HANDLE VIA
[redacted] TALENT-KEYHOLE
CONTROL SYSTEMS JOINTLY

[redacted]

24 February 1965

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MEMORANDUM FOR: Director, (S) National Reconnaissance Office

SUBJECT: NPIC Requirement for Attitude Data

1. Measurement of photographic images is an integral part of the NPIC photographic interpretation activities. Requests for measurements are included in the majority of photo interpretation requirements levied upon the Center. To meet these requirements for measurements, the NPIC has developed a substantial capability, both in personnel and instruments. However, regardless of NPIC's technical capability to provide measurements, the precision of such measurements depends largely upon the quality of the photographic image and knowledge of the camera orientation and position. NPIC has continually stated the importance and need for precise camera attitude, has cited its requirements and has repeatedly worked for, or participated in, efforts to provide attitude data. Attachments one (1) through six (6) are examples of NPIC's participation in this work.

2. The application of precise camera attitude applies equally to both aircraft and satellite system. As photographic quality is improved, greater object detail is discernible resulting in increased requirements for accurate measurements. This, in turn, necessitates more precise camera attitude and position data. Thus, it is imperative that all photographic collection systems include a means for providing camera position and attitude data. NPIC has conducted studies to ascertain the degree of accuracy required in such data. For photography of the quality currently being exploited by NPIC, attitude is needed to an accuracy of plus or minus 15 minutes of arc or better. As improved camera systems are developed there will be a need for even greater accuracy, approaching five minutes of arc. Attachment one (1) is the report of a recent NPIC study of the effect of attitude upon measurements. There are other requirements for accurate camera attitude, as enumerated in attachment two (2). Exposure time is required to an accuracy of plus or minus two milliseconds. To assist in the rapid and accurate reduction of the exposure time, it would be most advantageous to have an error detection and correction coding system included, such as Hamming codes for the recording of time on the edge of the film.

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3. The present CORONA and [redacted] systems have a stellar/index camera that records information from which the attitude of the primary camera can be reduced. This method is dependent upon reading the exposure time of each frame of primary photography and interpolating the attitude for a large majority of frames, since the stellar exposures occur much less frequently than the primary camera exposures. More frequent stellar exposures are required to obtain an accurate record of the camera orientation, for vehicle perturbations are often irregular and cannot be determined with the current frequency of stellar exposures. The CORONA system also records horizon images from which pitch and roll, but not yaw, may be determined provided ephemeris and time data are available. While both of these sources of information are subject to malfunction, they do provide data from which the camera attitude can be determined to within an accuracy of 15 minutes of arc or better. To reduce the attitude from either of these sources as now done for the CORONA and [redacted] system requires a minimum time of 48 hours with the expenditure of more than 200 man-hours effort by NPIC for each mission. The OXCART collection program is utilizing the inertial guidance system to record data on a tape from which attitude can be reduced by computer within only a few hours after receipt of the data at NPIC. The characteristic drift associated with an inertial guidance system can be corrected by including a stellar/index system. By computing a relatively few stellar exposures the INS attitude readout could be adjusted.

4. In preparing to accommodate future operational capabilities, such as greater volumes of photography, more frequent inputs and a much shorter processing/interpretation cycle, the source of attitude data must be designed to permit correspondingly voluminous, rapid reduction of pitch, roll and yaw. To accomplish this, serious consideration should be given to development of a means to record attitude data on magnetic tape or the edge of the photography. Such data should be in a form and code that permits automatic computer or instrument readout, conversion and tabulation of actual attitude values for immediate use. NPIC considers accurate, timely attitude an absolute necessity in fulfilling the photographic interpretation mission.

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ARTHUR C. LUNDAHL
Director

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Attachments:
[redacted] (Nov. 1964)
(Mar. 1964)
(Feb. 1964)
(Oct. 1963)

[redacted]