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To: W. C. Williams

Date: 10 September 1968

Subject: Guidance & Control Laboratory
Justification

From: D. J. Griep

The purpose of the Guidance and Control Laboratory is to provide direct hardware support and hardware studies for Air Force satellite programs. This support involves the activities currently underway in support of the MOL Program.

Approximately 80% of the lab activity is involved with MOL related support. The following brief summary of contributions to the MOL Program are listed below:

1. Large Diameter Ball Bearing Study - A study of the torque noise in large diameter ball bearings for the Tracking Mirror (TM) drive on MOL has been conducted in the lab. Bearings procured and tested in the G&C Lab have to date provided the only bearings which will meet the overall drive performance for TM control. Bearings evaluated at Aerospace have been supplied to General Electric for the purpose of TM drive studies. The results of these General Electric tests provided the first instance of "in-spec" performance of the TM drive simulator. In addition, the Aerospace bearing test fixture has a greater capability for evaluating ball bearing torque noise. General Electric is currently redesigning their fixtures to copy the Aerospace configuration. Current plans in the G&C Lab involve the experimental investigation of the effects of installation cocking angle and the evaluation of nine-inch diameter bearings, for the roll axis of the TM drive servo.
2. TM Drive Electronic Evaluation - An experimental investigation of the bias and bias stability in TM Drive electronics is underway. Current Image Velocity Sensor (IVS) limitations make it desirable to reduce the electronic biases in the TM Drive and determine its stability. Aerospace is in disagreement with G. E. on the level of bias and stability of bias. Experimental verification is mandatory to resolve this item.
3. Air Bearing Table - A three axis air bearing table is being installed in the Lab. Using this table, initial experiments are planned to develop a single axis simulation of the TM Drive system on MOL.

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This simulator is necessary due to the problem of data correlation at General Electric. Current General Electric studies have been unable to correlate individual component data with overall TM Drive performance. General Electric does not possess the proposed simulation capability and would dilute their effort if required to develop this simulator. These experiments are necessary to develop the rationale for the TM Drive system evaluation before flight. Unless adequate correlation between component measurements and overall TM Drive performance can be made, a component/system buyoff criteria cannot be developed. This simulator will be used in the future for feasibility studies involving advanced MOL control system concepts such as CMG's (Control Moment Gyros).

4. MOL ACTS Thruster Electrical Performance - At program office request, the low voltage performance of the ACTS thruster valves was experimentally determined. These data provided Aerospace with technical information to require the contractor to consider alternative solutions to an overall MOL system problem involving low voltage operation.
5. Low Thrust Study - The determination of the thrust and total impulse imparted to the MOL vehicle by expelling water from the fuel cell/life support system is under study. A measurement apparatus capable of measuring 10^{-5} pounds of thrust for short duration pulses (.050 sec.) is being developed in the lab.
6. Low Frequency Instrumentation - A RMS meter capable of measurements at frequencies below 0.001 Hz was developed in the Lab during studies for another program. This meter configuration and associated techniques were supplied to General Electric at their request. This device is being used in the TM Drive data evaluation.
7. TM Drive Gyro Noise - Initial estimates of the noise level present in the proposed TM drive gyros indicated that these units could possibly be improved by redesign of the electronics. A brief study was conducted in the Laboratory and the results obtained indicated that an electronics redesign would not significantly reduce the noise level. This information was supplied to G. E. and eliminated any extensive studies by G. E. or the gyro manufacturer.

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8. Image Velocity Sensors - In support of the Image Velocity Sensor development, a laboratory breadboard simulation of the processing electronics will be constructed in the Lab. This breadboard will start when the selection of a final sensor is made and at the completion of current analytical studies associated with input scene characteristics. A major study has been underway during the past year to develop a model of input scene characteristics suitable for IVS design and evaluation.

In addition to the MOL activity, the Lab supports other Air Force satellite programs in the areas of Guidance & Control Hardware. Programs being supported are: 467 Program, 110 Program, Low G accelerometer studies (LOGACS) and T-III Program.



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