# CONTENTS AND ABSTRACTS

## RADIO ENGINEERING AND COMMUNICATION SYSTEMS



Key words: radio signal, telemetry information, error-correcting coding, multi-criteria approach, complex technical object.

The issues of improving the quality of the results in telemetric information processing are considered in the interests of an objective assessment of the state of complex technical objects (STO) in the process of testing. The aim of the work is to develop a multi-criteria procedure for choosing an encoder (decoder) of telemetric radio signals of a service station, which ensures resistance to the influence of interfering factors in transmission channel. Comparison of known encoders efficiency is made according to the following criteria: the ratio of radio signal energy per one message bit to the average value of noise power $E_b/N_0$ with undetectable error rate after decoding less than $10^{-9}$, the delay (in bits) between the moment when a source bit appears in channel encoder and the moment of bit reproduction in a decoder neglecting transmission delay, the number of computational operations per bit during decoding, the amount of memory (in Kbits) required to decode a code of a certain type. Multi-criteria approach has shown that a compromise between increased error correction of telemetric radio signals and reduced requirements to hardware costs for decoding requires the application of CC (3.1 / 2), CC (5.1 / 2), LDPC codes (128, 64) and LDPC (256,128), providing the decrease in indicator value $E_b/N_0$ on 3.8-9.9 dB relative to uncoded channel.



Key words: bandpass filter, sector resonator, coupled microstrip lines, electrodynamics and circuit simulation, machine experiment, S-band.

The design of compact bandpass filter based on half-wave resonator with two barrage poles provided by two sector resonators open at the end is considered. A study of the proposed filter design is carried out using analytical relations obtained on the basis of circuit theory and matrix analysis as well as electrodynamics methods of Green's function and finite elements. The aim of this work is to study the original design of bandpass filter with improved quality indicators (compensation of parasitic band at doubled central frequency and increase in stop level and band). The correctness of modeling results is confirmed by a comparative analysis of the data from machine experiment obtained using circuitry and electrodynamics modeling in S-band. The possibility of using the filter in infocommunication systems of space communication is substantiated.

## MATHEMATIC AND SOFTWARECOMPUTER SYSTEMS AND COMPUTER NETWORKS

and used to make key decisions in many technological areas. The paper considers the most important laws on which performance assessment is based, a numerical and graphical comparison of assessment methods is carried out, graphs of effective dependence of algorithms on hardware are obtained, and mathematical description of ensuring balanced load and optimal memory access is formulated.

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## INTELLIGENT INFORMATION SYSTEMS AND TECHNOLOGIES



Key words: knowledge models, big data, artificial intelligence, neural networks, ICF ontology, ontological taxonomies, hierarchical numbers, software tools, measure of concept semantic similarity, Semantic Web technology, Python, Anaconda, generic and causal relationships.

The most important task to design learning algorithms for mining big data, including neural network, is considered. To improve their efficiency, taxonomies for artificial intelligence knowledge models are used. It is proposed to use ICF contiguous inheritance relation as basic taxonomy relationship. This approach makes it possible to effectively design general and applied ontologies to solve artificial intelligence problems. The article uses mathematical apparatus of hierarchical numbers allowing to analyze applied ICF ontologies by calculating the main characteristics of taxonomic hierarchies. Such characteristics include, for example, a measure of concepts semantic similarity or the complexity of structural path in taxonomic hierarchy between two concepts. As an example that confirms the possibility of effective use of ICF taxonomies in solving real problems of data analysis, we propose the solution of clustering and classification problems in «Reducing churn and attracting customers of telecommunication company» subject area. For this problem the possibility of interdependent design of neural networks and applied ontologies with a priori libraries of causal taxonomies, for example, in Semantic Web technology, is shown. In the experimental part, to test the capabilities of information retrieval in global networks based on Semantic Web technology using ICF taxonomy, an experimental bench program for data mining methods (ESMIAD v.12.02.2021) is considered, which allows by placing fragments of program text in comments or vice versa perform experiments for analytical algorithms with training samples. The experimental stand is implemented in Python v.3.7 in Anaconda v.3.0 development environment. The purpose of this stand is to analyze the effectiveness of data mining methods using knowledge representation models.

The aim of the work is to analyze design features of learning algorithms for data analysis using general and applied ICF ontologies with the apparatus of hierarchical numbers to efficiently solve urgent problems of clustering and classification.

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The aim of this paper is to present a mathematical description of qubit, qudit, N-qubit system, and ensemble density matrix. In this paper, we define the concept of qubit as a quantum system with two well-distinguishable orthogonal quantum states. Qubits are shown to move on to qudits, i.e., to d-dimensional system, which, respectively, will be described by 2d-2 number of parameters, the possibility to move to N qubit system, the dimension of which, in general, growing exponentially is also proved. In case when the system is factorized, it grows linearly.

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Key words: digitalization, bank, banking sector, net profit, tonality, financial technologies, fintech.

At the moment, the digitalization process has become ubiquitous at all levels of management decision-making. The consequence of this process is the transformation of both information consumption process and business processes of enterprises in all sectors of the economy. One of the most sensitive to this transformation is a banking sector due to information specifics of the services provided. Thus, the efficiency and competitiveness of a modern banking organization is largely determined by the efficiency of digitalization process. The aim of this work is to analyze the impact of digital transformation indicators on technical and economic indicators of banking enterprises. As part of this study, a regression analysis was carried out, the result of which is mathematical formalization of the impact of identified and quantified indicators of digital transformation on net profit of key representatives of banking sector. Also, a significant scientific result is a quantification algorithm for the analyzed indicators of digital transformation, described in this article. The results obtained allowed us to identify the most significant indicators of digital transformation and formulate generalized recommendations for banking enterprises, which would potentially increase their competitiveness in the context of widespread digitalization.

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## SYSTEM ANALYSIS, MANAGEMENT AND INFORMATION PROCESSING



Key words: information and measurement support of rocket launches, trajectory measurements, machine learning, system analysis, telemetry information.

The paper considers on-board data classifier model obtained from rocket and space equipment vehicle on the basis of implicit features of trajectoral deviations. The proposed classification model is based on specific binary classification algorithm in terms of modern and perspective machine learning methodology algorithms such as decision tree and random forest. The aim of the work is to find a generalized algorithm for determining the occurrence of abnormal and emergency onboard situations in complex multiparametric objects (rocket and space equipment vehicle) based on trajectory data analysis. The trajectory data is obtained by polygon measuring instruments as part of general flow of onboard telemetry information during flight experiment. The paper presents a step-by-step process of constructing effective classifier model for normal and abnormal on-board states. The model is based on modern methods of data mining and

## PHYSICAL ELECTRONICS AND NANOELECTRONICS



Key words: microwave generator, efficiency, diode, diotron, gap, generation zone, convection current, saturation mode, spatial charge mode, cathode current cut-off mode.

A brief review of publications on single-cavity microwave generators of straight-through type (diode, monotron, two-gap resonator in generation modes) is given. The aim of this work is to study interaction processes and electron efficiency of a diode generator (diotron) of planar construction in various modes including cathode current cut-off mode by numerical simulation. Based on the model of an electron beam consisting of large particles and the solving the equations of particle motion by the Runge-Kutta third order method, the ways to calculate the efficiency by energy method and calculate the shape of convection current pulses using charge conservation law are developed. The authors have shown that the result of speed modulation under the influence of alternating voltage are bunches of electrons being formed that at certain transit angles fall into negative half-waves of alternating voltage leading to the formation of generation zones. Without cutting-off cathode current in case of particle charge equality (electrons enter high-frequency gap from external cathode or diode cathode operates in saturation mode) efficiency values in the center of zones were 12 % for the first zone, 8,3 % for the second and 6,1 % for the third at transit angles, respectively, 4,8 rad, 9 rad and 13,3 rad. In case of particle charge dependence on AC voltage phase, maximum efficiency decreases to 2,4 % for the first zone, 5,3 % for the second and 4,3 % for the third. The decrease is mainly due to the fact that the center of initial bunch formed at cathode and the center of bunch formed by subsequent grouping are shifted in phase by 0,5 π. Cathode current cut-off mode did not give expected efficiency increase as in klystrod operating in this mode.



Key words: silicon crystalline solar cells, HJT, amorphous intrinsic silicon layers, PECVD, hydrogen plasma treatment.

The aim of this work is to investigate the effect of hydrogen plasma treatment of layers of amorphous hydrogenated silicon on their defectiveness in the manufacture of heterojunction solar cells. Hydrogen plasma treatment after deposition of the first layer of amorphous hydrogenated silicon with thickness of 5-6 nm allows passivation of defects in layer volume and, due to surface hydrogenation, creates conditions for defect-free growth of next layer to total thickness of 10 nm. The lifetime of minority charge carriers increases from 3.5 to 5 ms. The parameters of treatment with hydrogen plasma are determined, which makes it possible to reduce the level of defectiveness of intrinsic hydrogenated amorphous silicon layers in the production of high-efficiency solar cells. .

Key words: silicon crystalline solar cells, amorphous intrinsic silicon layers, PECVD, hydrogen plasma treatment.

The aim of this work is to study the influence of process step factors on the formation of defects in amorphous silicon in the manufacture of heterojunction solar cells (HJT). Defects of layers in amorphous hydrogenated silicon, their appearance and changes in the structure of layers in the process of manufacturing a solar cell are studied. The change in amorphous silicon structure after hydrogen plasma treatment and annealing after the process of transparent conducting oxide deposition is carried out. The parameters of the processes that allow reducing the level of defectiveness in the production of high-performance solar cells have been determined.

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