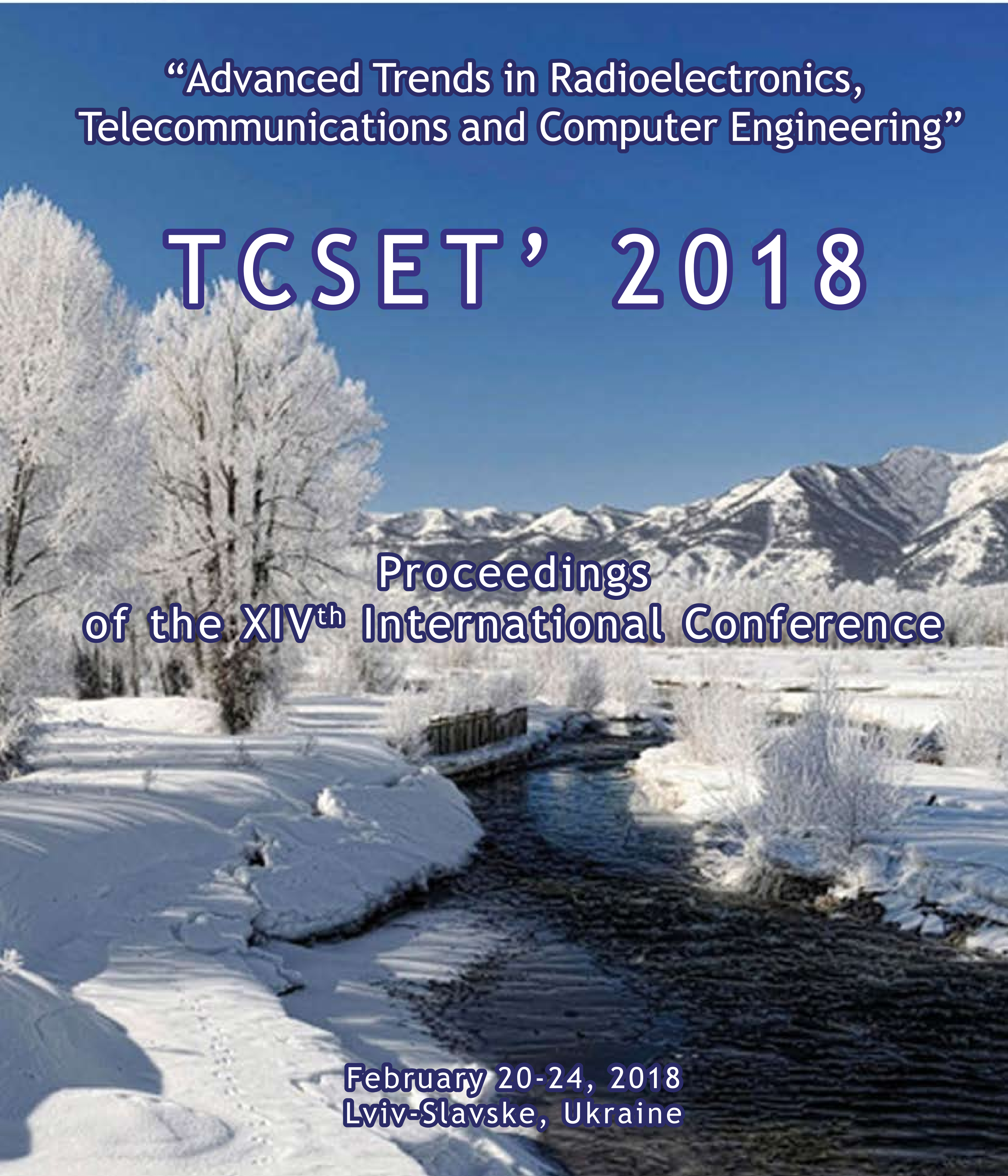
NATIONAL UNIVERSITY LVIV POLYTECHNIC 1816

IEEE
IEEE UKRAINE SECTION

Military University of Technology



“Advanced Trends in Radioelectronics, Telecommunications and Computer Engineering”

TCSET’ 2018

Proceedings of the XIVth International Conference

February 20-24, 2018
Lviv-Slavske, Ukraine

in partnership with

14th International Conference on

Advanced Trends in Radioelectronics, Telecommunications and Computer Engineering (TCSET)

Conference Proceedings

Lviv-Slavske, Ukraine

February 20-24, 2018

Proceedings of 14th International Conference on Advanced Trends in Radioelectronics, Telecommunications and Computer Engineering (TCSET), Lviv-Slavske, Ukraine, February 20 – 24, 2018, 270 papers.

These proceedings depict new areas of development of information and communication systems, networks and technology, principles of optical transport networks construction, signals processing methods and methods of data protection in telecommunication networks, radioelectronic devices and systems, and computer engineering.

IEEE Catalogue Number: **CFP1838R-ART**
ISBN (IEEE): **978-1-5386-2556-9**

Papers are presented in authors' edition.

Magnetic Antennas and Magnetic Probes

Pawel Bienkowski, Hubert Trzaska
Telecommunications and Teleinformatics Department
Technical University of Wroclaw
Wrocław, Poland
pawel.bienkowski@pwr.wroc.pl,
hubert.trzaska@pwr.wroc.pl

Vitalij Nichoha
Department of Radioelectronic Devices and Systems
Lviv Polytechnic National University
Lviv, Ukraine
nich@org.lviv.net

***Abstract* – In the paper are presented designs and applications of magnetic field radiators and sensors mainly in the aspect of basic bioelectromagnetic studies and measurements related to H-field measurements for labor safety and environment protection purposes.**

Keywords – H-field sources; exposure systems and measurement; bioelectromagnetics; labor safety; environment protection; electromagnetic compatibility.

I. Introduction

The magnetic field generation and sensing is mainly based upon loop antennas applications. Although the size of a loop (in electrical sense) may be arbitrary one, presented deliberations are focused upon small-size devices. The approach is a result of the authors' involvement in the area of the standard ElectroMagnetic Field (EMF) generation and metrology for susceptibility studies. Especially in bioelectromagnetics and generally understood EM environment protection. It requires a special attention to be paid to phenomena characterizing the near-field that usually are omitted in considerations related to telecommunications, limited to the far-field.

The paper is based mainly on the authors experience and their proposals related to new solutions and applications of H-field standards, exposure systems and the field sensing. Till now presented ideas [1, 2] are widened and the newest concepts are added.

II. A LOOP AS A TRANSMITTING ANTENNA

The main advantage of the loop antenna is a possibility to design a resonant loop even at very low frequencies. A concurrent solution, sometimes used in telecommunications, is here a whip antenna. Let's briefly compare the both solutions.

The input resistance of a short whip (ground plane antenna) R_w, over perfectly conducting ground, is expressed by [3]:

$$R_w = 10(kh)^2 \tag{1}$$

Where: h is a length of the whip,
k = 2π/λ – propagation constant,
λ is the wavelength.

The losses resistance of the whip R_{wl} is given by [4]:

$$R_{wl} \approx \frac{100 \cdot 10^{-6} h}{r}\sqrt{\frac{f}{\sigma}} \tag{2}$$

Where r is the radius of the whip wire,
f is frequency,
σ is conductivity of the wire.

Combining both the formulas we may evaluate the radiation efficiency of the whip η_w:

$$\eta_w \approx \frac{1}{1 + R_{wl} / R_w} \tag{3}$$

Similar considerations for the small loop give its radiation resistance R_l [3] and the losses resistance R_{ll} [4] in the following form:

$$R_l = 320\pi^4 \left(nS\lambda^{-2}\right)^2 \tag{4}$$

and:

$$R_{ll} = \frac{315 \cdot 10^{-6} nc}{r}\sqrt{\frac{f}{\sigma}} \tag{5}$$

Where S is the loop surface,
n is number of turns,
c is the loop circumference.

Both the formulas allow to introduce radiation efficiency of the loop η_l:

$$\eta_l = \frac{1}{1 + 0.82 \cdot 10^{26} c / rnS^2 \sigma^{1/2} f^{7/2}} \tag{6}$$

An important parameter of a transmitting antenna is its efficiency. Strict analysis of presented formulas allows to conclude that the loop antenna, as a transmitting one, is more effective at frequencies below several megahertz. The efficiency of the whip, as given by formula 3, was introduced for ideal ground. The real earth (or other type of counterpoise) reduces the efficiency and makes it dependent from the earth conductivity. An advancement of the loop is its relatively small sensitivity to surroundings and a possibility to increase a current feeding the loop in Q-times (where Q is quality factor of the loop) while the loop is tuned to resonance.

978-1-5386-2556-9/18/$31.00 ©2018 IEEE

III. A LOOP AS A RADIATOR

As may be concluded from the above considerations a loop antenna, as a transmitting antenna, has several advancements at relatively low frequencies. In our case, as a radiator, has important possibility: a generation of H-field which parameters (intensity, polarization) may be precisely calculated. The first application here is a H-field standard.

The basic set of a H-field standard, widely applied for H-field meters calibration, is shown in Fig. 1.

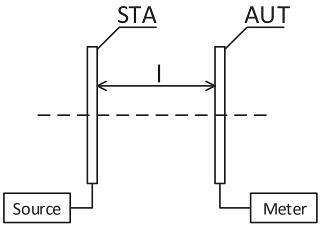


Fig. 1 H-field meter calibration

Axially, at distance l from a standard transmitting antenna (STA) is placed loop antenna of a calibrated meter (AUT). The average H-field intensity (H_{av}), at the surface of the antenna, in the first approximation, is given by [1]:

$$H_{av} = \frac{IS}{2\pi l^3}\sqrt{1+k^2l^2} \quad (7)$$

Where I is current feed to the STA.

This approach is applied for H-field probes calibration in vide frequency range as well as for selective E-field meters designated for propagation studies at frequencies below 30 MHz. Apart from an loop antenna, in the latter case, the meters shows indications in E-field units. It is often forgotten that the procedure is valid only for the far-field conditions, where relation between the both field components is constant and equals $E = HZ_0$ (where Z_0 is intrinsic impedance of frees space, $Z_0 = 120\pi$ ohms). The procedure is invalid in the near-field conditions.

Similar set as above may be used in so called substitution method. In this method a role of a radiator may be played by arbitrary loop. Thus, at distance l, coaxially to the radiating loop, is firstly placed a standard receiving antenna (SRA) and then it is replaced by an antenna of calibrated meter. One of our first improvements, which allow an increase the calibration procedure accuracy, was a proposal of the double calibration method. The idea of the calibration is shown in Fig. 2.

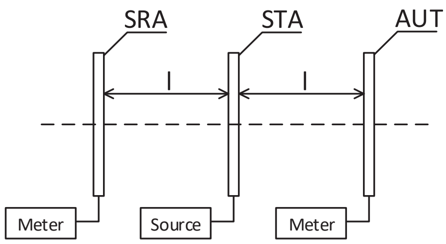


Fig. 2 Double calibration method

In the center, between a SRA and an antenna under test (AUT) is placed a STA. The set allows simultaneous calibration using both the methods. Then a replacement of SRA and AUT and distances l makes it possible to reduce calibration errors and a more accurate estimation of the calibration accuracy. The bench for H-field probes double calibration, in the authors' lab, is shown in Fig. 3.

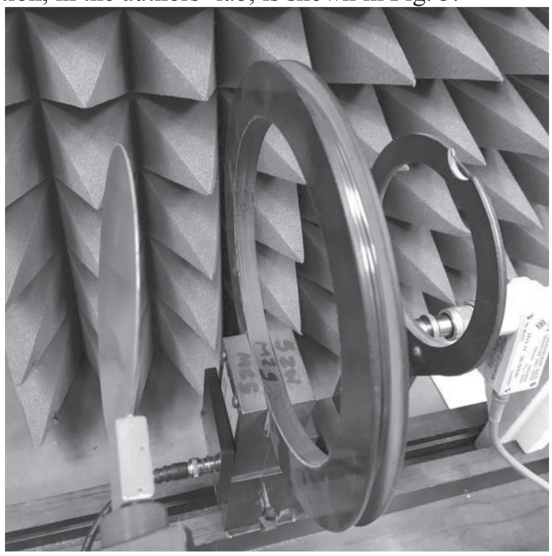


Fig. 3. Double calibration of a H-field probe

Another possibility of the set shown in Fig. 1 is its use for whip and dipole antennas calibration. Such a calibration especially performed at lower frequencies. The use of traditional methods using for calibration standard whips or dipoles, is sensitive to geometry of propagation between radiating and calibrated antenna, surroundings and even wiring configuration. It makes the approach troublesome and inaccurate. Proposed method assures more stable and accurate calibration and is more comfortable and easier in the use. An idea of the method is shown in Fig. 4.

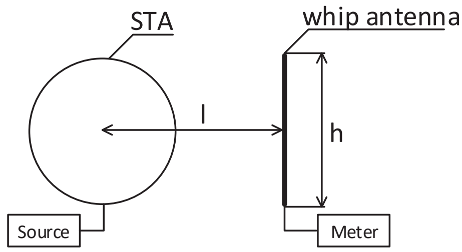


Fig. 4. A whip antenna calibration

A whip (or dipole) antenna of length h is placed at distance l from the STA, in the plane of the STA. Average E-field intensity E_{av}, at the calibrated antenna length is given, in the first approximation, by [1]:

$$E_{av} = \frac{IS}{2\pi l^3}\sqrt{1+k^2l^2} \quad (8)$$

An input impedance of a loop antenna, well below its resonant frequency, is majorized by imaginary part of the impedance. The reactance is proportional to frequency. Thus, if the antenna is fed with a constant voltage, the H-field intensity increases proportionally with frequency. This effect may make more difficult measurements of a frequency response of wideband H-field probes. Although it is possible to take into account this effect in computer controlled calibration systems, in order to simplify the procedure was proposed to feed the STA through a low band-pass filter is set as shown in Fig. 5.

Fig.5. A frequency independent concept.

In above presented considerations and solutions a polarization of the field was not taken into account. For the far-field meters calibration in linear polarized H-field is enough. Traditional calibration of omnidirectional H-field probes, containing three mutually independent loops, was performed by triple calibration – separate for any of the probe's three loops. A bit more advanced method has been proposed. The method is almost identic to the solution presented in Fig. 1, however includes two identic STAs, placed perpendicular one to each other and fed with a current in the quadrature, as shown in Fig. 6.

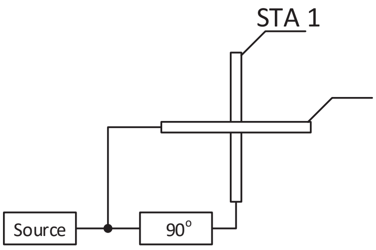


Fig. 6 H-field standard with circular polarization.

All the above designs may be applied both as primary standards for meters calibration (as discussed) and as exposure systems for electromagnetic compatibility (EMC) purposes. As far as susceptibility to H-field of nonliving devices or materials is performed the linear polarization may be enough; however, in the case of exposure *in vivo* the approach leads to errors in the real exposure estimations as absorbed energy of the field depends upon position of an exposed animal in relation to the field vector (-s). Thus, it is possible (and, unfortunately, widely applied in bioelectromagnetic experiments) to immobilize the animal; however, a stress due to the immobilization may totally falsify results of the experiment. In the case of animal's unlimited behavior a precise estimation of EMF energy deposed (absorbed) in the animal's body is impossible. The best solution it would be a spherical polarized field. Unfortunately, such a solution is physically impossible. Thus, a quasispherical polarization is proposed. An idea of the polarization is shown in Fig. 7. Three, mutually perpendicular and placed coaxially, loops are fed with currents given by formulas:

$$\begin{aligned} I_1 &= A\cos(\Omega t + \Phi) \\ I_2 &= B\sin(\Omega t + \Phi)\sin(\omega t + \varphi) \\ I_3 &= C\sin(\Omega t + \Phi)\cos(\omega t + \varphi) \end{aligned} \tag{9}$$

Where: I_1, I_2 and I_3 are currents fed to separate antennas,
Ω is a carrier wave frequency,
Φ is phase of the carrier wave,
ω is a rotating frequency,
φ is phase of the rotating frequency
A, B and C are amplitudes.

The vector sum of the currents (and, as a result, generated by them H-fields, for A = B = C, leads to a direction independent constant value – equal to the amplitude of generated H-field of quasispherical polarization. The field in the center of the loops is polarized circularly (elliptically) at the carrier wave frequency and then rotated in the space with auxiliary rotating frequency. It assures presence of three spatial components of the field. Selection of phases and amplitudes assure a possibility to generate H-field from linear to quasispherical polarization, arbitrary located and with arbitrary rotations' direction (left- and right-hand polarization).

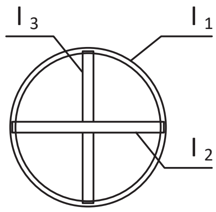


Fig. 7. A concept of quasispherical polarization.

Solution presented in Fig. 7 assures very limited volume in which uniformity of the field may be assumed as satisfying. In the case of larger objects exposure a set of three, mutually perpendicular Helmholz coils is proposed as shown in Fig. 8.

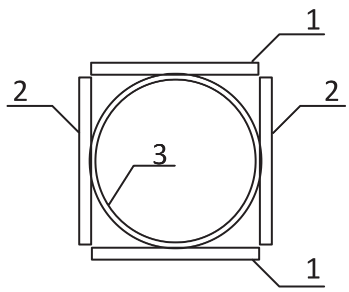


Fig. 8. Three Helmholz coils.

Apart from quite uniform exposure of free moving animals presented solutions of quasispherical polarized fields may be of use in EMC studies as well. They would assure a possibility to study a response of an object under test to arbitrary polarized field without a necessity to move (turn) it.

IV. A LOOP AS A RECEIVING ANTENNA

Contrary to the transmitting case, here an effective high h_{eff} of the antenna is of concern. It is given by [2]:

$$h_{eff} = \frac{2\pi nS}{\lambda} \quad (10)$$

It means that the electromotive force, induced by the field in the loop, is frequency dependent. This is of secondary importance in loop antennas applied in the far-field E-field meters, H-field SRAs', ferrite rod antennas in radio-receivers and similar applications. However; it creates problems of twofold nature in the case of the loops playing a role of sensors in wideband, H-field meters:

1. The frequency response of wideband meter (probe) should be flat within the measuring frequency range. Required flatness is obtained by the way of the probe connection to it's' load via a low band-pas filter matched to the lower corner frequency of the probe (LF_1, see Fig. 9).
2. Formula (10) is valid for small-size antennas. At higher frequencies an antenna may become resonant one and number of the resonants may be infinite one: the first at resonant frequency of the antennas' self-inductance and self-capacitance, including dispersed capacitances of the circuitry, the second at frequency at which the antenna reaches resonant sizes and farther at its any harmonic frequency. In order to eliminate deformations of the frequency response another low-pass filter (-s) (LF_2) is indispensable.

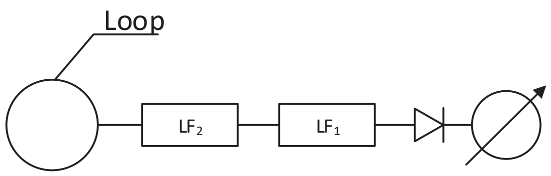


Fig. 9 Block diagram of a wide-band H-field meter

Another requirement to the near field meters, especially that designated for protection purposes, is an ability to simultaneous measure the three spatial H-field components. Solutions are known in the form of three probes (antennas) placed perpendicularly one to each other [5]. However; the solution, although widely used in meters offered at the market, is loaded by an inconvenience, that was never discussed or revealed before. As shown in Fig. 9 the output voltage of an antenna is detected by a diode. In an omnidirectional probe the output voltages of the three loops are summed. The pattern is omnidirectional if the sum is with square. Dynamic characteristic of a diode is square-law only in its beginning part, and then it becomes linear. Thus, as a result, the sum becomes linear as well. It results in the pattern deformations as deep as 3 dB, as shown in Fig. 10.

At the end it should be mentioned that H-field measurements for our purposes, especially at low frequencies, may be performed using other types of sensors; for instance: Hall cell, magneto-resistors or diodes and others. They were here omitted as the presentation is limited to antenna-type sensors. The main advantages of the latter are their sensitivity and widebandness

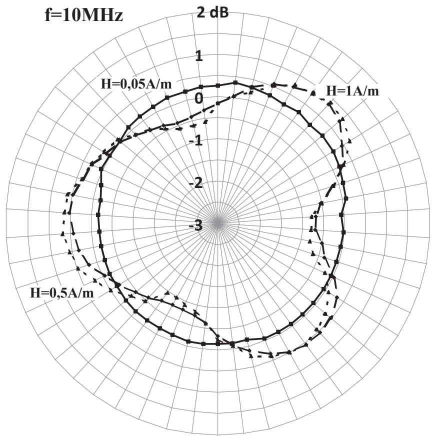


Fig. 10 Measured directional patter deformations of a omnidirectional H-field probe at two different field levels.

V. FINAL COMMENTS

In the paper several problems of H-field antennas were discussed. The main role in the considerations played a loop antenna in dual role: as a receiving and as a transmitting antenna. The considerations were limited mainly to the authors' involvement in the field of EMF standard fields generation (for H-field meters calibration an in a role of exposure systems) and H-field measurements, related to protection against unwanted exposure to EMF. All these problems are related to specific conditions of the near-field, where any approximations, specific to the far-field relationships, are nonacceptable.

The main aim of the authors work is a possibility to make discussed procedures easier, simpler and more accurate. The latter is the most important as the EMF measurements and standards are one of the least accurate within metrology of other physical magnitudes. The importance is justified by urgent necessity to precise estimation of a role played by electromagnetic environment pollution in humans and, especially in the conditions while more and more people is exposed to EMF and trends here are unidirectional.

In order to illustrate possibilities in the area several original solutions, proposed by the authors, are presented.

REFERENCES

[1] E. Grudzinski, H. Trzaska, "EMF standards and exposure systems," SciTech Publ. Inc. 2013.

[2] P. Bienkowski, H. Trzaska, "EM Measurements in the near-field," SciTech Publ. Inc. 2012.

[3] A.S.Lavrov, G. B. Reznikov, "Antenna & feeder devices" (in Russian), Moscov, Sowetskoe Radio 1974.

[4] R. W. P. King, "The theory of linear antennas", Harvard University Press, Cambridge, MA, 1956.

[5] V. Nichoga, I. Gontar, P. Dub, "Three-component Wide-band Low-frequency Magnetic Antenna for Diagnostics of Magnetic Fields in Outboard Space," Proc. 5th Int. Conf. TELSIKS'2001, Nis, Yugoslavia, 19-21 Sept. 2001, Vol. 2, pp. 657-660.

TABLE OF CONTENTS

No.	Paper Title	Page No.

S1: Radar systems, satellite communication, navigation, positioning systems, monitoring

1.	**Two Frequency Radiometric Complex for Atmosphere Research** Olexiy Odokienko, Volodymyr Pavlikov, Nikolay Ruzhentsev, Valeriy Volosyuk, Semen Zhyla, Sobkolov Anton and Nguyen Van Huu	**28**
2.	**Radar Recognition of Given and Unknown Meteorological Objects** Valeriy Bezruk and Grigoriy Khlopov	**32**
3.	**BER measurements in the evaluation of operation correctness of VSAT modem traffic interfaces** Jan Kelner, Bogdan Uljasz and Leszek Nowosielski	**36**
4.	**A Method of Swath Calculation for Side-looking Airborne Radar** Michał Łabowski and Piotr Kaniewski	**41**
5.	**Drone-Based System for Localization of People Inside Buildings** Piotr Kaniewski and Tomasz Kraszewski	**46**
6.	**Determining the Radiation Field of UWB and Multiband Antenna** Valeriy Volosyuk, Simeon Zhyla and Volodymyr Holopov	**52**
7.	**Filtration of parameters of the UAV movement based on the RSS-measurement at the unknown power of the transmitter** Igor Tovkach, Oleksandr Neuimin and Serhii Zhuk	**57**
8.	**Performance of Corrugated Feed Horn for Satellite Earth Station Antennas** Aykut Demirci and Nurhan Turker Tokan	**61**
9.	**Fuzzy Verification Method for Indoor-Navigation Systems** Olga Petrova, Galyna Tabunshchyk, Tetiana Kapliienko and Oleksandr Kapliienko,	**65**
10.	**Accuracy analysis for object positioning on a circular trajectory based on the UWB location system** Damian Grzechca, Krzysztof Hanzel and Krzysztof Paszek	**69**
11.	**Methodical maintenance of radiometric measurements of atmosphere at millimeter waves range** Oleksandr Tsopa, Nikolay Ruzhentsev, Vladimir Pavlikov and Anatolii Merzlikin	**75**

No.	Paper Title	Page No.
12.	**Radar signal identification using a neural network and pattern recognition methods** Jan Matuszewski	**79**
13.	**Algorithm for Optimal Primary Signal Processing in a Radiometer with an Unstable Gain** Valeriy Volosyuk, Olexiy Odokiyenko and Volodymyr Pavlikov	**84**
14.	**Compensation of frequency instabilities of a magnetron auto generator as a way of incoherent radar stations characteristics improving** Anatoliy Zubkov, Yehor Herasymenko, Andrii Diakov and Sergiy Fabirovskyy	**88**
15.	**Synthesis of Components Effectiveness Factors of Guard Signaling Complex with Layout of Three Seismic Sensors in Control Zone and with Majority Principle of Taking Decisions** Bohdan Volochiy, Volodymyr Onyshchenko, Mykhailo Zmysnyi and Ihor Kulyk	**92**
16.	**The problem of low-flying and small-scale targets monitoring over the water surface by a millimeter-wave radar** Petro Kondratov, Albert Oganesjan, Viktor Tkachenko, Sergiy Fabirovskyy and Leonid Lazko	**98**
17.	**Methods of multispectral image fusion at the pixel level** Andrii Hryvachavskyi, Ivan Prudyus, Leonid Lazko and Sergiy Fabirovskyy	**102**
18.	**Microwave motion sensor with amplitude-manipulated reflected signal** Valeriy Oborzhytskyy, Volodymyr Storozh and Yurij Matiieshyn	**108**

S2: Information systems and technologies, computer-aided design

No.	Paper Title	Page No.
19.	**Advanced Software-Technological Approaches for Mobile Apps Development** Andriy Luntovskyy	**113**
20.	**Detection of multispectral input images using nonlinear artificial neural networks** Vasyl Lytvyn, Ivan Peleshchak, Roman Peleshchak and Roman Holoshchuk	**119**
21.	**The Special Deep Neural Network for Stationary Signal Spectra Classification** Sergey Subbotin	**123**
22.	**Implementation quadtree method for comparison of images** Galina Kirichek and Viacheslav Kurai	**129**
23.	**Parallel 3D Brain Modeling & Feature Extraction: ADNI Dataset Case Study** Savas Okyay and Nihat Adar	**133**

No.	Paper Title	Page No.
24.	**Creation of Software for Constructive Calculation of Devices with Active Hydrodynamics** Artem Artyukhov, Nadiia Artyukhova and Andrii Ivaniia	**139**
25.	**Designing A Shared Access Memory And Its Application In Data Transmission And Protection Systems** Humenniy Petro, Orest Volynskyy, Ivan Albanskiy and Artur Voronych	**143**
26.	**Computational Accelerators for Analog-to-Digital and Digital Processing of Sensor Signals in Information Measuring Systems** Yaroslav Nykolaichuk, Borys Krulikovskyi, Volodymyr Gryga and Alina Davletova	**148**
27.	**Organizational-Information Technology for Providing and Decisions Making in Situational Management** Tatiana Vlasova, Oleksii Kovalenko and Vladimir Kosolapov	**152**
28.	**Deploying Multidimensional Cellular Automata in the Hash Function Construction** Yuliya Tanasyuk, Sergey Ostapov and Olexiy Konstantinyuk	**158**
29.	**Methods and Means of Expert Evaluation of Software Systems on the Basis of Interval Data Analysis** Iryna Spivak, Svitlana Krepych and Sergiy Budenchuk	**164**
30.	**Production and project activities modeling module of instrument-making enterprise** Nataliia Yehorchenkova and Oleksii Yehorchenkov	**168**
31.	**Experimental Research of Lexical Ontologies for textual information processing** Oleg Bisikalo and Ilona Bogach	**172**
32.	**Ant Colony Optimization algorithm for UAV path planning** Stanislaw Konatowski and Piotr Pawłowski	**177**
33.	**The Approach to SDN Network Topology Verification on a Basis of Temporal Logic of Actions** Vadym Shkarupylo and Olga Polska	**183**
34.	**The methodology of increasing the functional safety of aviation enterprises** Volodymyr Temnikov, Petro Pavlenko, Olena Temnikova and Andrii Temnikov	**187**
35.	**On agent-based approach to influenza and acute respiratory virus infection simulation** Dmytro Chumachenko, Viktoriia Dobriak, Mariia Mazorchuk, Ievgen Meniailov and Kseniia Bazilevych	**192**

No.	Paper Title	Page No.
36.	**An Approach to Synthesis of a Phonetically Representative English Text of Minimal Length** Natalia Bloshchynska, Hennadii Dobrovolskyi, Natalya Keberle and Natalia Myronova	**196**
37.	**Infocommunication System of Scientific Activity Management on the Basis of Project-Vector Methodology** Andrii Biloshchytskyi, Svitlana Biloshchytska, Alexander Kuchansky, Olena Bielova and Yurii Andrashko	**200**
38.	**EMI Simulation of GaN Power Stage for Audio Class D Amplifiers** Yuri Onikienko, Anna Vlasjuk, Volodymyr Lazebnyi and Olga Gedz	**204**
39.	**Classification by Fuzzy Decision Trees Inducted based on Cumulative Mutual Information** Jan Rabcan, Patrik Rusnak and Sergey Subbotin	**208**
40.	**Segmentation of atmospheric clouds obtained by remote sensing** Bohdan Rusyn, Oleksiy Lutsyk, Rostyslav Kosarevych and Valentyna Korniy	**213**
41.	**Growing small businesses using Software system for intellectual analysis of financial performance** Artem Rodin	**217**
42.	**Meta model of compensatory-decompensational approach for architecture of critical it infrastructure designing** Yaroslaw Dorogyy	**223**
43.	**Basics of Using Connected Me System in the Transmission of Information Signals** Kirill Trapezon, Tamara Gumen and Alexandr Trapezon	**229**
44.	**The Method Of Video Streams Processing For Information Technologies Of Aero Monitoring** Vladimir Barannik, Alexsander Musienko, Yuriy Ryabukha, Oleg Suprun and Alexander Slobodyanyuk	**233**
45.	**Dynamic Management of Data Center Resources Using Reinforcement Learning** Sergii Telenyk, Oleksandr Rolik, Eduard Zharikov and Andrii Koval	**237**
46.	**Analysis of Models for IT Projects Prioritization in Telecommunication Company Portfolio** Volodymyr Ostakhov, Viktor Morozov and Nadiia Artykulna	**245**
47.	**Peculiarities of Melin transform application to symbol recognition** Yuriy Furgala and Bohdan Rusyn	**251**

No.	Paper Title	Page No.
48.	**Comparison of optimal path planning algorithms** Mehmet Korkmaz and Akif Durdu	**255**
49.	**Fractal dimension of infinite growing discrete sets** Vadim Shergin, Larysa Chala and Serhii Udovenko	**259**
50.	**Computer-aided Thermal Design of Hermetically Sealed Stackable Electronic Units** Galina Shilo, Yuliya Lopatka and Evgeniy Areshkin	**264**
51.	**Clustering Model of Cloud Centers for Big Data Processing** Mykhailo Klymash, Olga Shpur, Nazar Peleh and Iryna Lutsiuk	**268**
52.	**Information Technology for Structural and Statistical Identification of Hierarchical Objects** Diana Zahorodnia, Yuriy Pigovsky, Pavlo Bykovyy, Viktor Krylov and Anatoliy Sachenko	**272**
53.	**Performance Evaluation of the Grid-based FastSLAM in V-REP Using MATLAB** Salim Azak and Eray Erdogan	**276**
54.	**Experimental Performance Analysis of Software-Defined Network Switch and Controller** Mykola Beshley, Oleksiy Panchenko, Oleg Zyuzko, Marian Seliuchenko and Ihor Kahalo	**282**

S3: Electronic circuits and signals, electro-technical and electro-energetic systems

55.	**Parametrization and identification of energy flows in the ship propulsion complex** Vitalii Nikolskyi, Vitalii Budashko, Sergii Khniunin and Mark Nikolskyi	**288**
56.	**Multichannel system for structuring and transmission entropy-manipulated cipher signals** Artur Voronych, Nataliya Vozna, Oleg Zastavnyy, Taras Grynchyshyn and Taras Pastukh	**295**
57.	**The method of applying acoustic signals in vector and two-dimensional Hemming spaces given in cartesian and in polar coordinates** Bohdan Trembach, Andrij Sydor, Rostyslav Trembach and Roman Kochan	**300**

No.	Paper Title	Page No.
58.	**Speed Synchronization Methods of the Energy-Efficient Electric Drive System for Induction Motors** Mikhaylo Kotsur, Dmytro Yarymbash, Igor Kotsur, Yuliia Bezverkhnia and Andrienko Daniil	**304**
59.	**An Application of Scheme and Field Models for Simulation of Electromagnetic Processes of Power Transformers** Dmytro Yarymbash, Mikhaylo Kotsur, Serhiy Yarymbash, Iryna Kylymnyk and Tetyana Divchuk	**308**
60.	**Fractional Order Transfer Function for Eddy Current Simulation** Volodymyr Moroz, Dariusz Calus and Oleksandr Makarchuk	**314**
61.	**Interval Model of the Piezoelectric Drive** Roman Voliansky, Nina Volianska and Alexander Sadovoi	**318**
62.	**Interconnection and Damping Assignment Passivity-Based Control of Semi-Active and Active Battery/Supercapacitor Hybrid Energy Storage Systems for Stand-Alone Photovoltaic Installations** Ihor Shchur and Yurii Biletskyi	**324**
63.	**Performance of Spread Spectrum System with Noise Shift Keying Using Entropy Demodulation** Mykola Kozlenko and Andrii Bosyi	**330**
64.	**Choice of a Capacitor and Formation of the Characteristics of a One-Phase Asynchronous Motor** Vasyl Malyar, Orest Hamola and Volodymyr Madai	**334**
65.	**Coefficient of efficiency of coupled electric power transmission lines** Dmitry Maevsky, Artem Savieliev, Elena Maevskaya, Aleksandr Semenyug and Serhii Horokholynskyi	**340**
66.	**Computer modelling of drill string of an oilwell drilling rig** Andriy Verlan and Volodymyr Fedorchuk	**346**
67.	**Simulation of the Combined System of Power Grid Peak Load Compensation** Valeriy Martynyuk, Grygoriy Il'Chuk, Mykola Fedula and Roman Petrus	**351**
68.	**Inverse Bifurcation Problem for von Karman-type Elliptic Equations** Obodan Natalia, Adlucky Victor and Gromov Vasilii	**357**
69.	**Simulink-model of magneto-thyristor voltage regulator for active load** Yaroslav Paranchuk, Roman Paranchuk and Volodymyr Tsyapa	**361**
70.	**The estimation of the influence of the multiplier characteristics nonlinearity on the output signals of the quadrature modulator QPSK** Bohdan Mandziy, Yuriy Shapovalov, Ksenia Chaban and Dariya Bachyk	**365**

No.	Paper Title	Page No.
71.	**Transient Analysis of High-Frequency Transmission Lines as Components of Heterogeneous Systems** Serhiy Rendzinyak and Vasyl Korud	369
72.	**Features of calculation procedures used for transient processes calculation in electric systems and their components described by macromodels** Petro Stakhiv and Oksana Hoholyuk	375
73.	**Designing of Omnidirectional Speaker for Automation of Acoustic Measurement Process** Mykhaylo Melnyk, Roman Vynarovych, Taras Kvasnytsya and Mykhailo Lobur	380

S4: Electronics, photonics and innovative optical technologies: systems and devices, micro- and nanotechnologies

No.	Paper Title	Page No.
74.	**Microelectronic Frequency Transducer of Power of Optical Radiation** Alexander Osadchuk, Vladimir Osadchuk, Seletska Olena and Lyudmila Krylik	385
75.	**Laser technology of receiving semiconductor glass's microstructures** Vsevolod Novikov, Zenon Hotra, Oleksandr Mieshkov and Lidiya Novikova	389
76.	**The optimization of technology ITO layers for thin-film solar cells** Gennady Khrypunov, Eugene Sokol, Dmytro Kudii and Maksim Khrypunov	393
77.	**Multifunctional Sensors based on Si < B,Ni > microcrystals for Harsh Environment** Anatoly Druzhinin, Igor Ostrovskii, Yuriy Khoverko, Oleksiy Kutrakov and Serhii Yatsukhnenko	399
78.	**The local electron interaction with point defects in zinc blende GaN, CdTe and ZnTe: ab initio calculation** Orest Malyk and Stepan Syrotyuk	405
79.	**Theory of Natural Oscillatory Systems and Advance in Nanoelectronics** Alexander Gritsunov, Igor Bondarenko, Alexey Pashchenko and Oksana Babychenko	410
80.	**Acoustoelectronic processes on the adsorbed surface of a solid** Mariana Seneta, Vasyl Teslyuk and Roman Peleshchak	416
81.	**Road surface hazard warning system for vehicle drivers** Stanislaw Konatowski and Maciej Gołgowski	421
82.	**Analytical Approximations of the Noble Metals Dielectric Permittivity** Volodumyr Fitio, Oleksandr Vernygor, Iryna Yaremchuk and Yaroslav Bobitski	426

No.	Paper Title	Page No.
83.	**Special Features of Structural Design for a Fiber- Optic Microdisplacement Transducer** Sergey Brostilov, Alexey Grishko, Nikolay Yurkov, Tatyana Brostilova and Igor Kochegarov	**431**
84.	**Surface and Bulk Modes of Magnetophotonic Crystals** Alexandr A. Shmat'Ko, Viktoriya N. Mizernik and Eugene N. Odarenko	**436**
85.	**Radiation resistant BJT-based Temperature Sensor for IoT Sensor Nodes** Victor Gorbachev, Ivan Vikulin, Anna Gorbacheva, Victoria Krasova and Sergey Polakov	**441**
86.	**Studies piezoresistive properties of n-type conductivity Indium Antimonide Thin Layers** Anatoly Druzhinin, Inna Maryamova, Oleksiy Kutrakov and Natalia Liakh-Kaguy	**445**
87.	**The global maxima of piezo-optic effect in crystalline materials determined by extreme surfaces method** Oleh Buryy and Anatoliy Andrushchak	**449**
88.	**New high-efficiency material for acoustooptic modulators. Anisotropy of piezooptic effect in TGS crystals** Nataliya Demyanyshyn, Andriy Vas'Kiv, Oleh Buryy, Olena Horina, Victor Shut, Maria Vistak, Bohdan Mytsyk and Anatoliy Andrushchak	**454**
89.	**The Shape Effect on the Optical Properties of Metallic Nanoparticles** Vasyl Varyshchuk, Tetiana Bulavinets, Iryna Yaremchuk and Yaroslav Bobitski	**458**
90.	**Formation of GaAs\AlGaAs epitaxial layers, with gradient profiles of charge carrier distribution** Semen Krukovskyi, Rostyslav Krukovskyi, Hryhoriy Ilchuk, Emilia Zmiiovska and Ihor Semkiv	**462**
91.	**Prospects of graphene use in sensor technology** Inessa Bolshakova, Dmytro Dyuzhkov, Yaroslav Kost, Maxim Radishevskiy, Fedir Shurygin, Oleksandr Vasyliev, Zhenxing Wang, Daniel Neumaier and Martin Otto	**466**
92.	**Temperature effect on electrophysical properties of as-deposited gold nanofilms for use in electronics devices and sensor technology** Inessa Bolshakova, Fedir Shurygin, Anatoly Moroz, Yaroslav Kost, Yuriy Mykhashchuk, Maxim Radishevskiy, Oleksandr Vasyliev and Thomas Kuech	**471**
93.	**Stability of gold nanofilms' based Hall sensors under thermal loads typical for the DEMO ex-vessel environment** Inessa Bolshakova, Fedir Shurygin, Anatoly Moroz, Yaroslav Kost, Yuriy Mykhashchuk, Maxim Radishevskiy, Oleksandr Vasyliev and Thomas Kuech	**475**

No.	Paper Title	Page No.
94.	**A digital lock-in technique for small signal detection with square wave reference over a wide frequency range** Denis Afanassyev and Vasyl Rabyk	**480**
95.	**Nanoengineering of Anisotropic Materials for Creating the Active Optical Cells with Increased Energy Efficiency** Nazariy Andrushchak, Petra Goering and Anatoliy Andrushchak	**484**
96.	**Coherent Laser Induced Synthesis of Rare Earth Doped Nanocrystallites of 50PbO–25Bi2O3–20Ga2O3–5BaO** Iwan Kityk, Ahmed El-Naggar, Abdullah Albassam, Nazariy Andrushchak, Daniel Kulwasis and Bouchta Sahraoui	**488**
97.	**Application of retardation-modulation polarimetry in studies of nanocomposite materials** Andriy Kityk, Patrick Huber, Anatoliy Andrushchak, Przemysław Kula and Wiktor Piecek	**492**
	S5: ICT systems and networks, Internet of Things, Cybersecurity	
98.	**Markov Model of Normal Conduct Template of Computer Systems Network Objects** Ihor Tereikovskiy, Serhii Toliupa, Ivan Parkhomenko and Liudmyla Tereikovska	**498**
99.	**Adaptation of The Neural Network Model to The Identification of The Cyberattacks Type "Denial of Service"** Oleksandr Oksiiuk, Liudmyla Tereikovska and Ihor Tereikovskiy	**502**
100.	**Provision Security in SDN/NFV** Dmytro Ageyev, Oleg Bondarenko, Walla Alfroukh and Tamara Radivilova	**506**
101.	**LVQ models of DDOS attacks identification** Tetiana Babenko, Serhiy Toliupa and Yuliia Kovalova	**510**
102.	**Method For Determining Optimal Transparency Windows For Mobile 5th Generation** Volodymyr Saiko, Volodymyr Nakonechnyi, Serhii Toliupa and Mykola Brailovskyi	**514**
103.	**LUT-object Integrity Monitoring Methods Based on Low Impact Embedding of Digital Watermark** Kostiantyn Zashcholkin and Olena Ivanova	**519**

No.	Paper Title	Page No.
104.	**Improvement of Information Protection Quality of Systems for Observing Airspace** Alexey Strelnitskiy, Ivan Obod, G Zavolodko, Dmytro Gavva and Vasyl Alieksieiev	**524**
105.	**Analysis of Methods for Reducing Topology in Wireless Sensor Networks** Ievgeniia Kuzminykh and Oleksii Popov	**529**
106.	**Metaheuristics in cloud platform traffic engineering** Orest Kostiv, Ivan Demydov, Anatoliy Makarenko and Mykola Tverdohlib	**533**
107.	**The Video Stream Encoding Method in Infocommunication Systems** Vladimir Barannik, Sergey Podlesny, Denys Tarasenko, Dmitriy Barannik and Oleg Kulitsa	**538**
108.	**A Steganographic Method Based On The Modification Of Regions Of The Image With Different Saturation** Vladimir Barannik, Ali Bekirov, Albert Lekakh and Dmitriy Barannik	**542**
109.	**Multilevel Selective Data Processing Method of Frames with Different Information Comparison for Mobile Sensor Networks** Dmytro Havrylov, Vadym Fustii, Oksana Stetsenko, Denis Medvedev and Pavlo Gurzhiy	**546**
110.	**Realization of Rsa Cryptographic Algorithm Based on Vector-Module Method of Modular Exponention** Igor Yakymenko, Mykhailo Kasianchuk and Stepan Ivasiev	**550**
111.	**Automated Subjective Evaluation of Speech Intelligibility in Noise and Reverberation** Arkadiy Prodeus, Vitaliy Didkovskiy, Maryna Didkovska and Igor Kotvytskyi	**555**
112.	**Studying of keystroke dynamics statistical properties for biometric user authentication** Vasyl Alieksieiev, Yuliia Synytsia, Aleksey Strelnitskiy, Dmitry Gavva and Denis Gorelov	**559**
113.	**Innovative Metrics for Assessing the Catastrophic Collapse of the Complex Networks Under the Greedy Attacks on Their Most Important Vertices and Edges** Artem Potebnia	**564**
114.	**Semi-Markov Availability Model Considering Deliberate Malicious Impacts on an Infrastructure–as–a–Service Cloud** Oleg Ivanchenko and Vyacheslav Kharchenko	**570**

No.	Paper Title	Page No.
115.	**The Detection of Hybrid Vulnerabilities and Effects on the Basis of Analyzing the Information Activity in Cyberspace** Yuriy Danyk and Valery Shestakov	**574**

S6: Antennas, microwave technology and electromagnetic compatibility

No.	Paper Title	Page No.
116.	**Application of Superimposed Properties Cards for Efficient 3D MID Process Choice** Larysa Hlinenko and Volodymyr Fast	**579**
117.	**The Log-Periodic Dipole Array Antenna for Monitoring** Olga Shcherbyna and Roman Zadorozhniy	**583**
118.	**Suitability of S-PIN Diodes Used in Reconfigurable Antennas** Yevhen Yashchyshyn, Krzysztof Derzakowski, Grzegorz Bogdan, Konrad Godziszewski, Cheol Ho Kim and Bonghyuk Park	**587**
119.	**Impact of Non-linear Switch Characteristics on the Reconfigurated Antenna Properties** Dmytro Gavva, Olekcii Strelnitskiy, Dmytro Gretskih, Denis Gorelov and Eugene Medvedev	**591**
120.	**Wideband Six-Port Reflectometer** Szczepan Odrobina, Kamil Staszek, Krzysztof Wincza and Slawomir Gruszczynski	**597**
121.	**New Type of Metamaterials based on Composite Spiral Scatterers** Pavel Molochko, Viktor Dmitrenko and Sergiy Romanenko	**602**
122.	**Low-Voltage Class E/F3 High Frequency Oscillator** Vladimir Krizhanovski, Dmitriy Chernov and Andrei Grebennikov	**607**
123.	**Design Procedure of a U-slot Patch Antenna Array for 60 GHz MIMO Application** Mahdi Salarpour, Forouhar Farzaneh and Robert Bogdan Staszewski	**612**
124.	**Magnetic Antennas and Magnetic Probes** Pawel Bienkowski, Vitalij Nichoha and Hubert Trzaska	**616**
125.	**UWB Coplanar Spiral Antenna** Serhii Siden, Anna Vakarchuk and Volodymyr Pyliavskyi	**620**
126.	**Lambert W function application for construction of antipodal Vivaldi-type antenna** Mateusz Pasternak	**624**

No.	Paper Title	Page No.
127.	**Tolerance Definition Method at the Calculation Stage of the Passive Symmetric Microstrip Two-Port Circuits** Valeriy Oborzhytskyy and Ivan Prudyus	**628**
128.	**The Microstrop Line Step Discontinuity Analysis by Transverse Resonance Technique: Method of boundary value problem algebraization** Yulia Rassokhina and Vladimir Krizhanovski	**632**
129.	**Determination of antennas characteristics based on combined beam width** Volodymyr Pelishok, Ihor Tchaikovskyi, Oleg Yaremko and Valeriy Koval	**637**
130.	**Theory of modulated plasmon-polariton antennas** Viktor Hoblyk	**641**
131.	**Determination of Antenna Shape using its Radiation Pattern** Mykhaylo Andriychuk and Yarema Kuleshnyk	**646**
132.	**Wire Media for Pixel Signal Transfer** Dmytro Vovchuk and Leonid Politanskyi	**651**

S7: Biomedical engineering

133.	**Application and automation of a clinical statistical method of Kaplan Meyer for prediction of patient's treatment dynamics** Vsevolod Novikov, Zenon Hotra, Anastasia Novikova and Oleksandr Mieshkov	**656**
134.	**System for registration and analysis of human stabilograms** Bohdan Kolomiiets and Anton Popov	**660**
135.	**Bionic Image Segmentation of Cytology Samples Method** Andrii Rabotiahov, Oleg Kobylin, Vyacheslav Lyashenko and Zoia Dudar	**665**
136.	**Information system for adaptive correction of newborns motor disorders** Sergii Kostishyn, Sergii Zlepko, Dmytro Shtofel, Alexandr Azarhov, Viacheslav Bychkov, Hanna Lepokhina and Sergii Goncharuk	**671**
137.	**Effect of reflection probe displacement on human skin spectra** Oleksandra Hotra and Magdalena Michalska	**675**
138.	**Backward design technology of stump socket for CAD / CAM prosthetics technology** Anna Melnyk, Igor Khudetskyy and Yuliya Antonova-Rafi	**679**
139.	**Variation of pulse signal pectrum under the action of an external force** Yevheniia Yakovenko and Yevhen Storchun	**683**

No.	Paper Title	Page No.
140.	**Measurement modules of digital biometric medical systems based on sensory electronics and mobile-health applications** Nataliya Dorosh, Kateryna Ilkanych, Halyna Kuchmiy, Ivan Boyko, Dmytro Voloshyn and Oleg Dorosh	**687**
141.	**New Signal Markers of Borderline Mental Disorders in EEG** Alexander Tychkov, Alan Alimuradov, Anna Tyhkova, Alexsey Ageykin and Churakov Petr	**692**
142.	**Functionally integrated sensors on magnetic and thermal methods combination basis** Oksana Boyko, Roman Holyaka and Zenon Hotra	**697**
143.	**Robotic hardware and software system for diagnostic and treatment of spine diseases using traction therapy** Kostiantyn Chornyi, Igor Khudetskyy and Yuliya Antonova-Rafi	**702**
144.	**Contactless monitoring of welding processes with computer processing of acoustic emission signals** Volodymyr Shelyagin, Ievgen Zaitsev, Artemii Bernatskyi, Volodymyr Sydorets, Andrii Dubko and Oleksandr Bondarenko	**706**
145.	**Adaptive Wavelet Diagnostic Neuro-Fuzzy System for Biomedical Tasks** Yevgeniy Bodyanskiy, Iryna Perova, Olena Vynokurova and Ivan Izonin	**711**
146.	**Optic Sensors of Enzymes with Sensitive Environment Based On Cholesterol Liquid Crystals** Fedir Vezyr, Zenon Hotra, Zenoviy Mykytyuk, Ivan Diskovskyi and Grygoriy Barylo	**716**
147.	**The method of evaluation bioelectric activity of the brain in the study of electroencephalography** Anna Sobko, Vasily Kozyar, Igor Khudetskyy and Yuliya Antonova-Rafi	**720**
148.	**Liquid crystal active medium for quercetin optical sensor** Orest Sushynskyi, Iryna Kremer, Volodymyr Virt, Marija Vistak, Romana Petrina and Grzegorz Blad	**724**
149.	**Device for the formation of a signal to study the influence of low-frequency field on biological objects** Volodymyr Shkliarskyi, Yuriy Shckorbatov, Yurij Matiieshyn, Volodymyr Grytsay and Taras Smarkutskyi	**728**
150.	**Formation of the Image of Investigated Biological Objects with Small Contrast in a Scanning TV Microscope** Volodymyr Shkliarskyi and Rostyslav Matviyiv	**732**

No.	Paper Title	Page No.
151.	**The Processing of Hyperspectral Images as Matrix Algebra Operations** Alexander Trunov	**738**
152.	**Optical non-invasive brain-computer interface system** Solomiya Lebid	**743**
153.	**Improving the Effectiveness of Electrophysiological Monitoring of the Recurence Laryngeal Nerve During Surgery on Neck Organs** Mykola Dyvak, Volodymyr Tymets and Vasyl Brych	**748**
	S8: Quality, reliability and diagnostics of electronic and information systems and devices	
154.	**Modelling Features of Type I and II Errors of Switching Device for System with Double Hot and Double Cold Redundancy based on Two-Terminal Dynamic Fault Tree** Serhiy Shcherbovskykh and Tetyana Stefanovych	**753**
155.	**Statistical Data Processing in Radio Engineering Devices Operation System** Oleksandr Solomentsev, Valeriyi Kuzmin, Maksym Zaliskyi, Oleksiy Zuiev and Yevhen Kaminskyi	**757**
156.	**Analysis and comparative study of methods of improving the quick-speed of communication of multimedia data in computer networks** Alla Goriushkina and Irina Ilina	**761**
157.	**Diagnostic Mathematical Model of Radio-electronic Devices** Mykola Kasian and Kostiantyn Kasian	**766**
158.	**Multi-Optional Hybrid Effectiveness Functions Optimality Doctrine for Maintenance Purposes** Andriy Goncharenko	**771**
159.	**Nondestructive hermetic seal diagnostics and prediction method for super-high-frequency modules** Igor Kovtun, Juliy Boiko and Svitlana Petrashchuk	**776**
160.	**Admittance Research and Simulation of Nonelectrical Nature Object Properties** Tetiana Bubela, Vasyl Yatsuk, Yevgen Pokhodylo, Mykola Mykyychuk and Vasyl Dmytriv	**781**
161.	**Solar Simulator for Photovoltaic Devices Based on the Electrodeless Sulfur Lamp** Tetyana Frolova and Andrii Frolov	**785**

No.	Paper Title	Page No.
162.	**Methods for Quantum Analysis of Digital Circuits** Vladimir Hahanov, Ivan Hahanov, Svetlana Chumachenko, Anastasia Hahanova and Eugenia Litvinova	**790**
163.	**Providing the Adequacy of Models of Quasi-Normal Distribution of Radio-Electronic Devices Parameters** Yuriy Bobalo, Myroslav Kiselychnyk and Leonid Nedostup	**797**
164.	**Method of Developing Unified Model for Estimating Safety and Reliability of Complex Systems for Critical Application** Bohdan Volochiy and Leonid Ozirkovskyy	**801**
165.	**Hidden faults in FPGA-built digital components of safety-related systems** Oleksandr Drozd, Viktor Antoniuk, Valeria Nikul and Myroslav Drozd	**805**
166.	**Analysis of the Maintenance Strategy Effectiveness Based on the Reliability/Cost Ratio** Leonid Ozirkovskyy, Ihor Kulyk, Andriana Mazur, Nataliia Petryshyn and Yuliia Malynovska	**810**

S9: Simulation in radio electronics, communications and computer sciences

No.	Paper Title	Page No.
167.	**Mathematical modeling of anisotropic visco-elastic environments with memory based on integro-differentiation of fractional order** Yaroslav Sokolovskyy, Maryana Levkovych, Olha Mokrytska and Vitalij Atamanyuk	**816**
168.	**Mathematical Model of the Generator on the Basis of Transistor Structure with the NDR** Olexander Osadchuk, Vladimir Osadchuk and Iaroslav Osadchuk	**821**
169.	**Inayet Ozge Aksu and Ramazan Coban** Second Order Sliding Mode Control of MIMO Nonlinear Coupled Tank System	**826**
170.	**Waveform generation for the digital synthesis systems based on embedded hardware** Andriy Samila, Galina Lastivka, Leonid Politansky and Taras Kazemirskiy	**831**
171.	**Mathematical Modeling of the Two-Stage Chaotic Colpitts Oscillator** Andriy O. Semenov, Anton Yu. Savytskyi, Oleg V. Bisikalo and Pavlo I. Kulakov	**835**
172.	**Accuracy of simulation for the network traffic in the form of Fractional Brownian Motion** Anatolii Pashko and Iryna Rozora	**840**

No.	Paper Title	Page No.
173.	**Numerical Study of the Deterministic Chaos Oscillator with a Differential Integral Element on the Colpitts Circuit** Andriy Semenov, Kostyantyn Koval, Anton Savytskyi, Oleksander Zviahin and Serhii Baraban	**846**
174.	**Details of High Definition Images and Compression Factor** Oleg Gofaizen, Olena Osharovska and Mikola Patlayenko	**851**
175.	**Correlation Analysis Traffic Intensity of the Motor Vehicles and the Air Pollution by Their Harmful Emissions** Iryna Darmorost, Mykola Dyvak, Ruslan Shevchuk, Volodymyr Manzhula and Natalia Kasatkina	**855**
176.	**Static Interval Model of Air Pollution by Motor Vehicles and Its Identification Method** Mykola Dyvak, Iryna Oliynyk, Yurii Maslyiak and Andriy Pukas	**859**
177.	**Model of Pollution on the Local Section of an Urban Highway and Its Identification Method** Roman Pasichnyk, Natalia Pasichnyk, Mykhailo Susla and Andriy Melnyk	**864**
178.	**Set-Theoretical Decomposition on the Basis of Symmetric Functions** Bohdan Rytsar	**868**
179.	**Statistical Estimation of Pseudorandom Number Sequences** Ruslan Politanskyi, Leonid Politanskyi, Oleksandr Hres and Valentyn Lesinskyi	**873**

S10: Information processing

180.	**Emulation of logical functions NOT, AND, OR, and XOR with a perceptron implemented using an information entropy function** Stepan Melnychuk, Serhiy Yakovyn and Mykola Kuz	**878**
181.	**MSE Prediction in DCT-based Lossy Compression of Noise-Free and Noisy Remote Sensing** Sergey Krivenko, Mikhail Zriakhov, Vladimir Lukin and Benoit Vozel	**883**
182.	**Analysis and Classification of Cloudiness in Ukraine by Clustering and Image Transformation** Roman Melnyk and Yurii Kalychak	**889**
183.	**The Signal Processing With Adaptation Based on Ateb-transformations** Ivanna Dronyuk and Olha Fedevych	**894**

No.	Paper Title	Page No.
184.	**Denoising Efficiency Analysis based on No-Reference Image Quality Assessment** Andrey Rubel and Vladimir Lukin	**898**
185.	**Development of the indicator set of the features informativeness estimation for recognition and diagnostic model synthesis** Andrii Oliinyk, Sergey Subbotin, Valerii Lovkin, Serhii Leoshchenko and Tetiana Zaiko	**903**
186.	**Analysis of approaches to hyperspectral data compression based on orthogonal transforms** Alexander Zemliachenko, Vladimir Lukin and Mohammad Alhihi	**909**
187.	**A Method for Rapid Quantitative Assessment of Incomplete Integral Contrast for Complex Images** Sergei Yelmanov and Yuriy Romanyshyn	**915**
188.	**Recognition of Maritime Objects Based on FLIR Images Using the Method of Eigenimages** **Tadeusz Pietkiewicz and Jan Matuszewski**	**921**
189.	**Hybrid Fuzzy Clustering Algorithm of Time Series with Unevenly and Asynchronously Distributed Observations in Information Processing Tasks** Olena Vynokurova, Dmytro Peleshko, Yevgeniy Bodyanskiy, Yuriy Rashkevych and Ilya Kobylin	**930**
190.	**Parallel algorithms and matrix structures for scalar product calculation** Ivan Tsmots, Vasyl Rabyk and Oleksa Skorokhoda	**936**
191.	**Study on vibrations diagnostics of gas turbine engines with wavelets** Tetiana Fedoronchak and Tetiana Kolpakova	**940**
192.	**Forecasting based on the trend model and adaptive Brown`s model** Viktoriia Onyshchenko, Oles Dibrivniy and Victor Grebenyuk	**944**
193.	**Recognition of tourism documentation fragments from web-page posts** Pavlo Zhezhnych and Oksana Markiv	**948**
194.	**Automatic Contrast Enhancement of Complex Low-contrast Images** Sergei Yelmanov and Yuriy Romanyshyn	**952**
195.	**Software for spatio-temporal trajectory analysis and pattern mining** Pavlo Pidhornyi and Marina Sidorova	**958**
196.	**Application of the Squared Mahalanobis Distance for Detecting Outliers in Multivariate Non-Gaussian Data** Sergiy Prykhodko, Natalia Prykhodko, Lidiia Makarova and Andrii Pukhalevych	**962**

No.	Paper Title	Page No.
197.	**Document Image Segmentation using Averaging Filtering and Mathematical Morphology** Marina Polyakova, Alesya Ishchenko and Natallia Huliaieva	**966**
198.	**Cloudiness Analysis in Ukraine by the 3-Stages Hierarchical Clustering Algorithm** Roman Melnyk and Ruslan Tushnytskyy	**970**
199.	**Model Of Syntactic Representation Of Aerophoto Images Segments** Vladimir Barannik, Andrii Krasnorutsky, Vladimir Larin, Anna Hahanova and Sergii Shulgin	**974**
200.	**Neural network approach for multispectral image processing** Andrii Podorozhniak, Natalia Lubchenko, Oleksii Balenko and Dmytro Zhuikov	**978**
	S11: Telecommunications: wired and wireless systems, network services, management	
201.	**Investigation of network infrastructure control parameters for effective intellectual analysis** Kirill Smelyakov, Anastasiya Chupryna, Vitalii Martovytskyi and Dmitry Pribylnov	**983**
202.	**Efficiency of generalized class orthogonal harmonic signals application in G.fast transmission systems** Vasyl Oreshkov, Olena Iegupova and Irina Barba	**987**
203.	**Empirical and analytical energy thresholds of Modulation-Coding Schemes research in IEEE 802.11n devices** Serhii Osypchuk, Leonid Uryvsky, Alina Moshynska and Mykhaylo Ilchenko	**991**
204.	**Research of Intelligent Services traffic in NGN** Serhii Shestopalov, Nina Kniazieva, Tatjana Kunup and Anastasiia Kondratenko	**995**
205.	**Comparison of synchronization reference signals of primary Atomic Clocks** Vyacheslav Vakas, Dmytro Domin, Oleksandr Manko and Oleksii Kulinskyi	**1001**
206.	**Tensor Flow-Based Model of Quality of Experience Routing** Oleksandr Lemeshko, Oksana Yevsieieva and Maryna Yevdokymenko	**1005**
207.	**Linear Optimization Model of MPLS Traffic Engineering Fast ReRoute for Link, Node, and Bandwidth Protection** Oleksandr Lemeshko and Oleksandra Yeremenko	**1009**

No.	Paper Title	Page No.
208.	**Hierarchical method of routing and resource allocation in DiffServ-TE Network** Oleksandr Lemeshko, Olena Nevzorova and Ahmad Hailan	**1014**
209.	**Two-level method of multipath routing for multicast flows in telecommunication networks** Amal Mersni, Andriy Ilyashenko and Tetiana Vavenko	**1019**
210.	**Correlation Properties of Signal at Mobile Receiver for Different Propagation Environments** Cezary Ziółkowski, Jan Kelner and Leszek Nowosielski	**1024**
211.	**Algorithms and the Aggregative Mathematical Model for Fragment of Optimization Task of Synthesis of Satellite Distribution Network of Television Broadcasting in Ukraine** Konstantin S. Sunduchkov, Ievgeniia Svetsynska and Sergey Volkov	**1028**
212.	**The structure of a mobile provider network with network functions virtualization** Mariia Skulysh and Oleksandr Romanov	**1032**
213.	**Dynamic Model of Queue Management based on Recourse Allocation in Telecommunication Networks** Tetiana Lebedenko, Oleksandra Yeremenko, Serhii Harkusha and Ali Salem Ali	**1035**
214.	**Dynamic Model of Routing in Telecommunication Network Considering Probability of Timely Packet Delivery and Information Security Requirements** Arkadii Snihurov and Vadym Chakrian	**1039**
215.	**The Method For Reducing Probability of Incorrect Data Reception In Radio Channels of Terahertz Frequency Range** Volodymyr Saiko, Serhii Toliupa, Volodymyr Nakonechnyi and Serhii Dakov	**1043**
216.	**Methodology of the Tactical Wireless Sensor Networks Control** Alexander Zhuk, Valery Romaniuk, Eugen Stepanenko and Anton Romaniuk	**1047**
217.	**Traffic Offload Improved Method for 4G/5G Mobile Network Operator** Roman Odarchenko, Anastasiia Abakumova, Sergiy Gnatyuk and Oleh Polihenko	**1051**
218.	**Quality of services evaluation method in next generation networks** Anastasia Kalchenko and Nina Kniazieva	**1055**
219.	**Modified routing algorithms for self-organized networks** Yulia Klymash, Mykola Kaidan and Bogdan Strykhalyuk	**1059**

No.	Paper Title	Page No.
220.	**WiMAX and WiFi Network Integration as Backhaul on Emergency Communications** Haider Mohammed Turki Al Hilfi	**1063**
221.	**Novel Wireless Communication System Using Ultra Wideband Pulse Triplet-Signals** Galina Proskura, Alexander Totsky and Victoriia Naumenko	**1069**
222.	**Optimization of entropy estimation computing algorithm for random signals in digital communication devices** Ihor Lazarovych, Stepan Melnychuk and Mykola Kozlenko	**1073**
223.	**Analysis of cell capacity in the reverse CDMA channel** Anna Vakarchuk, Eduard Sukachev, Serhii Siden and Volodymyr Pyliavskyi	**1078**
224.	**User Mobility Impacts to Mobility Load Balancing for Self-Organizing Network over LTE System** Sangchul Oh, Hongsoog Kim and Yeongjin Kim	**1082**
225.	**Features of creating based on chaos pseudo-random sequences** Anatoliy Semenko, Mykola Kushnir, Natalia Bokla and Grygoriy Kosovan	**1087**
226.	**Cognitive Radio Systems Clustering** Sergiy Veretiuk, Vladimir Pilinsky and Ivan Tkachuk	**1091**
227.	**Efficiency of construction of a cellular network on the basis of WiMAX technology** Arseny Goreskul and Mykola Ishchenko	**1096**
228.	**Some aspects of wireless Wi-Fi network throughput calculation** Volodymyr Lazebnyi and Cheng Liang Yin	**1101**
229.	**Advanced DOCSIS technology for providing UHDTV service in Cable TV Networks** Volodymyr Baliar, Oleg Gofaizen and Yulia Irkha	**1105**
230.	**Burst Error-Correcting Codes Based on Modular Correcting Codes** Vasyl Yatskiv, Nataliya Yatskiv and Taras Tsavolyk	**1110**
231.	**Cognitive Radio Network Simulation Model for Capacity Evaluation** Maryan Kyryk and Volodymyr Yanyshyn	**1114**
232.	**Method for Processing Multiservice Traffic in Network Node Based on Adaptive Management of Buffer Resource** Vasyl Romanchuk, Arthur Polishuk, Mykola Beshley and Marian Seliuchenko	**1118**

No.	Paper Title	Page No.
233.	**Frequency spectrum distribution dynamics: Evidence from an agent-based experimental economy model** Juraj Gazda, Marcel Volosin, Eugen Slapak, Peter Drotar and Taras Maksymyuk	**1123**
234.	**Eavesdropping-Resilient Wireless Communication System based on Modified OFDM/QAM Air Interface** Taras Maksymyuk, Mykola Beshley, Oleksiy Petrenko, Mykhailo Klymash and Yuriy Matsevityi	**1127**
235.	**Resource Management Method in LTE Heterogeneous Networks** Andriy Masiuk, Bogdan Koval, Halyna Beshley and Roksoliana Basa	**1131**
236.	**Network Functions Virtualization for Flexible Deployment of Converged Optical-Wireless Access Infrastructure** Olena Krasko, Haider Al-Zayadi, Volodymyr Pashkevych, Halyna Kopets and Bohdan Humeniuk	**1135**
237.	**Method of Cloud System Disaster Recovery Based on "Infrastructure as a Code" Concept** Orest Lavriv, Mykhailo Klymash, Ganna Grynkevych, Olga Tkachenko and Volodymyr Vasylenko	**1139**
238.	**Intelligent Data Flows Management for Performance Improvement of Optical Label Switched Network** Volodymyr Andrushchak, Stepan Dumych, Taras Maksymyuk, Mykola Kaidan and Oksana Urikova	**1143**
239.	**Method of Centralized Resource Allocation in Virtualized Small Cells Network with IoT Overlay** Halyna Beshley, Taras Maksymyuk, Mykola Beshley and Ihor Strykhalyuk	**1147**
240.	**Noise Immunity Calculation Methodology for Multi-Positional Signal Constellations** Vladimir Tolubko, Sergei Otrokh, Lyubov Berkman, Oleksandr Pliushch and Vladislav Kravchenko	**1152**

S12: Models, algorithms, software and hardware construction means of information and communication and radio electronic devices and systems

No.	Paper Title	Page No.
241.	**Practical Methods for de Bruijn sequences Generation using Non-Linear Feedback Shift Registers** Maryna Miroshnyk, Dmitry Karaman, Viktoriia Krylova, Inna Filippenko, Tetyana Korytchinko and Olexandr Demihev	**1157**

No.	Paper Title	Page No.
242.	**Analog-digital path of radio-technical systems with digital processing of high-frequency signals** Gennadiy Bortnyk, Mikola Vasylkivskyi and Vasyl Kychak	**1162**
243.	**Hardware and software implementation of data acquisition system for pulsed NQR spectrometer** Andriy Samila, Olexandr Hres and Georgiy Rozorynov	**1166**
244.	**Routing Procedure In Network With Nodes Dynamic Usage Rate** Pavel Pustovoitov, Galina Sokol and Natalia Rvachova	**1170**
245.	**Interference immunity of aircraft responders in secondary surveillance radars** Iryna Svyd, Ivan Obod, Ganna Zavolodko and Oleksandr Maltsev	**1174**
246.	**A Model For Estimating Firmware Execution Time Based On Peripherals' Time Behavior** Ratybor Chopey, Dmytro Fedasyuk and Tetyana Marusenkova	**1179**
247.	**Implementing Combined Finite State Machine with Heterogeneous Field Programmable Gate Array** Svitlana Hrushko	**1184**
248.	**Quantum Theory of Measurements: principQuantum Theory of Measurements: principles and methods of measuring convergence parameters of radio signals** Ivan Trotsyshyn	**1188**
249.	**Development and Research of an Ultrasonic Resonance Method Mathematical Model of Measuring Medium Parameter** Josyp Bilynsky, Konstantin Ogorodnik, Alexander Lazarev and Andrii Syrovatskyi	**1192**
250.	**Use of nonpositional numerical systems for design of high-speed computing frequency synthesizer** Igor Gula, Denis Makaryshkin and Viktor Mishan	**1195**
251.	**Precise time provider with speed optimal phase-locked loop for digital substations of smart grid systems** Dmytro Kalian	**1199**
252.	**Principles of Construction of Structural Units for Direct Digital Frequency Synthesizer** Oleksiy Polikarovskih, Liudmila Kovtun and Lesya Karpova	**1205**
253.	**Method for correcting the time position of pulses in direct digital synthesizers of frequencies** Lesya Karpova, Oleksiy Polikarovskykh, Liudmila Kovtun and Igor Gula	**1209**

No.	Paper Title	Page No.
254.	**Methods of modeling electromagnetic fields** Roman Saiko	**1213**
255.	**Stabilization and Control of the Floating Dock's List and Trim: Algorithmic Solution** Andriy Topalov, Oleksiy Kozlov, Oleksandr Gerasin, Galyna Kondratenko and Yuriy Kondratenko	**1217**
256.	**Parametric Synthesis of Piezoresonance Oscillation Systems in Multi-Frequency Excitation Mode of Quartz Resonator** Sergey Pidchenko, Alla Taranchuk and Anna Spivak	**1223**
257.	**Research of the Noise Influence on Software Phase-Locked Loop Dynamic Performance** Ivan Maksymiv, Andriy Bondariev, Yuriy Bobalo, Serhiy Altunin and Myroslav Kiselychnyk	**1228**
258.	**Regularization Methods for Differentiating Noise Signals** Vitaliy Ivanyuk, Vadym Ponedilok and Jo Sterten	**1233**
259.	**Planar Fractally-Shaped Terahertz Waveguide: on the Goos-Hänchen Effect** V.M. Onufrienko, T.I. Slyusarova and L.M. Onufrienko	**1237**
260.	**Use color appearance model for video applications** Volodymyr Pyliavskyi, Oleg Gofaizen, Anna Vakarchuk and Serhii Siden	**1241**
261.	**Optimization of Software Architecture Selection for the System Under Design and Reengineering** Ihor Bodnarchuk, Olexandr Kharchenko, Ihor Raichev and Natalia Zagorodna	**1245**
262.	**The laboratory stand with SCARA robot for training masters' students of electrotechnical specialties** Ihor Orlovskyi and Andrii Pirozhok	**1249**
263.	**Definition of approaches to the assessment of tactical unmanned aerial vehicles effective use in the state border guard body** Ivan Katerynchuk, Oleg Shynkaruk and Igor Balytskyi	**1255**
264.	**A Synthesis Method of Optimal Binary Sequnecies with Simple Dimensionality** Yuriy Bobalo, Volodymyr-Myron Mis'kiv, Ivan Prudyus and Roman Yankevych	**1260**
265.	**Discrete Sequencies with Optimal Aperiodic Autocorrelation Functions. Conditions for Existance** Andriy Mis'kiv, Volodymyr-Myron Mis'kiv, Ivan Prudyus and Roman Yankevych	**1264**

No.	Paper Title	Page No.
266.	**Research of Efficiency Indexes of Radio Telemetry System with Short-Term Use** Oleksandr Shkiliuk, Bohdan Volochiy, Leonid Ozirkovskyy and Volodymyr-Myron Miskiv	**1268**
267.	**Modeling the Process of Air Pollution by Harmful Emissions from Vehicles** Mykola Dyvak, Iryna Voytyuk, Natalia Porplytsya and Andriy Pukas	**1272**
268.	**Research and implementation of hardware algorithms for multiplying binary numbers** Ivan Dadiak, Volodymyr Gryga, Yaroslav Nykolaichuk and Bohdan Dzundza	**1277**
269.	**Computer Simulation of Water Flow in Networks on the Basis of Kinematic Approximation** Petro Venherskyi and Yaryna Kokovska	**1282**
270.	**Magnetometer on Avalanche Transistor** Myroslav Kiselychnyk, Mykhailo Melen and Fedir Pavlov	**1287**