Remote Sensing Image/Map Position Locator

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PROBLEM

When attempting to locate features between Landsat imagery and a map or aerial photograph, one often finds it impossible to localize the specific feature or area with any certainty. On Landsat imagery one may observe only tone or color, whereas a photograph or a map may add to these the more recognizable detail of shape to objects that are not resolved on satellite imagery. The same situation can occur between an aerial photograph and a map, where recognizable objects on the aerial photograph are not represented symbolically on the map. This dilemma has confronted me often in past project work, but the problem was especially evident during a recent project in East Africa, where most satellite imagery is interpreted manually and where aerial photographs may not be available to translate between a satellite image and the ground.

SOLUTION

My initial solution was to measure distances and directions from two to three known points on the satellite image and convert the distances to the scale of any map available using proportional dividers. But this seemed tedious and time consuming, especially when working in the field. After a few weeks of consideration I realized that for any set of points in their true horizontal position I was essentially just changing scale and that a triangulation or radial line plot technique would work. I drafted a number of protractors of various sizes until I arrived at the design portrayed in Figure 1—a 90° protractor with azimuth or radial lines every 5° and scales along the lines in millimetres from the origin.

To use the locator, place it on a Landsat image and locate three features on the image which you can also locate on a map and which preferably surround the "point of interest," i.e., a point which you cannot clearly locate on a map or the ground. Rotate the "locator" until an azimuth line goes through each of the three points. With a marking pen or china marker check those three lines, then put a mark at the "point of interest." The next step is to go to a map of any scale (larger or smaller), but one which will accommodate the three known points within the physical size of the "locator." Align the three azimuth lines previously checked through the corresponding three points which you identified on the Landsat image.

To find the true position of the "point of interest," you must convert for any change in scale between the Landsat image and the map and move the point of interest in or out along its radial line an appropriate distance. To determine the correct distance along the radial line, use the formula

$$y = \frac{X}{Y} \cdot x$$

where y = the distance of the "point of interest" from the origin along the radial line on the image/map where the point is to be clearly identified,
x = the distance of the "point of interest" from the origin along the radial line on the image/map where the position of interest is marked,
Y = scale reciprocal of the image/map where the point is to be clearly identified, and
X = scale reciprocal of the image/map where the position of the point of interest is marked.

For example, if we are attempting to locate the map position of a point from a 1:500,000 Landsat image (X) on a 1:250,000 scale map (Y) and the distance out from the origin on the locator laid over the Landsat image is 47 mm (x), then the map distance position (y) is

$$y = \frac{500{,}000}{250{,}000} \cdot 47 \text{ mm}$$

$$y = 94 \text{ mm}$$

USES

The "locator" can be used for any combination of

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0099-1112/86/5202-197$02.25/0

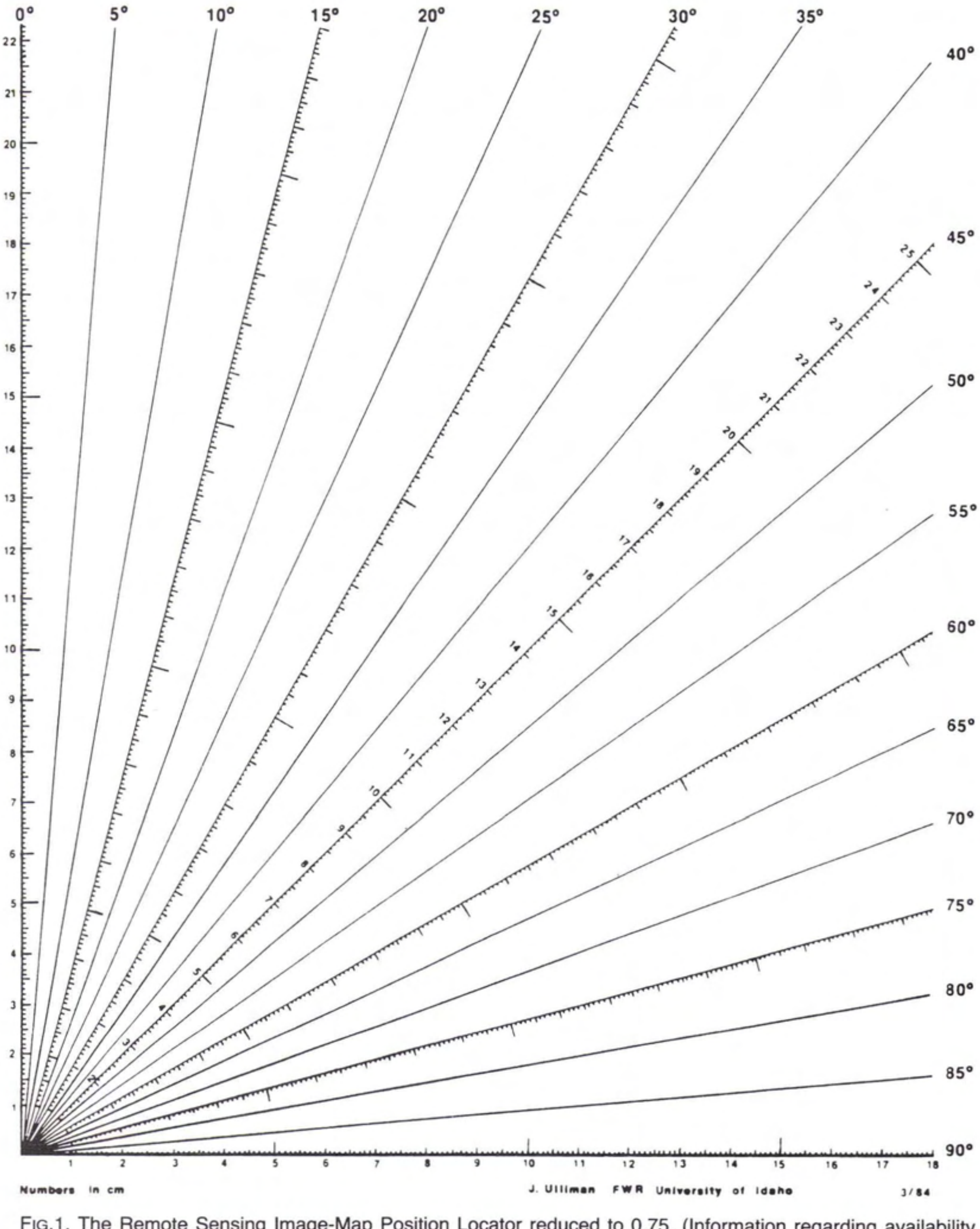

FIG.1. The Remote Sensing Image-Map Position Locator reduced to 0.75. (Information regarding availability of the Locator may be obtained from the author.)

images or maps (e.g., translation from Landsat images to aerial photos or maps or vice versa; from aerial photos to maps or vice versa; from maps to maps). Of course, one must be concerned about displacement in an aerial photograph, and if there is such, one must attempt to select points of equal elevation or center the "locator" origin over the principal point of the photograph (with no tilt) or otherwise recognize there may be some error in position location.

Locating points between two discrepant scales will depend on the physical size of the "locator," essentially the length of the azimuth lines. For the initial model I designed a locator for 8 by 10-inch Kodalith, in which case a factor greater than four between the image or map cannot generally be accommodated.

ACCURACY

The accuracy of this method will depend upon

- How well one identifies and locates the three known points between the two images;
- How well one aligns three azimuth lines through those points.
- How accurately one locates the "point of interest," its distance along the radial line, and determines the true position distance.
- How much displacement or geometric distortion there is in the image; and, of course,
- How accurate the map is.

In Kenya we found practical application of the locator very useful and accurate enough for most of our work, which mainly included locating points from Landsat images on a map, then on the ground for verification. However, we also found major errors in maps—needless to say more.

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New Sustaining Member

Earth Observation Satellite Company

4300 Forbes Boulevard, Lanham, MD 20706; (301) 552-0500

EARTH OBSERVATION SATELLITE COMPANY (EOSAT) was formed to commercialize the civil operational land remote sensing system, Landsat, for the purpose of continuing to provide high resolution space acquired data. Formed in 1984 as a joint venture by Hughes Aircraft Company and RCA Corporation, EOSAT is responsible for the operation of Landsats 4 and 5, and is the primary point of contact for marketing, ordering, and distribution of data from these spacecraft.

EOSAT has begun construction of the next generation, commercial Landsat spacecraft, the first of which is scheduled for launch in 1988. The new Landsat spacecraft will provide continuity of Thematic Mapper (TM) and Multispectral Scanner (MSS) products, and will serve the full community of Landsat users and introduce new applications of remotely-sensed data. The Advanced TM will provide extended capabilities in the form of 15-metre resolution with a new panchromatic band on Landsat 6, and Thermal Infrared capability providing 60-metre resolution in the 8 to 11.5-micrometre bands planned on Landsat 7.

The Commercial Ground System is located in the continental United States, and is used for communicating with the Landsat satellites, operating and controlling the satellites, managing the mission, and processing the received sensor data. Facilities include a Headquarters, Marketing, and Processing Center in Lanham, Maryland; a Satellite Operations and Control Center in Princeton, New Jersey; and a Data Receiving Center in Norman, Oklahoma.

EOSAT will maintain open, equal, non-discriminatory distribution of unprocessed data to all users. The operation of 13 international Landsat receiving stations ensures continuity of data, which EOSAT plans for use throughout the world in the development of renewable and non-renewable resources.