

THE MODEL OF FORMATION OF THE DIGITAL GEOSPATIAL INFORMATION BASED ON EARTH REMOTE-SENSED DATA

Vorobjev A.A., Romanov V.V., Uvarov A. N.
FRUP Kursky Research Institute, Russia

Based on the usage of theory of Markovian processes, a mathematical model was created. This model allows to define the probabilistic and time characteristics for the process of digital geospatial information creation, depending on the basis of ERS data, taking into account the parameters of processing system.

Scientific and technological revolution globally changed the views on the technical abilities of cartography, made principal changes in the process of mapmaking and map edition, as a result geospatial information systems (GIS) have appeared.

The basis for the information support of GIS is: the system of digital maps of a territory, digital models of the surface pattern, the earth remote-sensed data (ERS), connected with the data bases.

Nowadays, a great number of forms of digital geospatial information (GSI) is used to solve a wide range of problems. They differ in their detailing, observability, composition of forms and objects, spatial resolution.

This fact stipulates the specific character of work, during the performance of special technological procedures to create these types of GSI.

While solving these problems, the system of digital GSI formation should be adapted to the used information form, taking into account the available resources (including time resource).

At present, the organization of the system of digital GSI formation is done empirically due to the lack of science-based approaches, frequently, not taking into account the specificity and amount of work. In reality, either ineffective time usage or overloading of automation-equipped working places (development, management and control, which are used to solve specific problems connected with GSI creation) can occur. Moreover, a great number of errors doesn't allow to reach required completeness, quality and timeliness of data for geoinformational projects.

Thereby, the contradiction between the consumer's requirements for the process of data formation and the limited capabilities of the existing systems of digital GSI creation (based of earth remote-sensed data) is quite obvious.

One of the ways of disambiguation is connected with the optimization of the system composition and structure and with the management of the process of digital GSI creation on the basis of its mathematical modeling.

This report represents the results of mathematical model development for the process of digital GSI formation.

Generally, the process of digital GSI formation can be represented as the succession of the following procedures:

- acquisition of the original data in the form of ERS data and nomenclative lists of raster topographical map;
- estimation of the ERS original data quality;
- formation of informational layers of spatial data.
- digitization of ERS data: identification, classification, systematizing and grouping of the graphical images, according to the imposed requirements;
- filling and editing of the attributive information data bases;

- logical and mathematical integration of the graphical images located in the intersected areas of contiguous pictures
- examination and evaluation of the digitization quality
- formation of accountable documents;
- preparation and dispatching of the created GSI results to the customer.

The main feature of this process is the control of the quality of work materials. These control results are used for making the conclusion about next work reasonability.

The theory of Markovian processes is used, because it allows to decompose difficult operation into simple components of technological development process of the digital GSI and it allows to evaluate their influence on the final result.

Altogether, the model of the process of digital GSI formation can be represented by Markovian chain (MC), it's branches are ended with the fulfilment or non-fulfilment of digital GSI formation. During every technological cycle realization procedure, an individual processing of data is performed, so the received decision will be evaluated and either a new task to start a new procedure will be formed or the decision to stop the progress will be made.

The values of transition probability are the functions of: the time of the technological procedures fulfillment, the structure of processing system (number of automation-equipped working places) and the volume of work (number of claims). The calculation of probability values is based on equations:

$$P(T) = \frac{\sum_{i=0}^9 \pi_i \alpha_i + \sum_{j=10}^{16} \pi_j \alpha_j}{\sum_{i=0}^9 \pi_i \alpha_i + \sum_{j=10}^{16} \pi_j \alpha_j + \sum_{n=17}^{25} \pi_n \alpha_n}, \quad (1)$$

Where e_k condition ; $\alpha_k = f(T_i; n_{APM}; N_d)$ - is the average time of MC being in the

π_k - stationary probability of imbedded Markovian chain, defined by the combined equations:

$$\pi_k = \sum_{k=0, m=0}^{k=25, m=25} P_{m,k} \pi_m, \quad \sum_{k=0}^{25} \pi_k = 1, \quad m = \overline{0,25}, \quad k = \overline{0,25}, \quad k \neq m.$$

The values of time, used to perform technological procedures, are set by the standards, specified for this kind of work.

During the verification of the model, the existing structure of organization of digital thematic layers creation was used.

The result of this model approbation is that the probability of task fulfillment in the condition of on-peak load is 0,87-0,88, under the current requirements level to the number of ERS data and efficiency of digitization.

The received modeling results completely correspond to the real data, obtained in the progress of work (projects making), this fact allows to make a conclusion, concerning the adequacy of this model to the process of digital GSI formation, on the basis of ERS data.