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NASA TECH BRIEF

Lewis Research Center

Vertical Copy Camera System Provides Photographs from ERTS-1 Imagery

The Problem:

Many investigators have found it difficult to make useful photographic enlargements, or even copies, from the 70 mm negatives generated from the data from the ERTS-1 (Earth Resources Technology Satellite) scanner. The difficulty arises because these negatives appear very dark, especially for bright scenes where density range on the negative may be between 1.7 and 2.4. The negatives are necessarily dark in order to accomodate the wide range of scene brightness sensed in each spectrum band by the satellite. The transmitted data are converted to a 70 mm positive master, and the densities in it are duplicated in the negative without tone distortions.

On the other hand, ERTS-1 imagery is available as 240 mm (9.5 in) positive transparencies with densities that are in ranges generally usable with conventional photographic techniques. These more familiar density ranges are produced with the aid of computer processing.

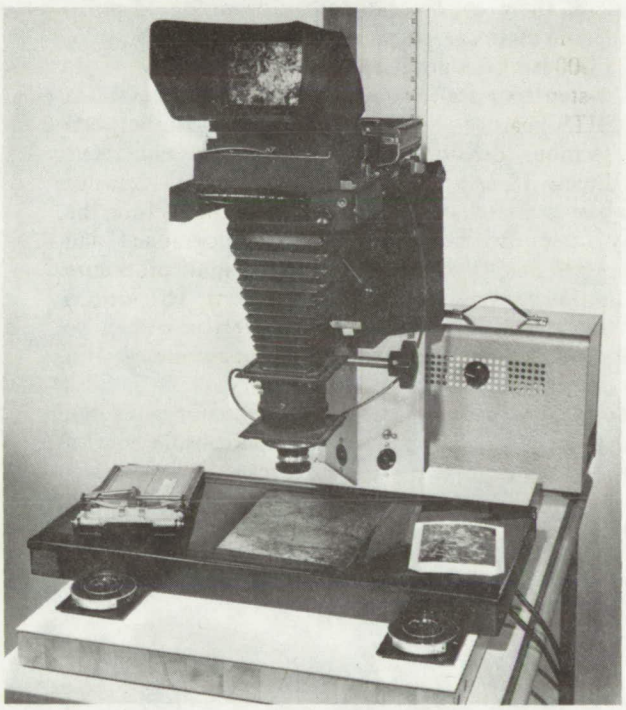
A further problem for many users, not only of ERTS-1 imagery, but others, is that for enlargements, prints or reductions, large transparencies usually require expensive equipment that is not generally available.

The Solution:

A relatively low-cost, portable, commercially-available vertical copy camera and light source are used to provide high quality negatives and/or prints from 240 mm positive transparencies. Negatives or prints with familiar, or more normal, densities can conveniently be obtained from ERTS-1 240 mm positive transparencies this way. Any photographic practitioner working with large transparencies, positive or negative, should find the equipment and method useful.

How It's Done:

A typical commercially available vertical copy camera system is shown in the figure. The high intensity uniform surface illumination is provided by a 25 x 50 cm (10 x 20 in), 15,000 candles/m^2 (4500 foot lambert), spectrally flat light source located on the baseboard of the vertical camera assembly. A standard 240 mm ERTS-1 positive transparency is shown positioned on this illuminator.



ERTS-1 240 mm positive transparencies were selected because unlike the 70 mm negatives, their densities lie more within the range usable with conventional photographic techniques.

The versatility of this camera system permits a wide range of enlargement (up to 10X) and reduction (down to 1/8) to be achieved with standard lenses. The use of readily available and easily interchangeable camera backs permits photographic formats from 35 mm to 10.2 x 12.7 cm (4 x 5 in) and permits black and white and color films and Polaroid materials to be used with ease. For example, with the above described system and using Polaroid materials, black and white prints magnified 10 times were regularly produced within minutes for detailed area analysis. For greater magnification and multiple reproductions, the Polaroid print material is easily replaced with

(continued overleaf)

Polaroid positive/negative material or conventional film to yield an average gradient negative which can be used for reproduction.

Notes:

1. The contrast of the resulting copy camera negatives (generated from the ERTS positive transparencies) can be enhanced to various degrees by the use of different films, developers, and exposures. Additional enhancement can be achieved by the use of variable contrast papers and filters in the printing stage. Polaroid print densities and contrast can also be controlled by means of exposure.
2. The photographic scale of the original 70 mm ERTS imagery is 1:3,369,000 while the 240 mm ERTS imagery is produced at a scale of 1:1,000,000. Ten times enlargement of the 240 mm transparencies results in a scale of 1:100,000. Subsequent enlargement of these copy negatives can be produced up to the point of image degradation. Imagery at a scale of 1:25,000 has been produced.
3. A 15-step gray scale tablet is exposed on every frame of ERTS imagery to indicate the relationship between the various densities within the image and scene brightness. If, as a result of selected area enlargement, the gray scale tablet is not included in the picture, the gray scale can be subsequently photographed and processed employing the same photographic procedure as used in making the initial enlargement. The various shades of gray in the enlarged imagery can then be compared with the radiometric values associated with the density levels in the original imagery.
4. Employing a variable intensity illuminator gives the added versatility of allowing greater exposure control with low density positive transparencies.
5. A vernier table can be employed in conjunction with the illuminator for precision position of 240 mm transparencies.
6. No additional documentation is available. Specific questions, however, may be directed to:
   Technology Utilization Officer
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   Reference: B74-10009

Patent Status:

NASA has decided not to apply for a patent.

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