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REMOTE SENSING IN MAP COMPILATION AND REVISION

ABSTRACT

Landsat I and II satellite informations were largely used in various field of activity, among which map compilation and updating hold its special attitude. Photogrammetric methods and equipment acquiring about a 65 m accuracy were used, thus enabling the possibility to compile and up-to-date maps as far as a 1:200,000 scale.

Some remarks related to the new sensor generation features and efficiencies reaching about a 10 m geometric resolution were made, considering remote sensing data possibilities and limits as regards cartographic purposes.

Some problems concerning error sources to be taken into account are analysed and the technology to compile and up-to-date maps as far as a 1:25,000 scale is established, when the above mentioned information accuracies are attained.

The use of the technological satellites equipped with sensors to collect data on the Earth surface and their receiving and processing by the ground stations give the possibility to apply them to various fields of activity, among which cartography plays an important part.

This situation arises because photogrammetry, which has many common points with remote sensing is, now, used in map compilations.

We must say that whatever technique is used to obtain data for

map compilation, they must answer requirements necessary to solve the same problems related to cartographic projection, topographic and thematic content, measurement accuracies , scale, a.s.o.

When data are collected by sensors as aerial metric cameras mounted on aerial or space platforms, which record images as central perspective, problems concerning data uses in map compilation belong to photogrammetric field of activity.

Besides aerial metric cameras, remote sensing uses other many sensors mounted on technological satellites recording in different zones of the electromagnetic spectrum simultaneously, collecting a lot of data, as well.

Data variety, large surface coverage in a short time and recording sequences are the advantages which remote sensing has. Their use is,also,a new stage of cartographic field of activity, as it was photogrammetry in comparison with topography in its early stage.

In the present-day remote sensing development,data recordings are provided by multispectral scanning sensors.

After a preliminary processing,aimed at carrying out some necessary geometric and radiometric corrections,data are supplied as magnetic tapes or images of some terrestrial areas to the interested users.

An image obtained by multispectral scanning is regarded as a two dimensional surface composed of pixels,each having proper geometric and radiometric features. Recorded image is related to the ground it represents, using the following expression:

$$(x,y) = T\ (X,Y)$$

in which:

x,y are the image point coordinates

X,Y are the ground coordinates corresponding to image points.

T transformation contains data regarding to:platform attitude as against terrestrial surface; image recording system features;terrain topographical features;illumination and weather conditions during recording; other image distorsion sources.

Such factors act as geometric transformation sources within the image field or as radiometric transformation sources modifying gray levels of the respective pixels, in accordance to their own features.

Geometric transformations establishing space connections between the recorded picture and pixel positions within the image field belong to cartographic representations,while radiometric transformations affect semantic information quality,which interest remote sensing applications to a great extent.

Besides the above mentioned transformations, other important systematic errors should be removed, to obtain a proper geometric representation.

Map compilation based on space multispectral scanning images requires T transformations and the above mentioned systematic error removals.

To this end,elements to establish rigorous spacecraft attitude on its tracking, during data recordings,should be well known.

When these rigorous data are not available,some control points common to image and the existing cartographic representations are used in map compilation,employing photogrammetric methods and space non-conventional images, as well.

Ensuring correspondance among homologous point categories, as regards their number and distribution within the image field and the existing cartographic representations,map compilation could be achieved,using rectifying or photogrammetric plotting methods. At the last years, these proper photogrammetric methods have been in current use, in order to compile maps based on images recorded by multispectral scanning sensors, which were mounted on Landsat satellites. So, some experimental works, using Landsat II satellite images, taken over South - East Romania, have been made in order to establish a technological process suitable for the known methods and the existing photogrammetric equipment, aimed at acquiring final result accuracies and the best scales in map compilation [1] . Copies of these enlarged images and the existing 1:50,000 scale topographic maps of the considered area have been used to identify

categories of topographic details as a relative homogeneous control point network having a 62.5 m mean square error, as regards the accuracy obtained and topographic detail resolving power respectively, 1:1,000,000 scale images have been used to compile 1:200,000 topographic and thematic maps,employing the established methods (Figure 1).

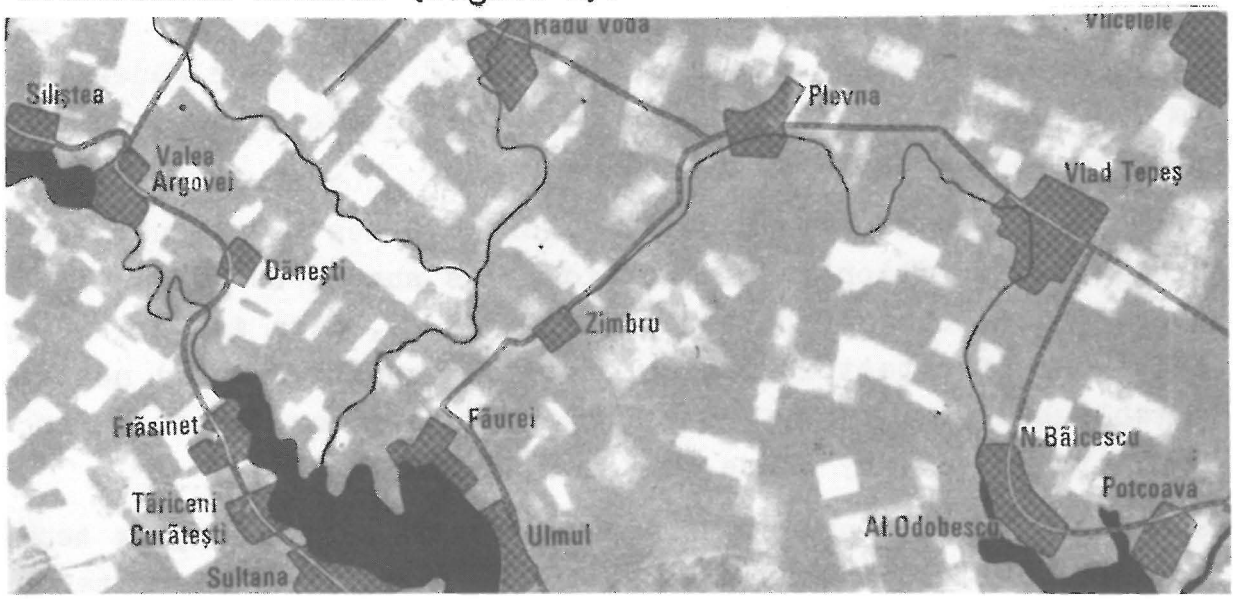

Figure 1. Sample of 1:200,000 scale map compiled using rectifying method, based on 1:1,000,000 scale satellite images.

Looking after the use of these multispectral images recorded by satellites to become operational in map compilation, considering larger scales than those underlined,image accuracy and resolving power should be increased to a large extent. Having this aime in view, sensors recording data,using technological satellites, should be improved. Optical - mechanical scanning sensor improvements have resulted in "Thematic Mapper" sensor, having a 3o m geometric resolution and 7 narrow spectral bands and 256 sensibility gray levels [2] . This sensor is to be used from 1981. Although "Thematic Mapper" performances prove the respective recordings to be useful in as far as 1:50,000 scale map compilation and updating, they, also, show limitations in the optical-mechanical scanning sensor developments. The new generation of sensor built on silicon solid-state linear arrays and which operates in a "pushbroom" scan mode provide a geo - metric fidelity for performances which"Thematic Mapper" has

attained.

As it was shown in [2] , in experiments related to sensor built using the above mentioned principle, about a 10 m geometric resolution has been attained; it answers accuracy and fidelity requirements in as far as 1:20,000 scale map compilation and updating.

As it was mentioned, the main feature of new sensor generation is data reception, using solid-state detectors mounted, corresponding to the spectral recording bands.

Although these sensors have superior features as against the previous generations, some difficulties should be taken into account in recording calibrations; that is, data is derived by thousands of detectors, which geometric position could not be established rigorously and radiometric detector features on each array are very close, but not identical.

Concurrently with new sensor generation achievements, new technologies and equipment suitable to use remote sensing data as images and magnetic tapes - in middle scale topographic map compilation and updating should be expected.

Two technological processes considering remote sensing data features are outlined, in order to process remote sensing data required by topographic and thematic map compilation and updating. A diagram showing main stages of an usual photogrammetric process, liable to be improved, which will be used in daily analogical data processing and non-conventional space image, respectively is presented in Figure 2. To use efficiently such a process, we need suitable equipment able to plot small scale (1:1,000,000) non-conventional images, in order to compile middle scale (1:50,000 and 1:25,000) maps, considering as far as a 40 x total increasing ratio and the important systematic errors. In this respect, analytical photogrammetric method advantages are appraised, emphasizing that their use is not limited by a certain transmission ratio among image scales and map scales and computations can remove systematic errors.

As regards data processing recorded on CCT tapes, a new technological process is proposed, which main stages are presented

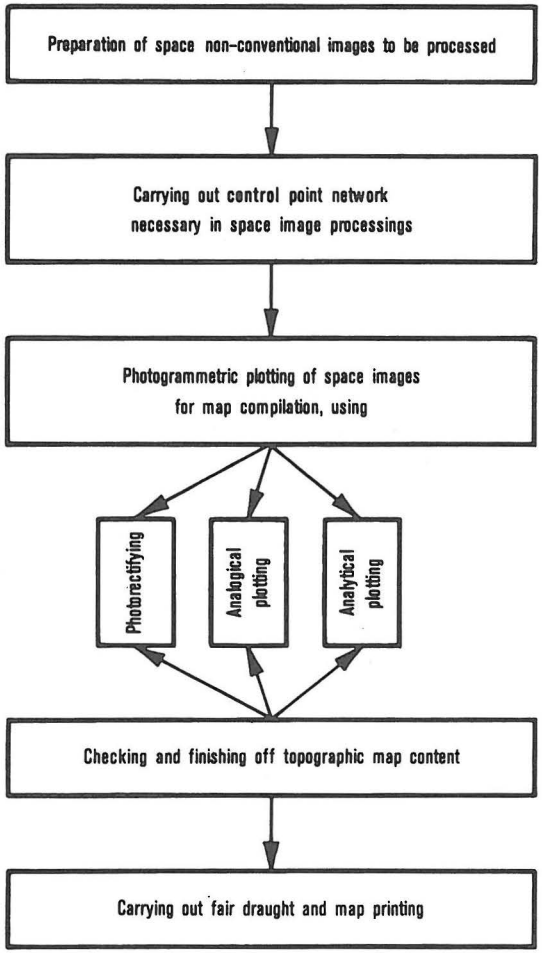

Figure 2. Space non-conventional image processings to be used in map compilation

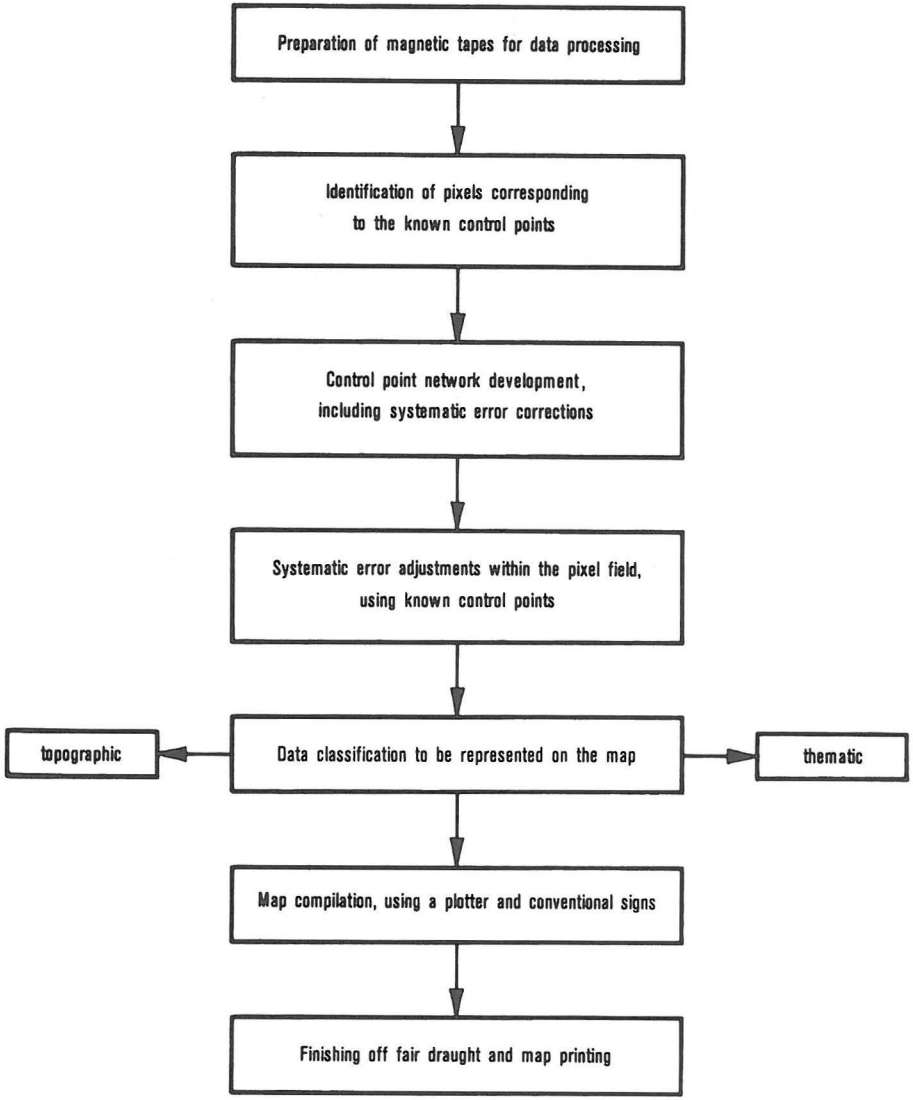

Figure 3. Digital remote sensing data processing to be used in map compilation

in Figure 3.

Because a main cartographic concern is the rigorous scale geometric representation of the topographic and thematic map content, the achievement of a rigorous control point network necessary to adjust the whole image pixel field is required. With this aim in view, known control points common on topographical maps and on images are identified; they are bridged using computation of a network configuration corresponding to the bridging of the systematic errors of the whole pixel image field, as it was mentioned above.

Various supervised and non-supervised classification systems are used, to establish topographic and thematic map content.

The respective topographic and thematic content, having applied the corresponding geometric corrections, is compiled using a plotter, considering the required scale and map specifications.

Among the achievements related to image cartographic repre - sentation, SPADAM - automatic digital multispectral data processing system is mentioned. This system is carried out by the Institute of Geodesy, Photogrammetry, Cartography and Land Management [4] . In SPADAM system designing, Felix C - 256 computer and ARISTO - plotter have been used.

Fair draught development requires checkings up of the topo - graphic and thematic content and ways to represent it on the map, using various existing data and documentation.

Relief representation can be achieved by transposing contour lines of the existing maps, using proper cartographic methods.

The present-day stage of remote sensing data processing related to cartographic applications is a new development stage being, especially, used to compile small scale topographic and thematic maps; these maps are employed in natural resource inventories, in difficult of access and unknown geographical areas.

The improvement of geometric and radiometric accuracies to represent pixels within the image field and methods and equipment used in efficient remote sensing data processing, as re-

gards cartographic applications, give the possibility to generalize middle scale map compilation mentioned above, using the new methods. It is, also, the 1980s requirements regar - ding this field of activity.

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