CONTENTS AND ABSTRACTS

RADIO ENGINEERING AND RADAR

Keywords: modification of the Khurgin-Yakovlev algorithm, theorem of V.A. Kotelnikov, primary coding, speech signal codecs, noise immunity, noise in communication channel, speech quality assessment

Research on modifying the Khurgin-Yakovlev algorithm with three-channel implementation to improve the quality in speech signals primary codecs has been carried out. The aim of the work is to modify amplitude-frequency and phase-frequency characteristics of synthesis filters in order to simplify the implementation and minimize signal reconstruction error, as well as to study primary codecs that use the proposed modification when exposed to interference in a communication channel. A block diagram of three-channel system for processing and transmitting speech signals has been developed based on a modification of the Khurgin-Yakovlev algorithm. Estimates of reconstructed speech signal quality at the output of various codecs under the influence of interference in a communication channel were obtained for the proposed modification of the Khurgin – Yakovlev algorithm, and were compared with the systems built on the theorem of V.A. Kotelnikov. The authors show that the application of the proposed three-channel modification of the Khurgin-Yakovlev algorithm improves quality characteristics and noise immunity of transmitted speech information.

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Keywords: image, structural radiometric noise, additive-multiplicative model, wavelet transform, Daubechies wavelet.

The article discusses an approach to detecting and analyzing structural noise («banding») in the images from Earth space observation systems by using a wavelet transform and constructing a wavelet packet decomposition tree. Wavelet transforms make it possible to adequately describe both spatially correlated changes in brightness and their abrupt changes, if necessary.

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Keywords: speech signal, noise immunity, adaptive codec, primary encoding, speech signals transmission, speech signals codecs, Khurgin – Yakovlev representation, speech quality, CELP codec.

INTELLIGENT INFORMATION SYSTEMS AND TECHNOLOGIES

have hierarchical structure. General and applied ontologies having significant differences in their design and application for understanding natural language sentences are distinguished.

As a cross-cutting example, we took the subject area of English-language political articles of international electronic media, in particular: RT, CNN, TASS, NYTimes. The technology for calculating the semantic similarity of natural language constructions is considered, for which well-known bert-base-cased neural network models of the latest versions are used, as well as the author's IYu-bert-cased model. A new method for computing semantic similarity using hierarchical number theory is presented.

The experimental part of the material is based on the use of software tools of Python v.3 language (Anaconda 3): Spacy library v.3.2.1, CorpusMining v.2.1 retriever, mIYu-bert v.1.0 software package. The last two tools were implemented by the author of the material.

The completed series of experiments allows us to qualify the methodology for using hierarchical numbers in calculating semantic similarity as the basis of the technology that is not inferior in efficiency to currently available international analogues.

The aim of the work is to present the effective use of hierarchical number algebra to obtain and use new neural network technology used to solve the problems of automatic calculation of semantic similarity in natural language constructions.

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Keywords: convolutional neural network, end-to-end 1DCNN, ESResNet, AST, PaSST, knowledge transfer, knowledge distillation, UrbanSound8k, ESC-50, FSD50K, audio signal classification, feature extraction, spectrogram, datasets, evaluation metrics.

Classifying the sounds of urban environment is a complex task that has some common facets both with the task of classifying images and the task of processing natural language. The article describes the methods of audio data preparation, and presents some types of deep neural network architectures used to classify sounds of urban environment such as 1DCNN, EsResNet, AST, PaSST. The advantages and disadvantages of such architectures are discussed. The methods of knowledge distillation and transfer used to increase the effectiveness of the methods used are considered. The aim of the work is to compare the results of model training on several datasets, including ESC-50, UrbanSound8K and FSD50K, based on mAP and Accuracy metrics.

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Keywords: speech recognition systems, speech synthesis systems, neural network training, noise, efficiency, Word Error Rate, dataset generation, noisy data.

The problem of speech recognition in the presence of extraneous noises of various origins is considered. The aim of the work is to develop and evaluate the effectiveness of meth-

ods that make it possible to recognize speech in the presence of noise using neural network techniques. The relevance of the work is a significant expansion of the range of industries in which speech recognition has become much simpler and more efficient due to the development of neural network techniques. Software solutions «Whisper» and «Vosk» which allow transcribing (recognizing) speech are considered. A classification of audio noise is given, and existing methods of dealing with them are described. The influence of noise on training a speech recognition system is shown. Methods for training speech recognition system using synthetically generated dataset with noise have been developed. A data noise module was designed and developed, and a test bench was assembled. Approbation of the developed methods is given. Finally, the results of analyzing the data obtained during the experiments are presented and conclusions are drawn.

MATHEMATICAL AND COMPUTER MODELING

Keywords: profilometer, 2-D sheet model, model of sheet rotations, detection of non-contact points, sickle shape, sickle shape estimation, metal sheet edges approximation.

The task to construct a mathematical model of metal sheet in the process of its movement along a roller is considered. A sheet of metal after it is rolled on mill can change its edge geometry as a result of which the phenomenon of sickle shape may occur. Traditionally, sickle shape and width of a sheet are measured manually. To automate the process of measuring width and sickle shape, a system based on a set of optical sensors (profilometers) is proposed. Data processing should be performed in a time not exceeding the time required to pass the entire sheet. The difficulties of estimating these parameters based on these data are associated with rotations and transverse displacements in the process of moving the sheet along the roller. The aim is to create an adequate model of a metal sheet in order to test algorithms for determining its characteristics: width, sickle shape, presence of other defects. The issues of constructing a general profile based on data from individual measurements of a system containing six profilometers are considered, as well as a description of algorithms for finding the angle of rotation, eliminating transverse displacements, estimating sickle shape and width of metal sheet are considered.

Keywords: measuring information systems, hardware and software complex, technological system, vibration, mechanical engineering production, monitoring, production process control, technological discipline.

The aim of the work is to develop the system for automatic control of technological discipline based on hardware and software systems. The article discusses the problem of using measuring information system for monitoring mechanical vibrations of technological system to monitor production process. The main reasons for violation of technological discipline are given. To monitor technological processes and adhere to technological discipline and exclude the human factor from decision-making chain, the authors have proposed the option to introduce automatic control system for technological discipline based on developed hardware and software complex for monitoring and optimizing technological processes (SPC) being a set of diagnostic modules installed on the equipment that take a certain set of indicators from the machine and allow you to interpret equipment operation over a given time. The information received is stored on a server being the source to determine equipment load factor, the number of processed workpieces, processed workpieces range and equipment operation rhythm. The use of the proposed method for indirect monitoring of technological equipment state makes it possible to monitor compliance with technological discipline by recording the fact of equipment operation at idle speed to simulate operation as well as the fact of equipment operation simulating the operation of a machine according to a control program; identifying the facts of changes in cutting modes; recording interruptions in technological process and reworking some operations; analysis of production rhythm and actual productivity of each operator; detection of non-compliance with daily shift assignments. The proposed option for using hardware and software complex makes it possible to increase the efficiency of technological processes of cutting processing due to timely systematic identification of deviations in a technological discipline.

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INFORMATION-MEASUREMENT AND BIOMEDICAL SYSTEMS

Keywords: measurement signal, offset, nonlinear component, integral nonlinearity, differential nonlinearity, analog-to-digital converter, histogram, least squares method, conversion function.

The task to find the contribution of nonlinear component of measurement signal (MS) during metrological tests to ADC integral nonlinearity is considered. The aim of the work is to determine ADC integral and differential nonlinearities by means of a new method, which reduces the requirements to reference measuring instruments in terms of accuracy class by taking into account MS nonlinear component. For this purpose, periodic MS of triangular shape, level-shifted downward MS and level-shifted upward MS are successively fed to the input of tested ADC. The first histogram of ADC code distribution is plotted in the absence of MS offset, second and third histograms are plotted in the case of MS downward and upward shifting. After that, for each ADC code in the second and third histograms with the help of the first histogram the authors construct two equations leading to a single one and solve the obtained systems of equations at MS

PHYSICAL ELECTRONICS AND NANOELECTRONICS

An electrodynamic model has been formulated describing induction discharge in pulsed plasmatron in terms of induced current density in a plasma clot under the action of pulsed magnetic field. Numerical calculations have been performed using a plasma model in the form of a cylinder, demonstrating the process of current layer formation in plasma. The aim of the work is to numerically study the dynamics of density distribution of induced current in a plasma clot located in a magnetic field with rapid decline of this field.

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