

ELECTRON BEAM RECORDER IMAGE CORRECTION FOR ERTS

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Video data from the Earth Resources Technology Satellite (ERTS) are entered into the initial image generation system at the Goddard Space Flight Center. The data are placed on film using an electron beam recorder (EBR). If the video data were applied directly to the EBR, both radiometric and geometric errors would result in the output film imagery.

To correct for these errors, a hardware unit called EBRIC was designed, fabricated, and incorporated in the image processing system. EBRIC is an acronym for Electron Beam Recorder Image Corrector. It operates under the control of a process control computer, as it varies the video signal and the x and y deflection signals of the EBR.

EBRIC corrects errors that basically fall into three categories: static, slow varying, and dynamic. Figure 1 gives examples of error conditions for each of the categories. An example of a static error condition is the multispectral scanner mirror velocity profile. Slow varying conditions are those that are nearly systematic, but tend to drift over a period of several weeks. An example here is the boresighting of the sensors with respect to each other, and with respect to the spacecraft attitude measurement system. Dynamic conditions are those that vary from frame to frame or within a frame, such as multispectral scanner attitude variations that are caused, for example, by spacecraft roll.

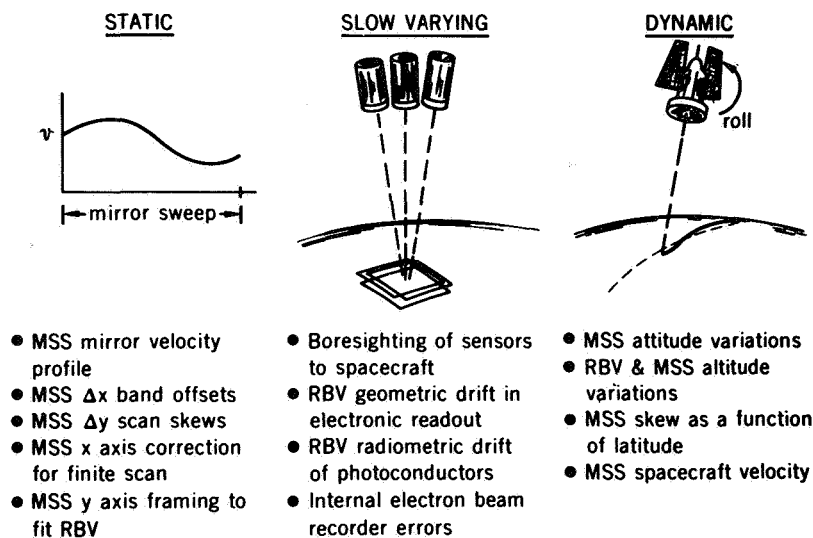


Figure 1. Error categories.

Resident in the core of the process control must be all information necessary to perform correction at the time video data are being processed. The manner in which this information is entered depends on the category. Referring to Figure 2, the static information is entered before launch by parameter card. For the slow varying conditions, the information is brought in from a computer tape (called an EBRIC tape) prior to video processing. For the dynamic conditions, another computer tape is used concurrent with processing. This tape has been named the image annotation tape. It is generated in another segment of the NASA data processing facility where both orbit data and spacecraft attitude data are merged.

The process control computer absorbs this information as needed and sums it in appropriate order. Then, in proper sequence and time, the computer delivers correction coefficients to EBRIC. This function is performed as the video data are being processed through the controller to EBRIC, where the EBR video and deflection signals are being altered to permit generation of a corrected film image. Except for Canadian data, the system shown in Figure 2 processes 100 percent of all received ERTS video data.

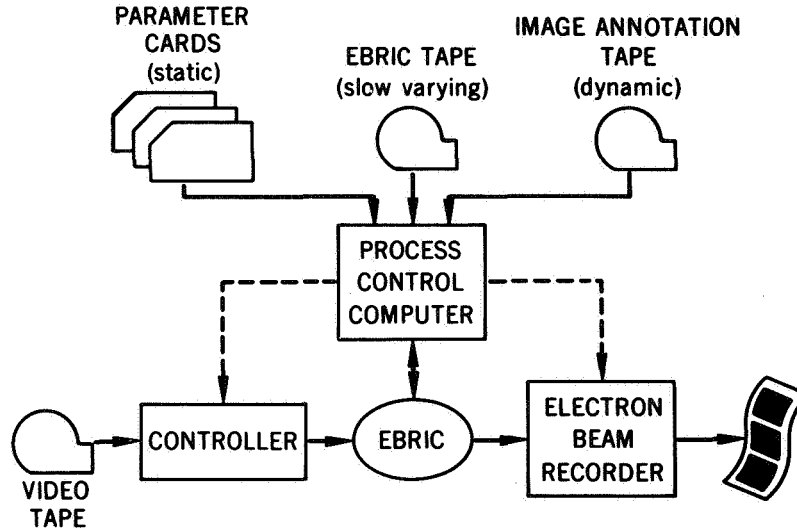


Figure 2. Initial image generation subsystem.

The EBRIC tape is generated using the EBRIC loop as shown in Figure 3. Here, another subsystem is used to calibrate the entire system. By processing video tapes through EBRIC in a nearly normal fashion (using a current EBRIC tape), a film copy is generated. After photo processing, the image is entered into viewer-scanner equipment within the scene correcting subsystem. The viewer-scanner equipment operates with its own dedicated process control computer as it measures the radiometry and geometry of the image. Automatically, a new EBRIC tape is generated which reflects changes which have occurred over the past several weeks. This new EBRIC tape is then brought into the initial image generation system where it becomes a current work tape for one or two weeks.

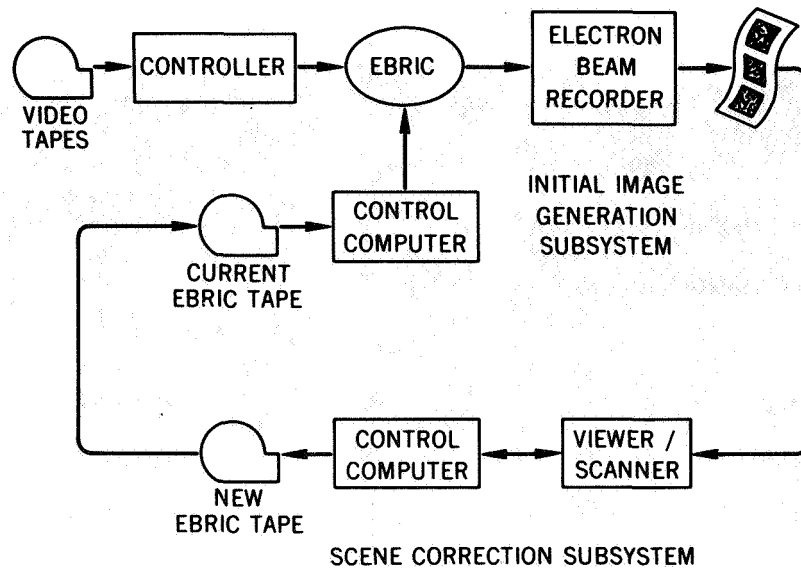


Figure 3. EBRIC loop.

In Figure 4 is shown an example of EBRIC correction. On the left is an uncorrected multi-spectral scanner image of southern California. On the right is a corrected image. There are many corrections in the picture on the right. The only one immediately obvious is that of skew; and this is put in by EBRIC to compensate for earth rotation as a function of latitude. As a measure of performance, USGS measured an ERTS image and found that the geometric correction given by EBRIC was within 70 meters rms.

In summary, an on-line correction capability has been satisfied by the design and implementation of EBRIC; and by the way in which EBRIC is configured with the total ERTS system at the Goddard Space Flight Center.

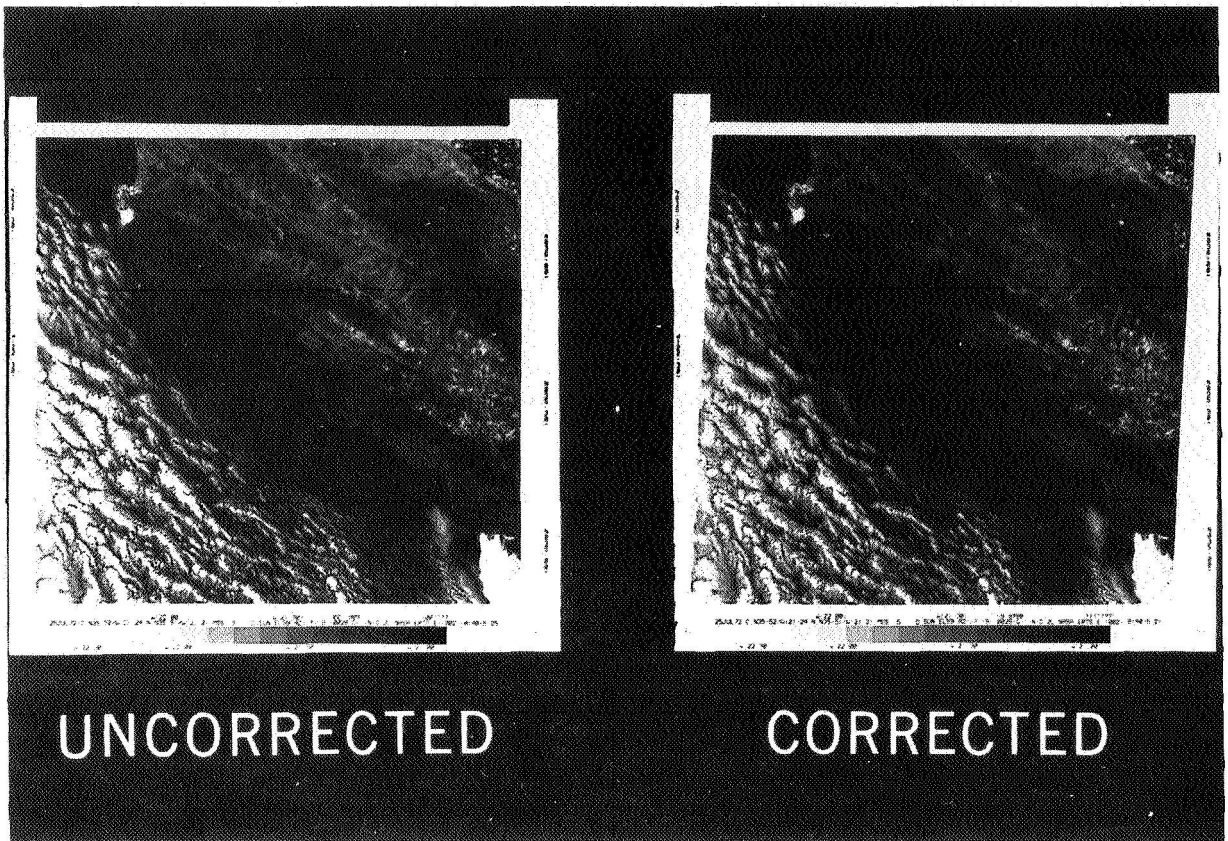


Figure 4. Example of EBRIC correction.