Practical Paper

Millimetric Coordinates (MMC): Communication and Teaching Aid

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COORDINATE SYSTEMS provide spatial communication for a wide variety of situations, including teaching, research, military actions, travel, and legal descriptions. Maps furnish coordinates of "absolute location," but such is not the case with most aerial photographs and other remotely sensed images that have scale variations, radial displacements, and no easy way to establish an accurate north axis on each of many thousands of images. Therefore, several methods of indicating objects by "relative location" on images are in use, including (1) finger pointing, (2) verbal description, (3) comparison with map coordinates, (4) coordinates printed on image margins, (5) printed indicators of specific locations, and (6) transparent overlays. The problems associated with these methods include (a) lack of precision, (b) verbosity of communication in one language or difficulties between languages, (c) lack of corresponding maps, (d) printing costs, (e) obstruction of the image by overprinting, and (f) special instruments or materials. These problems are overcome in a coordinate system not previously formalized or utilized sufficiently to have become part of the textbooks and training in remote sensing.

The system of Millimetric Coordinates MMC is designed to give precise point locations on aerial photographs, other images, and small maps when both the communicator (teacher, author, officer) and the recipient (student, reader, soldier) have in their possession identical images and a ruler marked in millimetres.

Step One: Verify that both parties have identical images and that each image has the same sharply defined straight margins between the actual image and the border. Teaching sets and published images fulfill these requirements, as does Figure 1.

Step Two. The communicator specifies the image orientation. For published materials this is usually predetermined by the author when deciding the image position on the page. With aerial photographs, the communicator specifies one of the four corners into which the photograph number is to be located by rotating the image. In Figure 1, the number has been placed in the lower-left corner (L-L), as opposed to the U-L, U-R, and L-R alternatives that could have been selected because of the flight line or shadows.

Step Three: The communicator selects an object or a location for which the coordinates are desired. (In an introductory situation it is preferred that the first object be distinct and in the upper right-hand quadrant of the image, but that is not a requirement.) The communicator measures in millimetres the distance from the left-hand margin (and parallel to the lower margin) to the object, stating that number in three digits. If the measurement is less than 100 millimetres, a zero precedes the other digits. In a similar fashion, a second measurement is made perpendicular from the lower (inferior) margin upward to the object. Special note: The measurements are made from the boundary of the image with its border and are not made from the cut edge of the paper or film.

Step Four: The coordinates are written with the prefix "MMC" before the first three-digits (the measurement to the right), which is followed by the second three-digit (measurement from the lower margin). Spaces are optional. Examples: MMC 158092; MMC 007 139; MMC143213.

With this simple explanation plus the example in Figure 1, the vast majority of users will understand the system and be able both to locate positions for which coordinates are given and to specify coordinates of other objects.*

Notes: (1) All of the Millimetric Coordinates on a aerial photograph will be different if the photograph is rotated to place the number in another corner of the image.

(2) For images in which the margins do not form right-angle corners (e.g., Landsat), do not measure perpendicular to the slanted left margin.

(3) When images lack distinct margins or have been cut, the communicator can mark each copy with identical artificial axes for the left and lower margins.

(4) Accuracy to quarter millimetres can be estimated by using a fourth digit of 0, 2, 5, or 7. Do not use 25 or 75 (for one-quarter and three-quarters) because that would mislead the true accuracy. Example: MMC 1337 2120 (The image is assumed to be smaller

* A more detailed explanation for classroom use can also be obtained from the author. Unrestricted reprinting of this article is granted provided that the author and journal are acknowledged on each copy.

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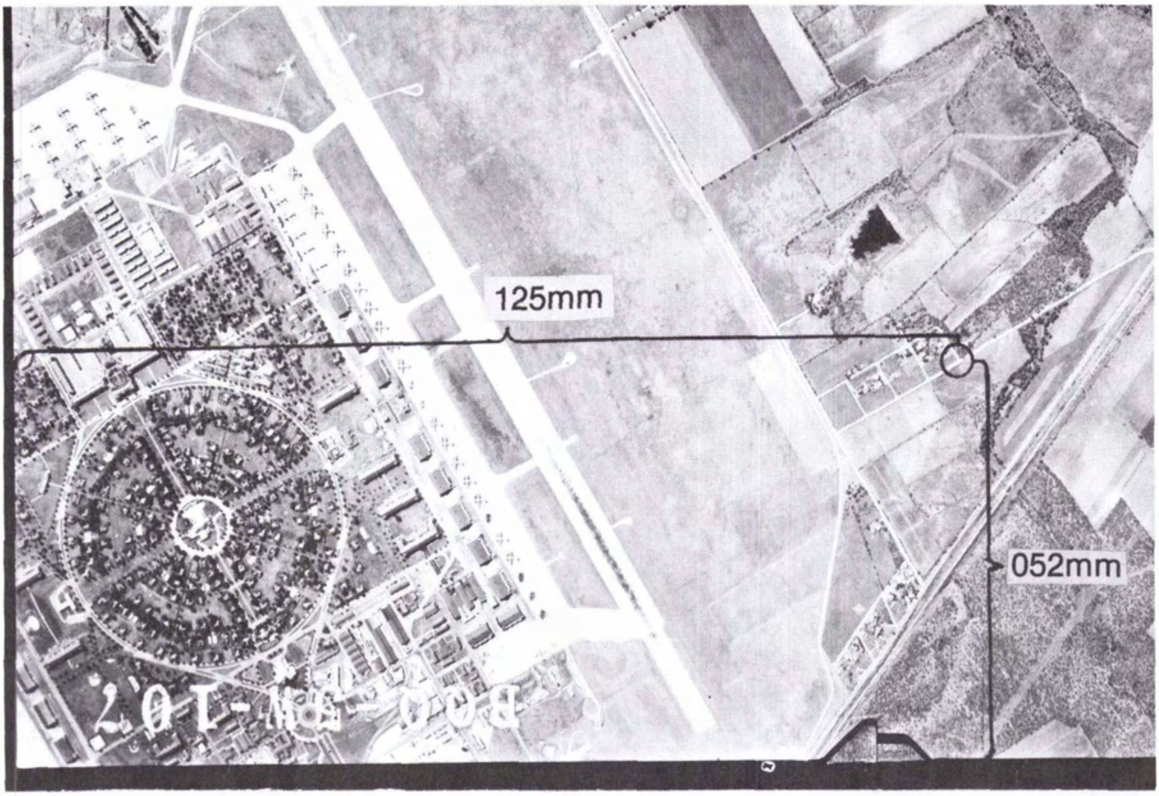

For MMC verification, this line should measure 100 mm.

FIG. 1. An example of the system of Millimetric Coordinates (MMC). With the photograph number BQQ-5W-107 in the lower left (L-L) corner, the road junction within the circle has coordinates MMC 125 052. (The MMC verification line will reveal any scale change from the printing process.)

than one metre in either direction; if larger, a special note should be given by the communicator).

(5) Disregard any irregularities because of fiducial (collimation) marks in corners or edges. Treat the margin as a *straight line*.

(6) Because reproduction can alter an image scale, authors using MMC in submitted articles should include an "MMC verification line" to be printed together with the image (see Figure 1).

(7) *To identify a line, use two MMC positions;* to designate an area, specify the radius of a circle around the MMC position or simply describe it: e.g., the triangular shaped field around MMC 112 024 in Figure 1.

The Millimetric Coordinates method is analogous to the UTM coordinates which uses the "over and up" method for "eastings and northings." However, MMC is more general in three important ways:

- Cardinal directions are immaterial (for example, north is not known in Figure 1);
- Image scale is inconsequential (for example, the same image reduced or enlarged has completely different coordinates); and
- The point of origin (MMC 000 000) is determined independently for each image by the communicator or photographer, not by the earth or objects shown.

The Millimetric Coordinate method is based on the long established fundamentals of cartesian coordinates and is therefore easily taught, remembered, and utilized. Because it involves virtually no cost, uses ubiquitous decimal-based metric rulers, and appears to have a niche to fill for education and publications, MMC should become a useful tool for remote sensing.

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