[redacted]

27 October 1964
[redacted]

TO: [redacted]

FROM: [redacted]

SUBJECT: VISUAL EVALUATION OF YAW PROGRAMMING ON MISSION 1009 (J-12)

The yaw programmer installed on the J-12 system was enabled for portions of Mission 1009-2. Operations during these times provided partial overlap with material obtained earlier in the flight. A detailed visual examination of the overlapping coverage was made in an effort to observe effects on image quality resulting from the yaw programming. This comparative examination was entirely inconclusive since the observed occurrence of fine image detail did not significantly correlate with the operation of the yaw programmer. Other factors, notably weather and illumination geometry, appeared to be of much greater significance for the available sample. Variability between the forward and aft pan instruments in recording the same small objects was also observed. Here again, weather and illumination geometry appeared to be significant factors, to the extent that any causes could be deduced.

Operations on Mission 1009 provided five pairs of passes with overlapping coverage for comparison of yaw programmer ON and OFF conditions, as follows:

Pass Number Yaw Programmer OFF	Pass Number Yaw Programmer ON
D-39	D-102
D-52	D-115
D-53	D-116
D-54	D-117
D-55	D-118

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Since all of these passes were in the stereo mode, there were in general four images to be examined for any given region of ground detail. Actually, more than three-quarters of the areas were rejected because of cloud coverage on one or both passes of a pair. Additional comparative material was rejected because, with a small percentage of overlap, two of the four images were in the soft spot region at the supply edge of format. This eliminated coverage south of approximately 40° to 45° north latitude. It should be noted that this also eliminated conditions of maximum yaw compensation, since the cross-track ground velocity was roughly proportioned to the cosine of the latitude. Finally, much of the remaining coverage was of semi-desert or other sparsely inhabited areas providing few interpretable objects for scaling and comparison.

A good example of the variability of detail encountered on pairs of prints is seen in a small town in the overlap area of frames D54 FWD 174 (yaw programmer OFF) and D117 FWD 022 (yaw programmer ON). Here, within a small ground area, the two passes have similar solar illumination conditions and both show many small objects. However, the viewing positions are quite different and some small fixed objects in each frame are not detectable in the other frame. In the case of groups of buildings with shed or gable type roofs oriented in the same direction that are well defined in one frame but not even detectable in the other, it is clear that detectability is primarily related to their relative orientation between the sun and the camera. These illumination conditions are illustrated in the attached diagram, which is typical of all Mission 1009 coverage that provides yaw programming comparisons.

The following data at 50° north descending is approximately correct for all of the comparative coverage passes enumerated above:

Altitude	101. N.M.
Slant Range to Targets	120. N.M.
Image Scale (at Target)	1/364,800
Velocity	24,850 fps
Yaw Angle	2.12°
Cross Track Ground Velocity	978 fps
Exposure Time	3.0 Msec.
Cross Track Ground Motion	2.9 Feet
Solar Elevation	47°

For the above condition, it is apparent that detection of yaw compensation effects cannot be expected, except perhaps on some statistical basis. Assuming that 0.7 resolution unit smear is allowable on high contrast targets, this would equate to a ground resolution (line pair) of 4.1 feet and an image resolution of 290 lines/millimeter, which is well beyond the bench capability of the system.

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It should be noted that the comparison conditions that occurred in this mission are not representative or indicative of the value of yaw programming for the system. The compensation of earth rotation is much more significant for targets close to the equator, near the center of format (near the ground track), and at longer exposure times. On pass D112, with the yaw programmer ON, exceptionally good quality results were observed with the following conditions.

Frame Numbers	FWD 010, AFT 016
Latitude	15° S
Altitude	154 N.M.
Slant Range	160 N.M.
Image Scale at Target	1/486,400
Velocity	24,100 fps
Exposure Time	5.0 msec.
Cross Track Ground Motion	7.35 feet

In this case the ground resolution limit (line pairs) due to uncompensated earth rotation alone would be 10.5 feet. The target areas included an airfield, a harbor facility, and a petroleum tank form. Within these areas, objects were observed with estimated dimensions of about four feet. While this is better than could be expected without yaw programming, there is no direct measure of the improvement because of the lack of any suitable comparative coverage.

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Performance Evaluation

APPROVED:

[redacted] Manager (Acting)
Operations & Analysis

Att (1)

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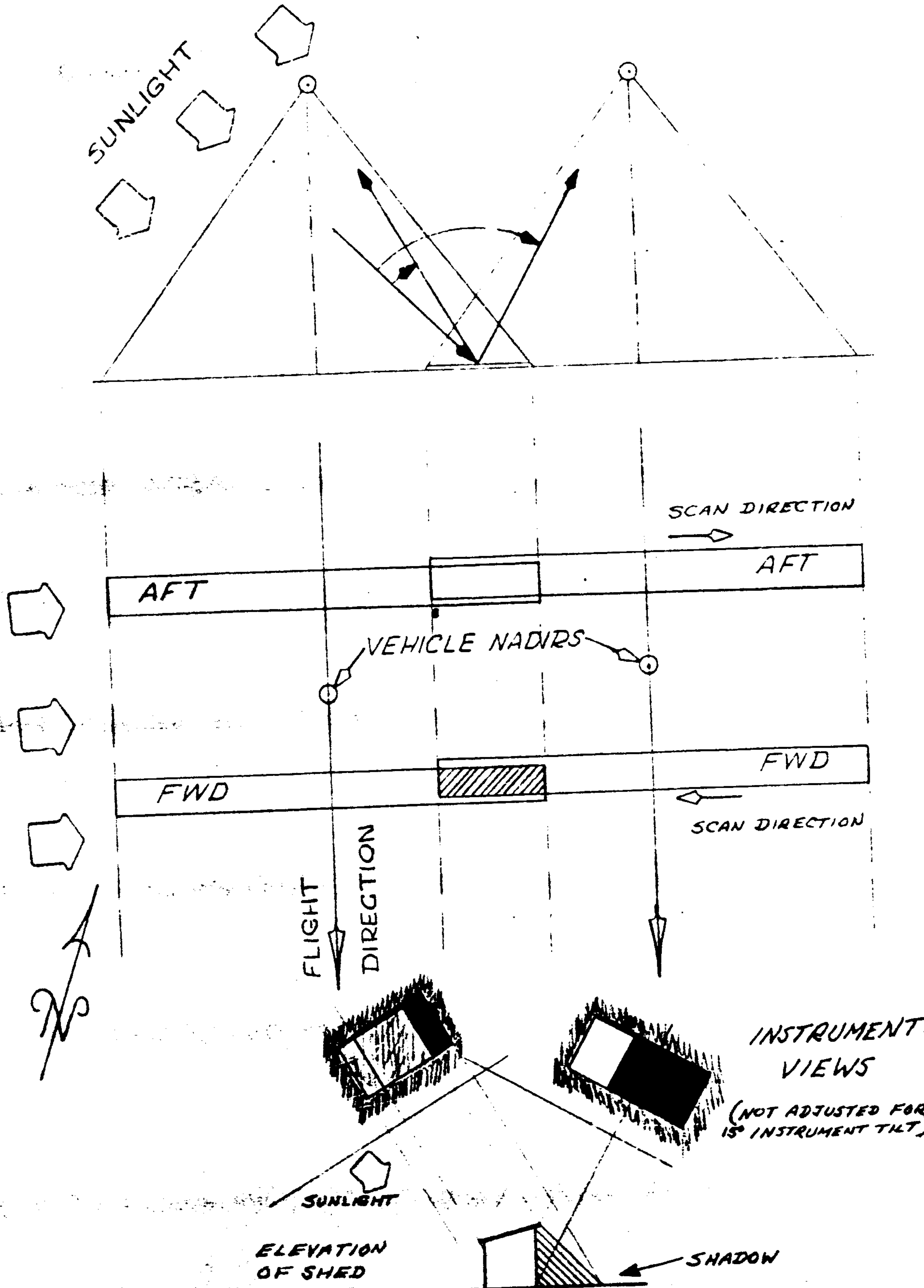
TYPICAL ILLUMINATION, MSN 1009

YAW PROGRAMMING COMPA' 'IVE COVER

Report



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