ABSTRACT AND REFERENCES

INFORMATION AND CONTROLLING SYSTEM

FEATURES OF EQUALIZATION IN LTE TECHNOLOGY WITH MIMO AND SC-FDMA (p. 4-8)

Abdourahaman Ali

The Long Term Evolution (LTE) is one of communication standards for next-generation mobile phones, which has evolved the high-speed data communication standard HSDPA for the mainstream 3G (third generation) mobile phone system W-CDMA at present. Data communication volume of mobile phones is rapidly increasing at present due to dissemination of smart phones and mobile communication. Therefore, expansion of communication band (capacity) is a critical issue for communication carriers. Because the LTE that allows high-speed data communication with low delay is superior in terms of the radio wave use efficiency, many of major communication carriers in the world have indicated a policy of adopting the LTE. The rapid dissemination of the LTE in the future is expected. In this report we overview the fundamental techniques of equalization in LTE technology with MIMO and SC-FDMA in channels where the maximum delay exceeds the length of the Guard Interval. The goal of employing narrow band subcarriers is to obtain a channel that is roughly constant over each given sub band, which makes equalization much simpler at the receiver. There are considering advantage and disadvantage three types equalization techniques: time domain, frequency domain and turbo equalization. On base of these compeering are giving practical recommendation for choice method of equalization. To enhance this frequency use efficiency, antenna technologies, including Multi Input Multi Output (MIMO) that allows transmission/reception with multiple antennas and Space Division Multiple Access (SDMA) that allows multiple access between base stations, have been introduced. Furthermore, Orthogonal Frequency Division Multiple Access (OFDMA) and Single Carrier Frequency Division Multiple Access (SC-FDMA) are used as multiplexing systems.

Keywords: LTE, SC-FDMA, OFDMA,MIMO, equalization, MMSE-BLE, RNN.

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INFLUENCE OF ERRORS ON THE ACCURACY OF THE SPATIAL MONITORING RESULTS UNDER REDUNDANT INFORMATION (p. 8-13)

Yuri Kulyavets, Oleg Bogatov, Elena Ermakova

The presence of information redundancy allows to obtain an overall estimate by various relatively simple measuring devices using minimally sufficient set of fundamental measurements. Herewith, estimated parameters tend to be related to the measured initial estimates of nonlinear functional relationships. Therefore, direct use of the maximum likelihood method leads to the necessity of solving systems of nonlinear equations. Applying the linearization method of nonlinear functional relationships allows to obtain optimal (in this case maximum likely) estimates of the final parameter and the correlation matrix of estimation errors in an explicit form. Herewith, solving the problem of optimal use of estimates of the same state vector obtained by different methods simultaneously, is reduced to a consistent application of the estimate filtering algorithm. However, the weight matrix, included in the expression for determining the overall estimate depends on the values of the measured parameter and is not always known a priori. Based on this, without dwelling on the possible ways of obtaining the weight matrix, the analysis of the influence of its determination accuracy on the overall estimate accuracy was performed. It is shown that the elements of the correlation error matrix of the overall parameter estimate

depend not only on the accuracy of the initial estimates, obtained from different measuring devices simultaneously, but also on the estimation accuracy of the weight matrix, methods of its determination and the closure error of initial parameter estimates.

Keywords: information integration, parameter measurement, independent measuring devices, estimate filtering, weight matrix.

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APPROACH TO THE REFERENCE DATABASE DEVELOPMENT FOR PROCESSING ABNORMAL SIGNALS OF TENSOMETRIC SYSTEMS (p. 13-20)

Nikolai Kopytchuk, Peter Tishyn, Igor Kopytchuk, Igor Mileiko

An algorithm for eliminating abnormalities when measuring signals in processes, proceeding under uncertainty was proposed in the paper. A mathematical model for representing an arbitrary signal, the parameters of which are calculated for a set of standard concepts make the basis of the formed reference database. Based on the analysis of the formed signal reference database, the possibility of applying the model for eliminating abnormalities in the current signal was proved. The problem of restoring signals with abnormalities, using the generated reference database was formulated. To solve the problem, the algorithm for eliminating abnormalities when processing the signals, obtained in the tensometric systems was developed. Its characteristic feature is the classification of the plurality of pilot signals using a set of fuzzy features.

Many standard representations of signals without the abnormalities, generated by an expert, have allowed to develop a reference database of signals without the abnormalities that is represented by a set of values of the mathematical model parameters.

The common result is the ability to process abnormal situations, arising in tensometric systems that can not be determined by other methods.

Keywords: time series, fuzzy logic, knowledge base, abnormality classification, tensometry.

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THROUGHPUT ANALYSIS OF WIRELESS CHANNEL IN BOOSTING MODES (p. 20-24)

Sergey Nesterenko, Iuliia Nesterenko

In addition to the basic transmission mode, leading manufacturers of integrated circuits for wireless devices such as Atheros, Broadcom and TexasInstruments insert a number of additional modes into their products, aimed at increasing the throughput of wireless channel of the IEEE 802.11g standard, the so-called boosting modes.

The analysis of the additional boosting modes for the wireless channel of the IEEE 802.11g standard was performed in the paper. It is shown that in contrast to the basic transmission mode for these modes, there are no mathematical models and throughput studies of wireless channels which operate in these modes.

The mathematical models for calculating the maximum throughput of the wireless channel of the IEEE 802.11g standard for boosting modes: CompressionMode, BurstingMode, FastFrames and DynamicTurbo were obtained. Mathematical models analytically express the dependence of the maximum throughput of the wireless channel on the data frame size. Using the obtained models, a study of the maximum throughput of the wireless channel of the IEEE 802.11g standard for the given transmission modes was carried out.

Studies have shown that these modes provide an increase in the maximum throughput of the wireless channel from 33 % to 50 % compared with the basic transmission cycle of the IEEE 802.11g standard. Based on the studies, a conclusion on the feasibility of using these modes for increasing the throughput of wireless networks was made. For each of the modes, upper limits of the throughput increase of the wireless channel of the IEEE 802.11g standard were defined.

Keywords: wireless channel, boosting modes, mathematical model, maximum throughput.

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RATIONALE FOR THE CHOICE OF PARAMETERS OF TEST CONTROL SYSTEMS IN DYNAMIC OPERATION (p. 24-29)

Sergey Kondrashov, Igor Hrihorenko, Marina Oprishkina, Mihail Trokhin

The paper considers an effective approach to scientific and practical problems of improving the accuracy of primary electrical transducers. We have analyzed the application of test experiments with non-dismantling control in working conditions with the use of relation and difference correction operators. Owing to the devised methods of minimizing dynamic measurement errors for transducers with non-linear converting function we managed to decrease the dynamic measurement error by 5.0 % from the current analogues. We have estimated the measurement errors for the exponential input signal and researched functional correction operators resulting from nonlinear indirect measurements. The devised engineering method for determining the parameters of test control systems allows solving the problems of synthesis and analysis of the latter: obtaining the necessary amount of ADC bits with the criterion of specified accuracy of measurements, or solving an inverse, in fact a more common, problem and calculating the system accuracy for a specified ADC capacity.

Keywords: test control, electrical transducers, fractional and rational transformation function, non-linearity error.

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K-PLUS-NEAREST NEIGHBOR METHOD DEVELOPMENT FOR CREDIT SCORING MACHINE LEARNING TASKS (p. 29-38)

Oleksandr Soloshenko

The pace of development of modern risk management and data mining technologies causes the relevance of searching for new or improved effective methods for statistical and non-statistical forecasting, as well as forming the problems of deep study of existing methods and characteristics of their application conditions. Machine learning, namely memory-based learning is one of the most practically useful, broad and insufficiently studied areas. Also, the development of modern information technologies and ways to improve readability and simplicity of code causes the relevance of the study support with the implementation of the fourth-generation programming language.

The research deals with developing basic and advanced k-plus-nearest neighbor method as significantly improved classical k-nearest neighbor method with eliminated shortcomings and inaccuracies of practical realization: the problem of selecting a metric space and the metrics itself, problem of using categorical (including sampled) variables on the set, the issue of probabilistic classification, problem of taking into account equally spaced groups of elements relative to the element to be classified, the model optimality criterion based on the method and the method of its use for selecting the optimal parameter, ways to accelerate application. The main work is focused on using the methodology and indicators of credit scoring in machine learning problems. The full code for the basic proposed method in the SQL language – MS SQL (T-SQL) dialect was given.

As a result of the study, efficiency was determined at the stage of applying the basic proposed method in terms of the optimality criterion – Gini index relative to probabilistic forecasts compared to logistic regression in terms of two factors: the quality of forecasts and number of parameters to be optimized.

The practical value of the results obtained on the example of simulation using mass consumer credit data lies in the simplicity and effectiveness of the proposed method by means only of the server part of the DBMS.

Keywords: k-nearest neighbor method, credit scoring, binary classification, structured query language.

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ROBUST ADAPTIVE CONTROL SYSTEM WITH UNKNOWN DELAY COMPENSATION UNDER NONSTATIONARITY AND EXTERNAL DISTURBANCES (p. 39-45)

Mykhailo Lysytsia, Pavlo Lysytsia

Robust control system of non-stationary object with unknown variable limited state delay under disturbances was synthesized using only the measured value of the object output signal and calculated values of the observer of derivatives of additional loop and observ e r of pseudoderivatives of the main loop.

The idea of calculation of pseudoderivatives lies in using the calculation formula of derivatives with the introduction of additional corrective matrix, which in the last line, at the observer matrix dimension of ≥2, includes the values, accordingly depending on the number μ, determining the gain of pseudoderivatives.

Based on the proposed calculation algorithm of pseudoderivatives instead of the algorithm of derivatives of the observer of the main control loop, object control error with the specified uncertainty class of up to 7×10^{-4}, which is by 37 times less than the error of the current system with the same value of the coefficient m was reduced. Comparative transients confirm the effectiveness of the proposed adaptive control method of non-stationary objects of the given uncertainty class based on the observer of pseudoderivatives.

Keywords: robust control system, variable delay, non-stationary object model, observer of pseudoderivatives.

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DEVISING THE LAW OF AUTOMATIC COMPENSATION FOR A FAILED ENGINE IN A GOING AROUND PLANE

Vadym Morozov, Sergii Morozov

The paper presents a numerical simulation of an automatic go-around of an aircraft with a failed engine. When an engine fails, it reveals additional resistance force as well

as entails unbalanced forces and moments at a roll and a yaw rotation. To quantify an automatic go-around of an aircraft with a failed engine, the value of the steady climb full gradient should not be lower than its minimum set point. Thus, for a four-engine airplane the minimum set value of the full steady climb makes up 2.7 %.

An automatic go-around of an aircraft with a failed engine (with no regard to the failure compensation) is characterized by a decreased full gradient of the steady climb and the current gradient as well as a "sluggish" acceleration of the aircraft speed and climb.

The synthesis of the law of automatic compensation for a failed engine is based on the principle of direct measurement of disturbances and their application in a loop control of the rudder. The measured disturbances typical of an engine failure include deviation of the set rotor speed of low-pressure fans for the left and right engines as well as a lateral acceleration in the direction of the failed engine.

The devised law of automatic compensation for a failed engine in the rudder channel allows to increase the supply of a complete steady gradient of an aircraft climb by 2.0–3.0 % and improve the dynamics of velocity acceleration and the aircraft climb.

Keywords: go-around, engine failure, full (complete) gradient, rudder.

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