550 | -63.040 | -54.020 | -20.550 | -31.730 |
| 1.25 | -14.880 | -36.010 | -20.160 | -12.100 | -20.628 | -62.970 | -55.670 | -20.380 | -33.610 |
| 1.50 | -16.510 | -34.350 | -21.380 | -12.590 | -19.281 | -63.430 | -57.160 | -20.350 | -35.600 |
| 1.75 | -18.100 | -31.910 | -22.480 | -12.940 | -17.550 | -62.940 | -58.130 | -19.930 | -37.390 |
| 2.00 | -19.650 | -27.970 | -30.450 | -13.610 | -7.740 | -60.500 | -57.840 | -18.380 | -39.500 |

key :  All longitudinal axis parameters

1) delta / F

2) $n_z$ / delta      3) $\dot{theta}$ / delta
   cp

4) $\hat{n_z}$ / $n_z$      5) $\dot{q}$ / $\dot{theta}$
   cp

6) $\hat{n_z}$ / F      7) $\dot{q}$ / F
   cp

8) $\hat{n_z}$ / F      9) $\dot{\hat{q}}$ / F
   cmd                  cmd

the data below is for easy reading into fortran programs

data

```
0.25   -14.070  -38.500  -12.950  -12.080  -28.800  -64.640  -55.820  -22.590  -27.590
0.50   -13.230  -40.540  -14.960  -10.990  -25.330  -64.760  -53.530  -22.950  -28.410
0.75   -12.550  -38.460  -17.490  -11.240  -23.110  -62.230  -53.140  -20.890  -29.800
1.00   -13.470  -37.300  -18.990  -12.270  -21.550  -63.040  -54.020  -20.550  -31.730
1.25   -14.880  -36.010  -20.160  -12.100  -20.628  -62.970  -55.670  -20.380  -33.610
1.50   -16.510  -34.350  -21.380  -12.590  -19.281  -63.430  -57.160  -20.350  -35.600
1.75   -18.100  -31.910  -22.480  -12.940  -17.550  -62.940  -58.130  -19.930  -37.390
2.00   -19.650  -27.970  -30.450  -13.610   -7.740  -60.500  -57.840  -18.380  -39.500
```

## Table A.11 - Simulator Data : Frequency Responses  continued

CONFIGURATION 4 : Phases

| freq | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|---|---|---|---|---|---|---|---|---|
| 0.25 | -78.74 | -57.56 | -167.21 | 49.24 | -294.23 | -87.06 | -180.18 | -87.28 | -263.01 |
| 0.50 | -60.85 | 28.80 | -244.27 | 22.44 | -323.19 | -9.61 | -268.27 | -6.68 | -344.53 |
| 0.75 | -98.30 | 14.01 | -257.98 | 14.45 | -343.75 | -69.85 | -340.03 | -62.85 | -46.84 |
| 1.00 | -140.38 | 7.15 | -262.39 | 3.26 | -2.44 | -129.96 | -45.20 | -120.76 | -100.40 |
| 1.25 | -176.94 | 2.65 | -267.70 | 0.02 | -22.19 | -174.27 | -106.83 | -164.70 | -144.95 |
| 1.50 | -205.62 | -1.64 | -269.66 | -3.99 | -43.97 | -211.25 | -159.25 | -199.58 | -179.99 |
| 1.75 | -228.99 | -7.28 | -277.21 | -8.62 | -60.23 | -244.90 | -206.44 | -229.42 | -209.31 |
| 2.00 | -244.08 | -27.79 | -27.75 | -9.54 | -1.19 | -281.41 | -273.01 | -265.53 | -241.42 |

key :  All longitudinal axis parameters

1)  delta / F

2)  $n_{z_{cp}}$ / delta          3)  theta / delta

4)  $\hat{n}_{z_{cp}}$ / $n_z$          5)  $\dot{q}$ / theta

6)  $\hat{n}_{z_{cp}}$ / F          7)  $\dot{q}$ / F

8)  $\hat{n}_{z_{cmd}}$ / F          9)  $\hat{\dot{q}}_{cmd}$ / F

the data below is for easy reading into fortran programs

data
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0.25 | -78.74 | -57.56 | -167.21 | 49.24 | -294.23 | -87.06 | -180.18 | -87.28 | -263.01 |
| 0.50 | -60.85 | 28.80 | -244.27 | 22.44 | -323.19 | -9.61 | -268.27 | -6.68 | -344.53 |
| 0.75 | -98.30 | 14.01 | -257.98 | 14.45 | -343.75 | -69.85 | -340.03 | -62.85 | -46.84 |
| 1.00 | -140.38 | 7.15 | -262.39 | 3.26 | -2.44 | -129.96 | -45.20 | -120.76 | -100.40 |
| 1.25 | -176.94 | 2.65 | -267.70 | 0.02 | -22.19 | -174.27 | -106.83 | -164.70 | -144.95 |
| 1.50 | -205.62 | -1.64 | -269.66 | -3.99 | -43.97 | -211.25 | -159.25 | -199.58 | -179.99 |
| 1.75 | -228.99 | -7.28 | -277.21 | -8.62 | -60.23 | -244.90 | -206.44 | -229.42 | -209.31 |
| 2.00 | -244.08 | -27.79 | -27.75 | -9.54 | -1.19 | -281.41 | -273.01 | -265.53 | -241.42 |

## Table A.11 - Simulator Data : Frequency Responses continued

CONFIGURATION 4 : Magnitudes

| freq | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|-----|------|------|------|------|------|------|------|------|
| 0.25 | -5.550 | -59.920 | -12.160 | 4.790 | -43.750 | -60.680 | -61.460 | -18.400 | -25.999 |
| 0.50 | -11.420 | -52.000 | -14.900 | -5.630 | -36.880 | -69.040 | -63.200 | -26.270 | -31.050 |
| 0.75 | -26.630 | -52.210 | -16.310 | -5.980 | -43.590 | -84.810 | -86.530 | -44.030 | -47.360 |

```
key :   All lateral-directional axes parameters

        1)   delta / F

        2)   ny    / delta       3)   p / delta
               cp

               ^                       .
                                       ^
        4)   ny    / ny          5)   p / p
               cp

               ^                       .
                                       ^
        6)   ny    / F           7)   p / F
               cp

               ^                       .
                                       ^
        8)   ny    / F           9)   p    / F
               cmd                      cmd


        the data below is for easy reading into fortran programs

data
    0.25   -5.550 -59.920 -12.160    4.790 -43.750 -60.680 -61.460 -18.400 -25.999
    0.50  -11.420 -52.000 -14.900   -5.630 -36.880 -69.040 -63.200 -26.270 -31.050
    0.75  -26.630 -52.210 -16.310   -5.980 -43.590 -84.810 -86.530 -44.030 -47.360
```

Table A.11 - Simulator Data : Frequency Responses continued

CONFIGURATION 4 : Phases

| freq | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|------|------|------|------|------|------|------|------|------|
| 0.25 | -179.45 | -4.35 | -116.22 | -179.07 | -63.58 | -2.87 | -359.24 | -179.93 | -261.36 |
| 0.50 | -258.68 | -342.05 | -92.94 | -221.48 | -105.05 | -102.22 | -96.68 | -258.56 | -348.98 |
| 0.75 | -301.21 | -335.80 | -82.84 | -163.92 | -159.34 | -80.92 | -183.39 | -291.11 | -34.49 |

key :   All lateral-directional axes parameters

   1)   delta / F

   2)   $ny_{cp}$  / delta          3)   $p$ / delta

   4)   $\hat{ny}_{cp}$ / ny         5)   $\hat{p}$ / $\dot{p}$

   6)   $\hat{ny}_{cp}$ / F          7)   $\hat{p}$ / F

   8)   $\hat{ny}_{cmd}$ / F         9)   $\hat{p}_{cmd}$ / F

the data below is for easy reading into fortran programs

data

```
     0.25   -179.45     -4.35   -116.22   -179.07    -63.58     -2.87   -359.24   -179.93   -261.36
     0.50   -258.68   -342.05    -92.94   -221.48   -105.05   -102.22    -96.68   -258.56   -348.98
     0.75   -301.21   -335.80    -82.84   -163.92   -159.34    -80.92   -183.39   -291.11    -34.49
```

Table A.11 - Simulator Data : Frequency Responses continued

CONFIGURATION 5 : Magnitudes

| freq | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|---|---|---|---|---|---|---|---|---|
| 0.25 | -14.260 | -38.090 | -12.680 | -11.640 | -28.870 | -63.970 | -55.800 | -21.760 | -27.600 |
| 0.50 | -13.790 | -41.380 | -14.280 | -10.930 | -25.570 | -66.080 | -53.640 | -24.140 | -28.490 |
| 0.75 | -12.890 | -39.620 | -16.710 | -11.370 | -23.510 | -63.870 | -53.110 | -21.720 | -29.760 |
| 1.00 | -13.510 | -39.280 | -18.190 | -10.450 | -22.220 | -63.230 | -53.920 | -21.930 | -31.440 |
| 1.25 | -14.560 | -39.120 | -19.230 | -12.170 | -21.890 | -65.830 | -55.670 | -22.630 | -33.040 |
| 1.50 | -16.040 | -39.080 | -20.080 | -13.220 | -21.680 | -68.320 | -57.790 | -24.060 | -34.900 |
| 1.75 | -17.460 | -39.020 | -20.690 | -11.540 | -20.704 | -68.010 | -58.850 | -25.430 | -36.520 |
| 2.00 | -18.710 | -39.000 | -21.300 | -12.670 | -19.376 | -70.380 | -59.390 | -26.660 | -37.940 |

key : All longitudinal axis parameters

1) delta / F

2) $n_{z_{cp}}$ / delta        3) theta / delta

4) $\hat{n}_{z_{cp}}$ / $n_z$        5) $\dot{\hat{q}}$ / theta

6) $\hat{n}_{z_{cp}}$ / F        7) $\dot{\hat{q}}$ / F

8) $\hat{n}_{z_{cmd}}$ / F        9) $\dot{\hat{q}}_{cmd}$ / F

the data below is for easy reading into fortran programs

data

```
0.25   -14.260 -38.090 -12.680 -11.640 -28.870 -63.970 -55.800 -21.760 -27.600
0.50   -13.790 -41.380 -14.280 -10.930 -25.570 -66.080 -53.640 -24.140 -28.490
0.75   -12.890 -39.620 -16.710 -11.370 -23.510 -63.870 -53.110 -21.720 -29.760
1.00   -13.510 -39.280 -18.190 -10.450 -22.220 -63.230 -53.920 -21.930 -31.440
1.25   -14.560 -39.120 -19.230 -12.170 -21.890 -65.830 -55.670 -22.630 -33.040
1.50   -16.040 -39.080 -20.080 -13.220 -21.680 -68.320 -57.790 -24.060 -34.900
1.75   -17.460 -39.020 -20.690 -11.540 -20.704 -68.010 -58.850 -25.430 -36.520
2.00   -18.710 -39.000 -21.300 -12.670 -19.376 -70.380 -59.390 -26.660 -37.940
```

Table A.11 - Simulator Data : Frequency Responses continued

CONFIGURATION 5 : Phases

| freq | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0.25 | -81.55 | -57.26 | -163.58 | 47.94 | -291.24 | -90.86 | -176.36 | -89.74 | -260.14 |
| 0.50 | -59.27 | 38.60 | -240.33 | 22.02 | -322.59 | -358.66 | -262.20 | -356.88 | -337.54 |
| 0.75 | -92.29 | 20.60 | -254.94 | 7.80 | -342.59 | -63.89 | -329.63 | -55.50 | -35.94 |
| 1.00 | -133.93 | 14.82 | -259.46 | 10.26 | -1.51 | -108.85 | -34.89 | -107.36 | -88.92 |
| 1.25 | -172.83 | 11.57 | -262.19 | -2.71 | -20.67 | -163.96 | -95.69 | -151.73 | -135.47 |
| 1.50 | -203.78 | 9.31 | -263.67 | -14.44 | -31.69 | -208.90 | -139.14 | -186.42 | -171.71 |
| 1.75 | -227.48 | 8.37 | -264.80 | -15.36 | -52.99 | -234.46 | -185.26 | -212.26 | -198.81 |
| 2.00 | -246.53 | 6.94 | -266.07 | -29.69 | -72.02 | -269.28 | -224.62 | -233.44 | -221.53 |

key :   All longitudinal axis parameters

1)  delta / F

2)  $n_{z_{cp}}$ / delta          3)  $\dot{theta}$ / delta

4)  $\hat{n_{z_{cp}}}$ / $n_z$          5)  $\dot{q}$ / theta

6)  $\hat{n_{z_{cp}}}$ / F          7)  $\dot{q}$ / F

8)  $\hat{n_{z_{cmd}}}$ / F          9)  $\dot{\hat{q}}_{cmd}$ / F

the data below is for easy reading into fortran programs

data

| | | | | | | | | | |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0.25 | -81.55 | -57.26 | -163.58 | 47.94 | -291.24 | -90.86 | -176.36 | -89.74 | -260.14 |
| 0.50 | -59.27 | 38.60 | -240.33 | 22.02 | -322.59 | -358.66 | -262.20 | -356.88 | -337.54 |
| 0.75 | -92.29 | 20.60 | -254.94 | 7.80 | -342.59 | -63.89 | -329.63 | -55.50 | -35.94 |
| 1.00 | -133.93 | 14.82 | -259.46 | 10.26 | -1.51 | -108.85 | -34.89 | -107.36 | -88.92 |
| 1.25 | -172.83 | 11.57 | -262.19 | -2.71 | -20.67 | -163.96 | -95.69 | -151.73 | -135.47 |
| 1.50 | -203.78 | 9.31 | -263.67 | -14.44 | -31.69 | -208.90 | -139.14 | -186.42 | -171.71 |
| 1.75 | -227.48 | 8.37 | -264.80 | -15.36 | -52.99 | -234.46 | -185.26 | -212.26 | -198.81 |
| 2.00 | -246.53 | 6.94 | -266.07 | -29.69 | -72.02 | -269.28 | -224.62 | -233.44 | -221.53 |

Table A.11 - Simulator Data : Frequency Responses continued

```
CONFIGURATION 5 : Magnitudes


freq !   1        2        3        4        5        6        7        8        9
     !_____
     !
0.25!  -6.490  -54.870 -13.990   0.050  -41.770 -61.300 -62.240 -19.100 -26.740
     !
0.50! -12.370  -51.470 -16.920  -8.950  -36.930 -72.790 -66.220 -28.480 -33.730
     !
0.75! -39.460  -51.910 -18.970   5.590  -35.340 -85.770 -93.780 -58.480 -62.210
     !


     key :  All lateral-directional axes parameters

           1)   delta / F

           2)   ny   / delta     3)   p / delta
                cp

                ^                     .
                                      ^
           4)   ny   / ny        5)   p / p
                cp

                ^                     .
                                      ^
           6)   ny   / F         7)   p / F
                cp

                ^                     .
                                      ^
           8)   ny   / F         9)   p   / F
                   cmd                  cmd


     the data below is for easy reading into fortran programs

data

   0.25   -6.490 -54.870 -13.990   0.050  -41.770 -61.300 -62.240 -19.100 -26.740
   0.50  -12.370 -51.470 -16.920  -8.950  -36.930 -72.790 -66.220 -28.480 -33.730
   0.75  -39.460 -51.910 -18.970   5.590  -35.340 -85.770 -93.780 -58.480 -62.210
```

Table A.11 - Simulator Data : Frequency Responses concluded

CONFIGURATION 5 : Phases

| freq | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0.25 | -236.74 | -300.30 | -59.71 | -189.32 | -70.17 | -6.36 | -6.62 | -184.30 | -267.87 |
| 0.50 | -286.22 | -329.91 | -64.90 | -232.36 | -129.92 | -128.48 | -121.04 | -268.65 | -4.06 |
| 0.75 | -306.74 | -330.99 | -64.16 | -140.25 | -6.56 | -57.97 | -17.46 | -282.70 | -44.36 |

key :  All lateral-directional axes parameters

1)  delta / F

2)  ny$_{cp}$  / delta       3)  p / delta

4)  $\hat{ny}_{cp}$  / ny       5)  $\hat{p}$ / p

6)  $\hat{ny}_{cp}$  / F       7)  $\hat{p}$ / F

8)  $\hat{ny}$  / F       9)  $\hat{p}_{cmd}$  / F
   cmd

the data below is for easy reading into fortran programs

data

| 0.25 | -236.74 | -300.30 | -59.71 | -189.32 | -70.17 | -6.36 | -6.62 | -184.30 | -267.87 |
| 0.50 | -286.22 | -329.91 | -64.90 | -232.36 | -129.92 | -128.48 | -121.04 | -268.65 | -4.06 |
| 0.75 | -306.74 | -330.99 | -64.16 | -140.25 | -6.56 | -57.97 | -17.46 | -282.70 | -44.36 |

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Volume One—Experiment, Results and Analysis

16. Abstract

The simulation experiment described herein addresses the effects of structural flexibility on the dynamic characteristics of a generic family of aircraft. The simulation was performed using the NASA Langley VMS simulation facility. The vehicle models were obtained as part of this research project. The simulation results include complete response data and subjective pilot ratings and comments and so allow a variety of analyses. The subjective ratings and analysis of the time histories indicate that increased flexibility can lead to increased tracking errors, degraded handling qualities, and changes in the frequency content of the pilot inputs. These results, furthermore, are significantly affected by the visual cues available to the pilot.

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