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26 July 1968

To: R. Buchanan

Subject: Use of Anamorphs in Simulator

From: B. Siegel/H. Bernstein

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1. It is recommended that the simulator optical systems be designed to provide maximum performance without anamorphic lenses. The proper simulation of field of view at forward look angles provided by the anamorph is more than outweighed by the resulting loss in on-axis resolution and by variation in off-axis field properties. For all tasks requiring a high fidelity optical simulation of the ATS, and in particular for activity mode simulation, it is our view that use of the anamorphic lens will result in incorrect operational procedures and negative training. For tasks that do not require a high fidelity optical simulation of the ATS, it has not been shown that the anamorphic lens adds anything significant to the simulation. We therefore further recommend that the anamorphic lens be deleted from the simulation program.

2. A decision of these matters is urgent, since the first MDS optical train is currently being assembled at Itek for delivery at GE in early November.

3. A more detailed discussion of these matters is attached.

B. Siegel

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Attachment

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ATTACHMENT

1. The optical simulation of the ATS, as originally proposed and presently configured, includes an anamorphic lens. Such a lens may be used to distort input stimulus to provide a proper initial presentation of viewed ground area, and if driven during a simulation of ATS tracking, can provide simulation of perspective change.

2. When the present ATS simulation approach was adopted, inclusion of the anamorphic lens was made contingent on the results of the bench test. There was concern that the anamorphic lens would so degrade image quality that valid data on crew performance could not be obtained.

   Bench test data now available indicates that while inclusion of the anamorphic lens at 1:1 power has little effect on optical performance on axis, any attempt to use these lenses to properly distort input stimulus causes a severe loss in system resolution, image quality and simulation fidelity. In particular, we note from the bench test that:

   a. On-axis resolution with 2:1 or 1.7:1 anamorphic power is about one-half that available with no anamorph or 1:1 anamorphic power and does not meet the present resolution specification. These results have been obtained by Itek, Air Force and Aerospace personnel. Recent data provided by Itek shows even poorer resolution than indicated earlier.

   b. Changing from 1:1 to 2:1 anamorphic power changes reticle plane field curvature by several diopters, thus making it impossible to simulate the ATS field curvature over a reasonable range of operational conditions.

   c. Changing from 1:1 to 2:1 anamorphic power changes off-axis resolution variation, thus making it impossible to simulate the ATS off-axis resolution variation over a reasonable range of operational conditions.

   d. Light scattering is apparently greatly increased off axis by changing from 1:1 to 2:1 anamorphic power, thus making it impossible to properly simulate scene contrast across the apparent field.

   This data indicates that valid information on crew performance cannot be obtained if the anamorph is driven during simulation.

3. The operational factors in favor of anamorphic lens use do not appear sufficient to overcome the concomitant loss in optical simulation fidelity. In particular, in regard to simulation of perspective change, we note that:

a. Nominal viewing time on the ATS is too short to permit significant changes in perspective.

b. For nominal initial viewing angles (45° stereo), the perspective change to nadir is small.

c. Driving the anamorphic lenses during track causes a continuously varying eyepiece field curvature and overall system resolution, conditions very different than expected using the ATS on orbit.

In regard to initial scene presentation, we note that while the proper viewed area can be shown,

a. The resolution on axis and across the field is not compatible with the ATS.

b. The variation of resolution with slant range is not simulated.

c. Field curvature is not simulated and varies from scene to scene.

It has been suggested that, while the anamorph should not be used for activity mode simulation, there are crew tasks where scene anamorphism is desirable. Unfortunately, no such tasks have been defined to date. In particular, for tracking tasks on ATS, perspective or perspective change is not significant, because tracking requires concentration on a small portion of the scene.

4. Despite previous agreements, the simulator optical train is being designed to provide maximum performance on axis with the anamorph at 1:1 power. We believe that this design approach penalizes system performance without the anamorph and cannot be justified on an operational or optical performance basis. The proper approach is to design the optical train for maximum performance without anamorph.