

Подаються рекомендації по оцінці похибок інерціальних вимірювальних модулів при їх випробовуваннях в точці земної поверхні, для якої значення астрономічної широти невідоме.

Ключові слова: широта, геоцентрична широта, інерціальний вимірювальний модуль, гіроскопи, акселерометри, астрономічна широта, геоїд, еліпсоїд, геодезичні системи координат, геодезична широта.

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DEVELOPMENT OF INFORMATION TECHNOLOGY FOR THE STAND OF MILITARY SIMULATION OF ADAPTIVE NAVIGATION SYSTEMS

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An important task of preventing terrorist threats is the improvement of navigation systems and remote monitoring of objects of increased danger [1]. One of the approaches is to create stands for modeling a number of location systems based on the principles of propagation of radio waves, as well as acoustic waves in air and underground environments. In this case, it is necessary to take into account the features of adaptation of signal reception systems in a changing interference environment. The main types of such interference for radar navigation systems are active noise and imitation interference, as well as interfering reflections from objects of various lengths (from the sea surface, fog, rain, angel echo). In the field of passive acoustic location systems, an analysis of experimental data from sources of acoustic radiation, for example, from stealth aircraft, is required. The reception of such signals

is associated with the features of the long-range propagation of sound waves in the atmosphere, as well as interference caused by wind, sea waves, and the operation of environmental mechanisms. To protect objects of particular importance, it is necessary to improve passive seismic systems for detecting impacts on the ground and recognizing human steps, tunnels, moving wheeled and tracked vehicles.

The modeling of these systems is carried out using information technologies (IT) designed to identify measurements, determine the parameters of signal models, automate data processing, model and evaluate the effectiveness of navigation systems, classify data based on knowledge and rules for creating reference signals.

Decision support IT was developed for building location systems (Fig. 1), which has knowledge base and rules for its formation on the characteristics of the objects under study. Information analysis is carried out using multi-channel measuring equipment to make a decision about the presence of an object and its belonging to one of certain classes. IT is a set of software and hardware tools for processing information represented by formalized knowledge, as well as methods and techniques for natural and mathematical modeling. The stand is designed to improve signal and interference models, evaluate the effectiveness of navigation systems, develop recommendations for adjusting system parameters and decision-making rules.

The databases consist of classified implementations containing signals and interference, which are ordered by field indices containing: object class, data acquisition range, data acquisition time, weather conditions (air temperature, wind speed). Databases are formed from control zone sensors supplied by experts through telecommunication networks from object registration systems operating in real time.

Due to the lack of real data, the results of experimental studies from the full-scale simulation stand and the machine for mathematical modeling of radiation objects are also used. Specialists serving specific full-scale test complexes act as cognitologists. They fill the databases with classified samples of real situations.

In the module of knowledge assimilation, preliminary processing of databases is carried out in accordance with the algorithmic support. The core of IT is the knowledge base, which consists of frames with many attributes for models of information and interfering processes. Facts are represented by reference signals, analytical models of signals and interference, which are corrected in accordance with a set of rules. The inference engine uses the rules for developing standards and interference models to evaluate the effectiveness of decisions made according to the rules of inference, analytical calculation and modeling of the developed navigation systems, then presents the results according to the goal set by the operator using the user interface.

The goals are conclusions on the applicability of the data provided from the studied areas for correcting models, justifying the introduction of a new class, determining losses in noise immunity, and analyzing decision errors. The goal contains sub-goals: building models of signal and noise classes; choice of model parameters in the time and spectral domain for separability of signal classes; choice of decision rules.

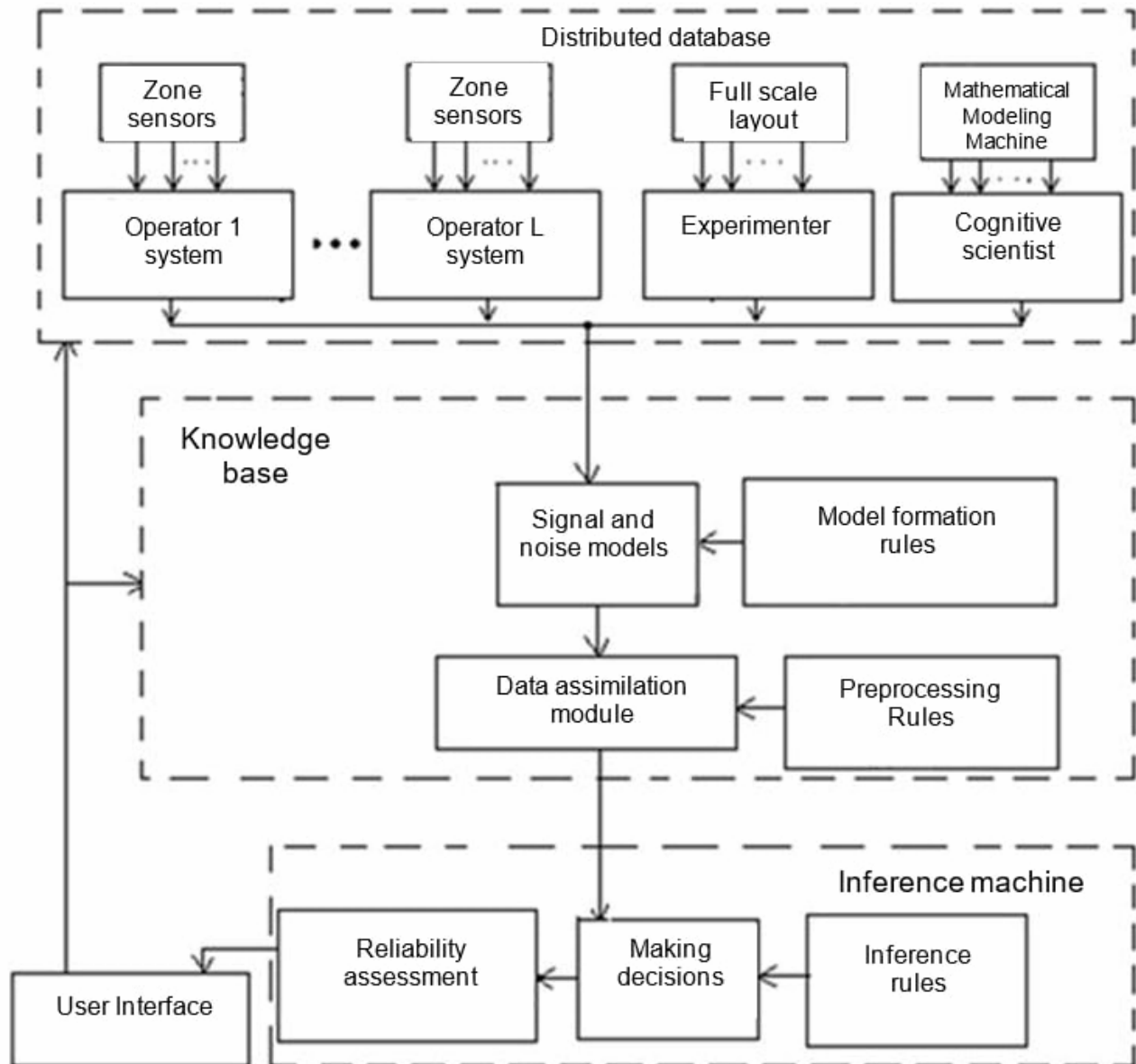


Fig. 1 Information technology decision support

The rules for extracting facts are determined by the task (detection, recognition, joint detection-recognition, estimation of object state parameters), the physical principles of location (radio, sound and seismic location), the features of the objects under study, determined by the choice of a signal model (a signal of a known shape, with partially known parameters, random signal). The efficiency of decision-making is checked within the range of changes in the parameters of the signal-interference environment, characteristic of the problem being solved. The stand for semi-natural modeling of location systems made it possible to automate the processes of building models of objects, short-term and stationary interference of various origins based on correlation functions, spectra, and distribution laws. Their approximations by analytical expressions are used to create statistical equivalents of signals and noise.

For the protection of important objects, a hybrid system of sound location and seismic location was investigated. The use of adaptive correlation algorithms for processing pulsed and continuous signals in it made it possible to increase the detection range by more than 1.5 times compared to known systems and to determine the coordinates of the steps of violators, impacts of mechanisms, the movement of wheeled and tracked vehicles, unmanned aerial vehicles [2]. The considered approach provides in a short time the design of systems for navigation and remote monitoring of high-risk objects.

Keywords: mathematical modeling, acoustic location system, interference environment, adaptive navigation system.

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АНАЛІЗ ПРОЦЕСІВ ТРАНСПОРТУВАННЯ ТА ЗБЕРІГАННЯ ОЛІЇ ЯК ОБ’ЄКТІВ КЕРУВАННЯ

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Олійно-жирова промисловість України – це потужна галузь виробництва, яка об’єднує виробників насіння і олійно-жирової продукції. Ця галузь орієнтована на виробництво соняшникової, соєвої та ріпакової олії, і пов’язаних з нею продуктів. Одним з етапів виробництва олії є її зберігання перед транспортуванням до споживачів. Такими місцями зберігання олійно-жирової продукції є промислові технологічні комплекси бакового господарства.

Автоматизація комплексів бакового господарства є досить складним та високотехнологічним процесом. Основними завданнями автоматизованої системи керування комплексом зберігання є автоматичне логістичне транспортування продукту до точок розливу, а також при цьому важлива швидкодія та точність дозування олії, оскільки ці показники мають прямий вплив на продуктивність комплексу зберігання олії в цілому.

Під час транспортування олії до точок відвантаження використовується динамічна маршрутизація між технологічними елементами. Тому необхідно реалізувати систему пошуку технологічних маршрутів та передбачити функцію встановлення параметрів динамічних логістичних процесів. До таких