LARGE SPACE STRUCTURES CONTROLS RESEARCH AND DEVELOPMENT

AT MARSHALL SPACE FLIGHT CENTER –

STATUS AND FUTURE PLANS

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OBJECTIVE I: STABILITY AND MODAL CONTROL

DEMONSTRATE THAT THE FIRST NINE MODES (THREE RIGID + SIX FLEX) OF THE SEPS TEST ARTICLE CAN BE ACTIVELY CONTROLLED.

FEATURES:

- LOW FREQUENCY (f < 1 Hz).
- ACTIVE MODAL DAMPING – EXPERIMENT GOAL OF 10%.
- CONTROL OF ASYMMETRIC STRUCTURE WITH COUPLED MODES.
- INVESTIGATE EFFECT OF CONTROLLER SATURATION ON DYNAMICS.

SEPS SOLAR ARRAY FLIGHT TEST MODES

<table>
<thead>
<tr>
<th>FREQUENCY Hz</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>0</td>
<td>RIGID BODY</td>
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<tr>
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<td>RIGID BODY</td>
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<tr>
<td>0</td>
<td>RIGID BODY</td>
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<tr>
<td>.032</td>
<td>OUT OF PLANE* BENDING</td>
</tr>
<tr>
<td>.035</td>
<td>IN PLANE BENDING + TORSION**</td>
</tr>
<tr>
<td>.059</td>
<td>IN PLANE BENDING + TORSION</td>
</tr>
<tr>
<td>.096</td>
<td>OUT OF PLANE BENDING</td>
</tr>
<tr>
<td>.117</td>
<td>IN PLANE BENDING + TORSION</td>
</tr>
<tr>
<td>.165</td>
<td>OUT OF PLANE BENDING</td>
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*PLANE OF SOLAR BLANKET
**TORSION OF MAST
OBJECTIVE: TO DEVELOP A MULTILEVEL CONTROL APPROACH WHICH SUPPORTS A MODULAR OR BUILDING BLOCK APPROACH TO THE BUILDUP OF SPACE PLATFORMS.

OUTLOOK: CONCEPT HAS BEEN DEVELOPED AND TESTED IN THREE-AXIS COMPUTER SIMULATION UTILIZING A FIVE-BODY MODEL OF A BASIC SPACE PLATFORM MODULE. ANALYTICAL EFFORTS HAVE CONTINUED TO FOCUS ON EXTENSION OF THE BASIC THEORY AND SUBSEQUENT APPLICATION.
DEPLOYABLE ANTENNA SURFACE SHAPE CONTROL

- OBJECTIVE - DEVELOP PRELIMINARY SPECIFICATIONS FOR A FLIGHT EXPERIMENT TO EVALUATE SEVERAL ALGORITHMS FOR CONTROLLING THE SHAPE OF LSS.

- STATEMENT OF WORK SUMMARY
  - DEMONSTRATE ANALYTICALLY THE FEASIBILITY FOR SUCH AN EXPERIMENT.
  - SPECIFY HARDWARE AND SOFTWARE REQUIREMENTS.
  - IDENTIFY REQUIREMENTS WHICH WOULD IMPACT CURRENT DESIGN.
  - DEFINE A FLIGHT TEST PLAN.

SAFE CONTROL EXPERIMENT

SAFE TEST ARTICLE
(105' x 14')

CONTROL SENSORS

AGS CONTROL COMPUTER

ASPS GIMBAL SYSTEM (AGS)

ORBITER VCS PROVIDES EXCITATION
OBJECTIVE II: DISTURBANCE ISOLATION AND LOAD ALLEVIATION DURING MANEUVERS
DEMONSTRATE THAT DISTURBANCES ORIGINATING IN THE 
ORBITER (VCS FIRINGS AND CREW MOTION) CAN BE EFFECTIVELY 
ISOLATED FROM THE TEST ARTICLE BY MEANS OF SOFTWARE AND 
ACTIVE CONTROL. IN A SIMILAR MANNER LOADS IMPOSED ON THE 
STRUCTURE BY MANEUVERING WILL BE ALLEVIATED.
- $1 \times 10^{-3}$ g DISTURBANCE LEVEL.
- 33 NM TORQUE ALLEVIATION.

OBJECTIVE III: POINTING
DEMONSTRATE CONTROLLER CAN POINT BASE OF APPENDAGE TO 1
° ACCURACY (EXPERIMENT GOAL). NO STAR TRACKER SUN SENSOR 
INPUT WILL BE USED AND PERIOD OF PERFORMANCE WILL BE SHORT TO 
MINIMIZE RATE GYRO DRIFT.
CONTROL GROUND TEST SCHEMATIC

CONSTANT TENSION SUSPENSION

AIR BEARING

LARGE SPACE STRUCTURE TEST ARTICLE

2 DEGREE OF FREEDOM CONTROL GIMBAL

CONTROL COMPUTER

AIR BEARING

EXCITATION