SPACE STATION CONTROL MOMENT GYRO CONTROL

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The potential large center-of-pressure to center-of-gravity offset of the Space Station makes the short term, within an orbit, variations in density of primary importance.

The large range of uncertainty in the prediction of solar activity will penalize the Space Station design, development, and operation.
CURRENT STUDY INTEREST AND EFFORTS

- CMG CONTROL SYSTEM SIZING *
- DUAL KEEL MOMENTUM SENSITIVITIES *
- MOMENTUM MANAGEMENT STRATEGIES AND SUPPORTING ALGORITHM DEVELOPMENT

*DATA PACKAGES INCLUDED FOR HARRY BUCHANAN
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<th>IXX</th>
<th>IYY</th>
<th>IZZ</th>
<th>IXY</th>
<th>IXZ</th>
<th>IYZ</th>
<th>XCG</th>
<th>YCG</th>
<th>ZCG</th>
<th>XCP</th>
<th>YCP</th>
<th>ZCP</th>
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<tbody>
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<td>WEIGHT DUAL KEEL</td>
<td>1.4060E8</td>
<td>1.0897E8</td>
<td>5.7214E7</td>
<td>6.5741E5</td>
<td>1.2931E6</td>
<td>24.45463</td>
<td>-5.011408</td>
<td>-1.022853</td>
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<td>WEIGHT (CONT.)</td>
<td>1.8900E8</td>
<td>1.8522E8</td>
<td>8.4067E6</td>
<td>6.9866E4</td>
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<td>CG</td>
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<td>XCP = 13.65645</td>
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<td>YCP = -29.40985</td>
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POWER TOWER + PL & SERVICING
- CMG SIZING KEY POINTS
  - POWER TOWER (IOC)
    - OUT-OF-ORBIT PLANE MOMENTUM WAS THE REQUIREMENT DRIVER DUE TO A LARGE CP. TO CG. OFFSET IN THE STATION X AXIS (> 100 FT.)
    - PITCH TCA WAS EMPLOYED TO REDUCE THE OUT-OF-ORBIT PLANE MOMENTUM
CMG SIZING KEY POINTS (CONT)

- DUAL KEEL (IOC)*
  - IN-ORBIT PLANE MOMENTUM WILL BE THE REQUIREMENT DRIVER DUE TO A POTENTIAL
  - LARGE CP. TO CG. OFFSET IN THE STATION Y AXIS (> 30 FT.)
  - ROLL TEA REDUCES IN-PLANE MOMENTUM SOMEWHAT
  - SOLAR DYNAMIC EXPERIMENT CONTRIBUTES LARGELY TO THE IN-PLANE MOMENTUM
  - LARGE AREA (∼ 2400 FT²)
  - LOCATED NEAR END OF UPPER BOOM (-112 FT.)

*NOT NECESSARILY CONFIGURATION OPTIMAL FOR CMG SIZING OR MOMENTUM MANAGEMENT
MOMENTUM IN E1 SYS

PTEA=+1.30  RTEA=-1.50

3-21-92  250NM  (dual keel+FL)  F10.7-230  Kp=9.0  B=0.

rotating TDFX exp. at -112 ft Y-axis

X
Y
Z
INERTIAL
AXES

MOMENTUM (FT-LB-SEC)

TIME (SEC)

Mission Planning and Analysis Division
• MOMENTUM MANAGEMENT KEY POINTS

• SECULAR CHANGES CAN BE RELATIVELY LARGE
  (~ 2500 FT-LB-SEC PER ORBIT, FOR STEA)

• IMPLIES FREQUENT, IF NOT CONTINUOUS, IN-PLANE MOMENTUM DUMPING WITH
  REASONABLY LARGE ROLL ANGLES (> .5 DEG) ABOUT ROLL TEA

• MANEUVER MOMENTUM MUST BE SUFFICIENT FOR REQUIRED MOMENTUM
  DUMPING (I_\Delta_\omega = 5000 FT-LB-SEC, \Delta _\omega = .002^o/SEC)

DUAL KEEL CONFIGURATION, CIR, ORBIT ALT. = 250 N.MI., B = 0, 3-21-92.
STEA - SHORT TERM EXTREME ATMOSPHERE F10.7 = 230, KP = 9.
• NATURAL ENVIRONMENT EFFECTS

• PEAK IN-PLANE MOMENTUM SENSITIVITY TO NATURAL ENVIRONMENT PARAMETERS

<table>
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<tr>
<th>F 10.7</th>
<th>KP</th>
<th>PEAK IN-PLANE MOMENTUM (NO SECULAR CHANGE INCL.)</th>
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<tbody>
<tr>
<td>150</td>
<td>3</td>
<td>~1200 FT-LB-SEC</td>
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<tr>
<td>150</td>
<td>7</td>
<td>~2500</td>
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<tr>
<td>150</td>
<td>9</td>
<td>~5000</td>
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<tr>
<td>230</td>
<td>3</td>
<td>~3000</td>
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<td>230</td>
<td>9</td>
<td>~7000</td>
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<tr>
<td>300</td>
<td>9</td>
<td>~10000</td>
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</table>

• WIDE RANGE OF MOMENTUM REQUIREMENT RANGING FROM AVERAGES TO EXTREMES OF NATURAL ENVIRONMENT PARAMETERS

DUAL KEEL CONFIGURATION, CR, ORBIT ALT. = 250 N.MI. B = O, 3-21-92
• NATURAL ENVIRONMENT QUESTIONS

• QUALIFICATION AND PREDICTIVE ACCURACY OF THE JACCHIA MODEL TO THE
  SPACE STATION FLIGHT ENVELOPE (INCL. = 28.5°, ALT = 210 - 270 N. MI.)
  RELATIVE TO

  - SHORT TERM CONTROL SYSTEM ANALYSIS (ORBIT TO ORBIT)
  - APPLICATION OF SOLAR FLUX AND GEOMAGNETIC INDEX PARAMETERS

• UNCERTAINTY OF THE PREDICTED SOLAR CYCLE ENVELOPE IN THE DESIGN TIME
  FRAME