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Fuzzy methods and algorithms in data mining and formation of digital plan-schemes in earth remote sensing

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Abstract

The approach to the formation of common geo-informational space (GIS) of the territories on the base of using of space information with features of fuzzy approach to its processing is proposed in the paper. The method of correction of GIS parameters is proved and proposed. The direction of designing of digital plan-schemes is showed.

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Keywords: Fuzzy methods;earth remote sensing;digital terrain model (DTM);united geo-informational space (UGIS);digital plan-schemes (DPS).

The management of economics of the country and the region which, in fact, forms complex dynamic systems, the predictability of its development is possible only through timely receipt and analysis of reliable information about its condition in multifactor uncertainty, and detection of regularity of common processes occurring there. And the most important tool of observation, analysis and prediction of the behavior of a complex system is the monitoring. It is quite important in tracking of situation in the construction and usage of the objects of railway infrastructure, territory of agricultural purpose, in searching and mining of minerals and etc. The identification of images of the object of earth surface, received in the process of sensing, and also measuring of coordinates of static and moving objects on the background of the surface are, on the one hand, very important, on the other hand, difficult achieved problems of space monitoring. The problems of fuzziness on all stages of receiving, data processing and interpretation of results, face on modeling of appropriate procedures.

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We consider the problem of uncertainty on common level of data receiving and processing. Herewith for every level of uncertainty it is necessary to implement:

- search (select) of appropriate mathematical description and representation of a particular type of uncertainty;
- select of mathematical device with which it is possible to manage (to configure the parameter) the model with selected type of uncertainty;
- finding of effective way to measure real uncertainty in any analyzed situation;
- designing of a methodology for the formation of appropriate models for real objects and processor of monitoring for choosing the parameters of uncertainty, which is possible to calculate.

The data of Earth remote sensing (ERS) is actively applied for monitoring of condition and dynamics of development in the sphere of agriculture and forestry, for control of land use, monitoring of construction, in first line extended objects.

Spatial distributed information, obtained including with using of ERS, consists of three big groups: semantic, metric and topological. Structured combination of these groups of information about specific information, is presented in a form suitable for automatic processing, forms a digital terrain model (DTM). The ability of one group of information (as system) to use part of another group (Kramarov, Povkh, Khramov, 2015; Akperov et al, 2015), that is, the ability to mutually use the information in each these groups is laid on the basis of such DTM. In other words, we talk about geo-interoperability.

International organization for standardization ISO 19119 provides the following definition: “Interoperability is the ability to communicate, execute programs or transfer data among various functional modules in a way that does not require that a user has knowledge about the characteristic of these modules” (Khramov, V.V., 2016).

This means that two systems can work together to solve problem in condition of their mutual interoperability. In the frame of geo-informational system “Geo-interoperability is the ability of informational system for:

- free exchange of all kinds of spatial information about the Earth and the objects and phenomena, as well as above and below the Earth's surface;
- joint network usage of software, intended for managing that information” (Khramov, V.V., 2016; Narinyani, A.S., 1986; GOST P 54500.3-2011).

Obviously, the storage and support of such a constantly developing model requires appropriate information resources available, at this stage, in the frame of the concept of data warehouse (DW). The form of organization of geodatabase, combining DTM and relational database, is the most widespread at present. However, the complication of such an organization, called a set of creation tools and support for topology of data, creates certain problems (Khramov, 2015). This data model does not allow greater flexibility and targeted to specific, specified by software, the database control systems.

1. Digital plan-scheme as projection of common geo-informational area

Digital plan-scheme (Kramarov, Povkh, Khramov, 2015; Akperov et al, 2015) allows to create output forms of monitoring of agricultural territories, the results of thematic decoding, and also digital plan-schemes are used for collection of data of survey and fixing of field research; preservation, processing and entering of data is performed by using digital plan-schemes. Plan-schemes are formed on the base of the principle of aggregation, that allows to build a hierarchy in which the higher level is composed of lower, that is the plan-scheme of rural settlements constitute the district level, in turn, the level of the district is subject, the subjects constitute a district level and so on. This principle allows to create temporary plan-schemes at any level. The basic unit, which is the base of plan-schemes, is outline of agricultural land and field rotation.

Digital plan-schemes is geocoded in the coordinate system PE 90.02. The coordinate system PE 90.02. is updated version of PE-90, and also general satellite navigation system GLONASS, that allows to use digital plan-schemes for integration in satellite navigation maps, and also to collect coordinates data.

Identification of pictures of objects on the earth's surface, received from the sensing and measuring of coordinates