THE INTEGRATION OF DIGITAL PHOTOGRAMMETRIC DATASETS IN GIS

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***Abstract**: The Datasets that are entered into a GIS can come from many different sources and may be of varying quality and can be obtained from existing sources such as maps, aerial photos, satellite images, engineering plans, and other documents and files which were produced for other purposes.*

The GIS is a computer system designed to allow users to collect, manage, and analyze volumes of spatially referenced and associated attribute data.

A GIS incorporates software for manipulating spatial data with database management software. This combination enables the simultaneous storage, retrieval, overlay, and display of many different spatially data sets.

Photogrammetry plays a very important role in the collection of information for most GIS databases producing a tremendous amount of information.

***Keywords:** photogrammetry, GIS, spatial data, aerial photos.*

1. Introduction

The data which are integrated in a GIS come from different sources and likewise they can be of different qualities. Thus it is imperative to differentiate between the acquisition of new data and the existent ones.

Photogrammetry and remote sensing play an important role in the acquisition of spatial data for most of the GIS database, irrespective of the way in which acquisition is made. The photogrammetric products, which are more frequently used as data for GIS, are of two types: images and digital data files, respectively. The products which belong to the image category include: aerial photographs, existent maps, mosaics, ortophotoplans, and satellitary images. These images or certain selected elements can be digitalized and stored a database.

The photogrammetric data digital files contain digital elevation models (DEM), linear digital data (DLG-Digital Line Graphs), transversal sections and profiles. The digital elevation models are digital recordings of the land elevation, facilitating the creation of a third dimension and offering the possibility to have a spatial land description. For a given X, Y position on the land, only one value can be deduced, i.e.: Z.

These digital photogrammetric files data will contain not only positional information for every point or land characteristic (coordinates X, Y, Z in the reference system), but also one or more associated codes which identify the point type or the type of the respective characteristic.

2. Additions

There are two types of data used in GIS, i.e. spatial and nonspatial.

The spatial data, sometimes also called ***graphical data,*** generally contain the land characteristics that can be represented on maps by lines or symbols or can be seen in photographic images. In a GIS, these data can be represented and located spatially, in a digital format, by using a combination of fundamental elements, called simple spatial objects or *primitive graphs.* The formats used in this representation are either *vector* or *raster*. The relative spatial relations of the primitive graphs are given by their topology [4].

Simple spatial objects (primitive graphs):

-*Points* are used to position geographic objects such as: phone poles, houses, fountains, mines, etc. The spatial positioning of the points is given by their coordinates;

- *lines and series* are made up by connecting the points. A line unites two points, and a series represents a succession of two or more connected lines. The lines and the series are used to represent and mark the limits of the properties, roads, watercourses, fences, etc.;

- *polygons* are used to represent geographical objects such as: lakes, parcels, district boundaries, etc.;

- *pixels* are little squares which represent the smallest elements in which a digital image can be divided. Continuous series of pixels arranged in lines and columns are used to introduce data from aerial photographs, satellitary images, ortophotoimages, etc. The distribution of the colors and of the color shades for the whole image is made by attributing a certain numerical value to each pixel.

- *cell networks* are made up of square shaped elements with various dimensions. These networks are used to represent: slanted lands, different soil types, covered lands, waters of a certain depth, population density. The distribution of different types of data on a surface is indicated by attributing a numerical value to each cell.

Topology

Topology is a branch of mathematics which can be used to define explicitly spatial relations, i.e.: to define the connections between lines, to identify adjacent polygons, and to define a polygon as a set of a multitude of lines.

In order to generate typology it is necessary to define, from the very beginning, the lines, the nodes and the polygons. There are some additional simple spatial objects which are ordinarily used to express precisely the topologic relations of the information put into a GIS database. Nodes define the initial and the final points of lines, or they identify their intersection points. Lines are used to define the limits of a surface or boundary limits. Polygons are similar to surfaces and are defined by the lines which are connected to mark an area. Sometimes, in topology there are isolated nodes inside polygons to mark different objects.

In the GIS technologies, the most important topological relations are the following:

1. connectivity- identifies the lines connected to each other at nodes;
2. direction - defines the node from which a line starts and the node it reaches;
3. boundary - identifies the adjacent polygons, by recording the polygons on the right and left of each line.

Topology will describe that the two owners have a shared boundary limit, which line *g* unites node 6 to node 3 and that Georgescu's property is placed on the left side of the line and the other property is placed on the right side (Figure 1). It is obvious that the direction of the common lines has to be established before the two parts are declared to be the left or the right side.

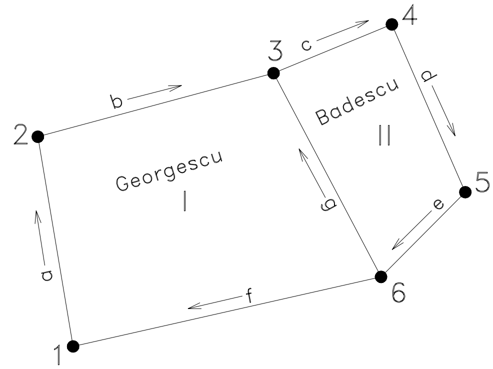

Fig. 1 Vector representation

Nonspatial data, also called ***attributes,*** describe the geographical regions or define the characteristics of geographical objects. Attributes are represented as graphic symbols. For example, roads are drawn with lines of different thickness, models, colors and labeled to represent different types; watercourses are drawn with blue lines and labeled with their names; schools are represented with the help of a special symbol; lakes are colored in blue and forests in green.

Thus the geographical objects can be displayed simultaneously with the associated descriptive data.

Spatial data and descriptive date are usually stored in different files (spatial databases, and tabular databases, respectively). That is why the power of GIS relies on the connection of these two types of data and on keeping the spatial relationships between the objects of the map.

The information from the tabular database can be accessed, by the use of geographical objects or can be used to create maps. For example, to find out the descriptive information (attributes) about a road, we can click on it, and vice versa, we can locate the road with the use of descriptive information.

The algorithm to make a geographic information system

1) Establishing the strategic directions and the objective of the project; the analysis of the project impact in the general context of the current situation in the organization where the GIS solution is to be implemented; the interference with other solutions is analyzed, as well as the interactions between different departments which can benefit from the implementation of the GIS solution;

2) The description and the analysis of the informatic solutions to be used, infrastructure (hardware and communications), type of the database to be used, the complexity of the software solution to be used (precision, current state, complexity degree); establishing the staff to be used (level of expertise, number); establishing the types of reports to be generated and of extreme importance will be to estimate the implementation costs of the project: value, duration, benefits, etc.;

3) The database project and the selection of a logical data model, which is to be the basis for later analysis. Subsequently, the costs connected with the data are analyzed: the use of the existent databases, the costs for migration and updating, the costs and benefits for the creation of a new database, the existent sources, etc.;

4) Establishing the system requirements. There are analyzed the infrastructure requirements (hardware and communications) to be used. These are imposed by factors such

as: dimension of the database, existent number of users, request response times, types of estimated operations to make, etc.;

5) Cost/benefit analysis. This stage is essential in the development and the implementation of any project. The GIS projects are usually projects of high complexity, with definite implications in the organization operating mode, but also with high costs, with strong implications on personnel training;

6) The planning of the implementation is an important stage for every project and is determined by the results obtained in the previous stages. In this stage, a re-evaluation of the results obtained in the previous stages is also made;

7) The identification and the description of the aspects concerning personnel, types of positions, different requirements, including the training ones. The costs, for this stage, are considerable;

8) A pilot project is made;

9) The requirements for previous stages are updated, especially those regarding the infrastructure (hardware and communications) and the next step is the implementation of the project.

3. Conclusions

Nowadays, photogrammetric works represent a field of interest both nationally and internationally, being extremely useful for varied engineering fields.

The big quantity of data, obtained by photogrammetric exploration procedures, has led to the development of geographic informational systems (GIS), which combine different photogrammetric products (DEM, ortophotoplans, topographic plan) to generate new information with specific subject character, closer to the way of understanding of the decision factors. From this point of view, the photogrammetric image is a product more and more used as a starting point in the structure of GIS database.

4. References

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