

**International Conference Program**

**«2021 Systems of Signal Synchronization,  
Generating and Processing in  
Telecommunications  
SYNCHROINFO-2021»**

**IEEE Conference Record #51390**

**June 30 – July 02, 2021**

**Nekrasova Street 3, Svetlogorsk, Kaliningrad region,  
Hotel Universal**

## ORGANIZERS

**Russian (Moscow) IEEE Circuits and Systems (CAS04) Chapter  
Institute of Radio and Information Systems (IRIS)**

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**Oleg V. Varlamov:** Doctor of Technical Sciences, Professor, Moscow Technical University of Communications and Informatics, Moscow, Russia (Senior Member, IEEE)

**Andrei V. Grebennikov:** Ph.D., Sumitomo Electric Europe, UK (Senior Member, IEEE)

**Oleg G. Morozov:** Doctor of Technical Sciences, Professor, Head of the Department of Radiophotonics and Microwave Technologies of KNRTU-KAI (Senior Member, IEEE)

**Artem S. Adzhemov:** Doctor of Technical Sciences, Professor (Member, IEEE)

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**Oleg V. Varlamov:** Doctor of Technical Sciences, Professor, Senior Member ,IEEE

**Elena R. Khasianova:** Program Committee Coordinator, Member, IEEE

**Svetlana S. Dymkova:** Conference Publication Program Coordinator, Member, IEEE

**Anna V. Dolgopyatova:** engineer

## CONFERENCE REGULATIONS

**29 июня**

**Pre-party with welcome drink** (*Ресторан гостиницы «Универсал»*)

Предварительная регистрация очных участников, оформление документов

**18:30 – 19:30**

**30 июня**

**10:30 – 11:00**

**Регистрация очных и заочных участников**

**11:00 – 13:00**

**Пленарное заседание** (*Конференц-зал*)

**13:00 – 14:00**

**Обед**

**14:00 – 18:00**

**Заседания секций**

Секции 1 и 4 (*1-й зал*)

Секция 3, 1-я часть (*2-й зал*)

**1 июля**

**10:00 – 14:00**

**Заседания секций**

Секция 2 (*1-й зал*)

Секция 3, 2-я часть (*2-й зал*)

**14:00 – 15:00**

**Обед**

**15:00 – 18:00**

**Заседания секций**

Секция 5 (*1-й зал*)

Секция 3, 3-я часть (*2-й зал*)

**19:00 – 22:00**

**Товарищеский ужин** (*Ресторан отеля «Универсал»*)

**2 июля**

**Экскурсионная программа**

## PLENARY SESSION

### FOREWORD

**A.V. Pestryakov**, *Chairman of the Organizing Committee, Moscow, Russia*

**V.M. Gevorkyan**

*NRU "MPEI", Moscow, Russia*

**V. N. Kochemasov** (*Member IEEE*)

*JSC «Radiocomp», Moscow, Russia*

**A.R. Safin**

*NRU "MPEI", Moscow, Russia*

**A. V. Chenakin**

*Anritsu company, Morgan Hill, USA*

### FERRITE-BASED MICROWAVE OSCILLATORS

**M.I. Zhodzishsky**

*Moscow Aviation Institute (National Research University);*

*Topcon Positioning Systems, Moscow, Russia*

**R.V. Kurynin**

*National Research University Higher School of Economics;*

*Topcon Positioning Systems, Moscow, Russia*

**F.B. Serkin, A.V. Veitsel**

*Moscow Aviation Institute (National Research University);*

*Topcon Positioning Systems, Moscow, Russia*

### COMPARATIVE ANALYSIS OF SNR METERS IN GNSS RECEIVERS

**D.N. Shubin, E.M. Lobov, E.O. Lobova, N.A. Kandaurov**

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**A DEVICE FOR PROCESSING A WIDEBAND SIGNAL OF THE HF**

**WAVEBAND USING A DIGITAL FILTER BANK**

### FOREWORD

**S.S. Dymkova**, *Conference Publication Program Coordinator, Member, IEEE, Moscow, Russia*

# **SECTION 1**

## **Synchronization Systems and Devices**

### **SECTION CHAIR**

**Alexander V. Pestryakov**, *Doctor of Science (Engineering), Professor,  
Moscow Technical University of Communications and Informatics, Moscow, Russia*

**V.L. Karyakin** (*Member IEEE*)

*Povolzhskiy State University of Telecommunications and Informatics, Samara, Russia*

**WAYS TO DEVELOP REGIONAL DVB-T2 STANDARD NETWORKS  
IN RUSSIA**

**T.A. Kuzovkova** (*Member IEEE*), **T.Yu. Saliutina** (*Member IEEE*),

**O.I. Sharavova** (*Member IEEE*)

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**THE IMPACT OF DIGITAL PLATFORMS ON THE BUSINESS  
MANAGEMENT INFORMATION SYSTEM**

**E.M. Lobov, V.O. Varlamov**

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**INVESTIGATION OF THE PROPERTIES OF AN FILTERBANK  
MULTICARRIER MODEM IN A BROADBAND HF CHANNEL**

**Sergei Melnik**

*ZNIIS;*

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**Elena Petrova**

*JSC STC KOMTEST, Moscow, Russia*

**Vladimir Soudovtsev**

*International Telecommunication Academy, Geneva, Switzerland*

**NEW GENERATION TELECOMMUNICATION NETWORKS:  
FREQUENCY AND TIMING METROLOGY**

**Mikhail L. Schwartz, Anatoliy V. Ryzhkov**

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**MODERN TRENDS IN THE DEVELOPMENT OF NETWORK  
SYNCHRONIZATION SYSTEMS. FROM PRC TO CNPRTC**

**O.I. Sheluhin, D.I. Magomedova, S.Y. Rybakov, A.G. Simonyan**  
*Moscow Technical University of Communications and Informatics, Moscow, Russia*  
**MARKING AUDIO SIGNALS USING FRACTAL GAUSSIAN NOISE**

**Oleg N. Sherstyukov, Amir I. Sulimov (Member IEEE), Ruslan R. Latypov, Danis K. Nurgaliev, Alexey D. Smolyakov**  
*Kazan Federal University, Kazan, Russia*  
**SIMULATION OF SHORT-TERM INSTABILITY OF UAV'S CLOCK**

**Artem A. Shvidkiy, Anastasiia A. Savelieva, Anton A. Zarubin**  
*The Bonch-Bruevich Saint-Petersburg State University of Telecommunications, Saint Petersburg, Russia*  
**CACHING METHODS ANALYSIS FOR IMPROVING DISTRIBUTED STORAGE SYSTEMS PERFORMANCE**

**Amir I. Sulimov (Member IEEE), Oleg N. Sherstyukov, Ruslan R. Latypov, Danis K. Nurgaliev**  
*Kazan Federal University, Kazan, Russia*  
**SIMULATION OF PERIODIC SYNCHRONIZATION OF UAV'S CLOCK**

**O.V. Varlamov (Senior Member, IEEE), A.A. Bychkova**  
*Moscow Technical University of Communications and Informatics, Moscow, Russia*  
**BASIS OF TECHNICAL DESIGN AND DEVELOPMENT A SINGLE-FREQUENCY DRM DIGITAL BROADCASTING NETWORK FOR VENEZUELA**

**S.L. Yablochnikov**  
*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**I.O. Yablochnikova**  
*Russian New University, Moscow, Russia*

**M.I. Kuptsov**  
*Ryazan State Radio Engineering University named after V.F. Utkin, Ryazan, Russia*

**M.N. Machiboroda, I.V. Bondarenko**  
*Academy of the Federal Penitentiary Service of Russia, Ryazan, Russia*  
**ON THE ISSUE OF SYNCHRONIZATION OF REAL AND VIRTUAL PROCESSES IN THE CONTEXT OF THE EVOLUTION OF THE MODERN INFORMATION SOCIETY**

## **SECTION 2**

# **Signal Generating and Shaping Devices**

### **SECTION CHAIR**

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**E.Y. Bushuev, S.E. Grychkin, E.P. Stroganova**

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**IMMUNITY INVESTIGATION OF QUANTUM CRYPTOGRAPHIC EQUIPMENT FOR INFORMATION PROTECTION IN INFORMATION TELECOMMUNICATION SYSTEMS**

**K.S. Bykov, L.N. Kazakov, E.A. Selyanskaya**

*The Yaroslavl Demidov State University, Yaroslavl, Russia*

**CONSTRUCTION OF NESTED TRUNCATED MINI-MAX GOLD CODES**

**I.V. Chernova**

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**ASYMPTOTICS OF THE PERTURBED OPERATOR**

**Ilya M. Lerner**,

*Kazan National Research Technical University n.a. A.N. Tupolev – KAI (KNRTU-KAI), Kazan, Russia*

**Dymkova S.S.**,

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**Rashid R. Fayzullin, Natan M. Solodukho**,

*Kazan National Research Technical University n.a. A.N. Tupolev – KAI (KNRTU-KAI), Kazan, Russia*

**Vladimir I. Il'in**,

*Kazan Federal University, Kazan, Russia*

**FORMATION OF A COMPETENCY MODEL IN TEACHING STUDENTS OF TECHNICAL UNIVERSITIES WITH HEARING IMPAIRMENT, WHICH IMPLEMENTS A CONVEYOR-BASED APPROACH TO LEARNING**

**S.I.Dinges, A.V. Pestryakov**

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**DEVELOPMENT TRENDS OF IOT EQUIPMENT**



**A.V. Dolgopyatova, O.V. Varlamov** (*Senior Member IEEE*)

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**ANALYSIS OF LONG-RANGE VHF RADIO WAVES PROPAGATION TO SPECIFY PROTECTION RATIOS BETWEEN COEXISTING DRM+, RAVIS AND IBOC SYSTEMS**

**D.V. Gadasin, A.V. Shvedov, I.A. Kuzin**

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**A MODEL FOR REPRESENTING THE COLOR AND DEPTH METRIC CHARACTERISTICS OF OBJECTS IN AN IMAGE**

**E.I. Glushankov, D.I. Kirik, D.V. Kozlov, K.O. Korovin, N.A. Afanasiev**

*The Bonch-Bruевич Saint-Petersburg State University of Telecommunications, St. Petersburg, Russia*

**STUDY OF TRELLIS CODED MODULATION WITH SPACE-TIME CODING**

**V.N. Gromorushkin, O.V. Varlamov** (*Senior Member IEEE*)

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**EXPERIMENTAL STUDIES OF THE ENVELOPE ELIMINATION AND RESTORATION HF POWER AMPLIFIER CHARACTERISTICS WITH BROADBAND UNMATCHED LOAD**

**V.V. Ionov, A.V. Pestryakov**

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**RESEARCH OF PROBLEMS AND PROSPECTS OF DEVELOPMENT OF RUSSIAN SPACE MONITORING SYSTEMS**

**Roman Yu. Ivanyushkin** (*Member IEEE*), **Ivan A. Volkov,**

**Alexander A. Severinenko, Alexey E. Mikenin**

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**ABOUT THE PROSPECTS OF THE APPLICATION OF MULTI-PHASE PULSE-WIDTH MODULATION FOR THE ENVELOPE TRACT OF TRANSMITTERS**

**D.V. Kochemasov**

*Radiocomp, LLC, Moscow, Russia*

**STUDY OF A QUADRATURE VCO WITH MUTUAL SYNCHRONIZATION**

**Boris Ya. Likhttsinder, Yulia O. Bakai, Valeria A. Larina**

*Povolzhsky State University of Telecommunications and Informatic, PSUTI, Samara, Russia*

**INTERVAL ANALYSIS OF GROUP POISSON MODELS OF VIDEO TRAFFIC STREAMS**

**Ivan Malygin, Vyacheslav Rysev, Vyacheslav Ivanov**

*Ural Federal University, Yekaterinburg, Russia*

**INVESTIGATION OF THE INFLUENCE OF THE RADIOSONDE TRANSMITTER OF THE 1680 MHZ RANGE ON THE RECEPTION OF GLONASS SIGNALS BY A NAVIGATION RECEIVER**

**N.E. Miroshnikova (Member IEEE), G.S. Petruchin, P.A. Titovec**

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**ESTIMATION OF THE EFFECT OF DISPERSION ON THE COMMUNICATION RANGE IN A WIRELESS UNDERWATER OPTICAL CHANNEL**

**Nikita D. Shmakov, Roman Y. Ivanyushkin (Member IEEE)**

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**RESEARCH OF DISTRIBUTED POWER AMPLIFIER FOR RADIO TRANSMITTERS OF THE DVB-T2 STANDARD**

**Olga A. Sivintseva, Maxim Yu. Zuev**

*Kazan National Research Technical University named after A.N. Tupolev-KAI, Kazan, Russia*

**ON PSEUDORANDOM SEQUENCES GENERATED BY MODIFIED LORENTZ SYSTEM**

## **SECTION 3**

# **Signal Processing Devices**

### **SECTION CHAIR**

**Denis S. Chirov,**

*Doctor of Science (Engineering), Professor, Moscow Technical University of  
Communications and Informatics, Moscow, Russia*

**Nikolay A. Kandaurov,**

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**Evgeniy M. Lobov,**

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Russia*

**A.S. Adzhemov (Member IEEE), A.Y. Kudryashova**

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**FEATURES OF BIJECTION OF SPACES WHEN TRANSMITTING  
MESSAGES FROM SOURCE TO RECIPIENT**

**Boris B. Borisenko, Sergey D. Erokhin, Aleksander S. Fadeev,  
Ivan D. Martishin**

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**INTRUSION DETECTION USING MULTILAYER PERCEPTRON AND  
NEURAL NETWORKS WITH LONG SHORT-TERM MEMORY**

**Igor A. Boyko, Evgeniy I. Glushankov, Dmitriy I. Kirik,  
Konstantin O. Korovin**

*The Bonch-Bruевич St. Petersburg State University of Telecommunications,  
St. Petersburg, Russia*

**Evgeniy A. Rylov**

*JSC «Design Bureau «RIO», St. Petersburg, Russia*

**ALGORITHMS FOR MULTIPLE SIGNALS ADAPTIVE PROCESSING  
IN RADIO ENGINEERING SYSTEMS ANTENNA ARRAYS**

**Anna A. Bukharina**

*Kazan National Research Technical University named after A. N. Tupolev-KAI,  
Kazan, Russia*

**ADVANTAGES OF METHOD OF COLLECTIVE DYNAMIC ROUTING  
IN IP NETWORKS**

**Valeriy V. Butenko, Evgeniy E. Devyatkin, Maria V. Ivankovich**

*FSUE NIIR, Moscow, Russia*

**Evgeniy M. Lobov, Vladimir O. Varlamov**

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**MODELING THE PHYSICAL LAYER OF ADVANCED RADIO ACCESS  
SYSTEMS WITH INCREASED SPECTRAL EFFICIENCY BASED  
ON FBMC TECHNOLOGY**

**Yuri R. Butkevich, Vadim V. Afanasiev, Sergey S. Loginov**

*Kazan National Research Technical University named after A.N. Tupolev - KAI,  
Kazan, Russia*

**COMMUNICATION SYSTEM BASED ON CHAOTIC MASKING BINARY  
PHASE MANIPULATION AND NONLINEAR FILTERING**

**Sergey D. Erokhin, Boris B. Borisenko, Ivan D. Martishin,**

**Aleksander S. Fadeev**

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**ANALYSIS OF THE MULTILAYER PERCEPTRON PARAMETERS  
IMPACT ON THE QUALITY OF NETWORK ATTACKS  
IDENTIFICATION**

**G.A. Evstafyev, E.A. Selyanskaya**

*The Yaroslavl Demidov State University, Yaroslavl, Russia*

**METHOD OF ENSURING STRUCTURAL SECRECY OF THE SIGNAL**

**E.I. Glushankov, D.I. Kirik, D.M. Kirsanov**

*The Bonch-Bruевич Saint-Petersburg State University of Telecommunications,  
St. Petersburg, Russia*

**E.A. Rylov**

*JSC «Design Bureau «RIO», St. Petersburg, Russia*

**ADAPTATION OF ANTENNA ARRAYS WITH USING CORRELATION  
MATRICES OF A SPECIAL TYPES**

**Dmitry V. Ivanov** (*Member IEEE*), **Vladimir A. Ivanov**,  
**Natalya V. Ryabova** (*Member IEEE*), **Vladimir V. Ovchinnikov**  
*Volga State University of Technology, Yoshkar-Ola, Russia*

**ACTUALIZATION OF PARAMETERS OF ADAPTIVE SDR-EQUALIZER  
OF WIDEBAND HF RADIO CHANNELS TO EFFECTIVELY CORRECT  
FOR FREQUENCY INTRAMODE DISPERSION**

**Kaib M. Kafarov, Sergey S. Loginov, Maxim Yu. Zuev**  
*Kazan National Research Technical University named after A.N. Tupolev - KAI,  
Kazan, Russia*

**MODIFIED LORENTZ AND CHUA SYSTEMS LARGEST LYAPUNOV  
EXPONENT AND STATISTICAL CHARACTERISTICS ANALYSIS**

**N.A. Kandaurov, V.I. Lipatkin, V.O. Varlamov**  
*Moscow Technical University of Communications and Informatics, Moscow, Russia*  
**IMPLEMENTING DIGITAL DOWNCONVERSION ON A GPU**

**E.O. Kandaurova, D.S. Chirov** (*Member IEEE*)  
*Moscow Technical University of Communications and Informatics, Moscow, Russia*  
**INTELLIGENT ALGORITHMS FOR DYNAMIC SPECTRUM ACCESS A  
SECONDARY USER IN COGNITIVE RADIO SYSTEMS**

**M. Yu. Klimenko**  
*RC Module, Moscow, Russia*

**A. V. Veitsel**  
*Moscow Aviation Institute (National Research University), Moscow, Russia*  
**EVALUATION OF NEURAL NETWORK-BASED MULTIPATH  
MITIGATION APPROACH FOR THE GNSS RECEIVERS**

**A. G. Koriakin, D.A. Tarasov, E.B. Vasilyev, I.A. Ovchinnikova**  
*All-Russian Scientific Research and Development Cable Institute, Moscow, Russia*  
**D. S. Kholodny**

*National Research University Moscow Power Engineering Institute, Moscow, Russia*  
**INFLUENCE OF SEISMIC AND VIBRODYNAMIC LOADS ON AERIAL  
OPTICAL FIBRE COMMUNICATION LINES**

**Sergey V. Kozlov** (*Member IEEE*)

*Kazan National Research Technical University named after A. N. Tupolev-KAI,  
Kazan, Russia*

**METHOD FOR ESTIMATING DATA RATE IN MIMO CHANNELS  
OF WI-FI COMMUNICATION NETWORKS**

**Sergey V. Kozlov**

*Federal Research Center “Computer Science and Control“ Russian Academy of  
Sciences, Moscow, Russia*

**Alexander N. Kubankov**

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**THEORETICAL ASPECTS OF PROCESS SYNCHRONIZATION IN  
ENSURING THE INTEROPERABILITY OF INTEGRATED CONTROL  
SYSTEMS**

**V.B. Kreyndelin, E.D. Grigorieva**

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**FAST MATRIX MULTIPLICATION ALGORITHM FOR A BANK OF  
DIGITAL FILTERS**

**Leonid V. Kurakhtenkov, Andrey A. Kuchumov, Yulia M. Serebrennikova**

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**Alexey G. Zhilichkin**

*Roscosmos, Moscow, Russia*

**ON THE PROBABILITY OF DECRYPTION OF THREE-SPANNED  
TEST-OBJECT**

**Vitaliy S. Kuznetsov, Alexey S. Volkov** (*Member IEEE*), **Alexander A. Bakhtin,**

**Alexey V. Solodkov** (*Member IEEE*), **Vladimir G. Soroka**

*National Research University of Electronic Technology (MIET), Moscow, Russia*

**EFFICIENT DIGITAL MODULATION SIGNAL SYSTEM**

**I.M. Lerner** (*Member IEEE*), **R.R. Fayzullin** (*Member IEEE*), **E.R. Falakhieva,**  
**N. Pankratov**

*Kazan National Research Technical University n.a. A.N. Tupolev – KAI (KNRTU-KAI), Kazan, Russia*

**V.I. Il'in**

*Kazan Federal University, Kazan, Russia*

**TO SOFTWARE IMPLEMENTATION OF SHARAPOV'S ANALYTICAL METHOD FOR ESTIMATING THE PARAMETERS OF A FREQUENCY MIXTURE WITHOUT COMBINATION FREQUENCIES AND SOLVING OPTIMIZATION PROBLEM**

**E.A. Liberman, V.R. Magsumov**

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**HYBRID FILTER BANKS WITH OVERLAPPING PASSBANDS**

**Nikita Yu. Liberovskiy, Vladimir S. Priputin, Denis S. Chirov** (*Member IEEE*)

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**INCOHERENT DPSK AND FSK RECEIVING IMPROVEMENT USING BLIND SOURCE SEPARATION ALGORITHM**

**Vladislav I. Lipatkin, Elizaveta O. Lobova, Kseniya E. Telengator**

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**THE INFLUENCE OF THE QUALITY OF THE ESTIMATION OF DISPERSION DISTORTIONS OF A BROADBAND HF SIGNAL ON THE NOISE IMMUNITY OF A RADIO LINK**

**Abdullah Majd, L.N Kazakov, J.S.F Olim**

*P.G. Demidov Yaroslavl State University, Yaroslavl, Russia*

**A STUDY OF THE AIR GAPS EFFECT IN THE WALLS ON THE DETECTION EFFICIENCY OF THROUGH-THE-WALL RADARS**

**Svetlana S. Matveeva, Anatoliy Yu. Perlov**

*Financial University under the Government of the Russian Federation;*

*National Research University of Electronic Technology, Moscow, Russia*

**Valerii A. Pankratov**

*JSC «Academician A.L. Mints Radiotechnical Institute», Moscow, Russia*

**Kirill V. Lvov**

*Lomonosov Moscow State University, Moscow, Russia*

**THE METHOD OF SYNTHESIS OF A HIGH-PERFORMANCE COMPUTING COMPLEX IN SOLVING THE PROBLEM OF FORECASTING THE TECHNICAL STATE OF INFORMATION AND MANAGEMENT SYSTEMS**

**V.Y. Mikhaylov, R.B. Mazepa**

*Moscow Aviation Institute (National Research University), Moscow, Russia*

**ESTIMATION OF THE FEATURES OF APPLICATION OF THE  
M-SEQUENCES SUBSET WITH THE POSSIBILITY OF JOINT  
PROCESSING**

**Oleg G. Morozov (Member IEEE), Ilnur I. Nureev, Gennady A. Morozov,  
Alexandr A. Ivanov, Airat Zh. Sakhabutdinov (Member IEEE)**

*Kazan National Research Technical University named after A.N. Tupolev-KAI,  
Kazan, Russia*

**BRAGG GRATINGS SLOPES SHAPE AND THE MEASUREMENT  
ERROR OF THE MICROWAVE SIGNALS INSTANTANEOUS  
FREQUENCY**

**Yu.B. Nechaev, I.W. Peshkov, N.A. Fortunova, I. N. Zaitseva**

*Bunin Yelets State University, Yelets, Russia*

**STUDY OF DIGITAL AZIMUTH-ELEVATION BEAMFORMING  
WITH DIRECTIONAL ANTENNAS IN VHF TWO-RAY  
REFLECTION PROPAGATION MODEL**

**Natalia E. Poborchaya**

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**SEPARATE ESTIMATION OF CONSTANT COMPONENTS, CHANNEL  
MATRIX, AMPLITUDE AND PHASE IMBALANCE OF THE QAM  
SIGNAL IN A SYSTEM WITH MIMO**

**V.S. Priputin, K.Y. Sokolov, N.A. Kandaurov**

*Moscow Technical University of Communications and Informatics, Moscow, Russia*

**IMPLEMENTATION OF A DISCRETE FREQUENCY DEMODULATOR  
USING FILTER BANK TECHNOLOGIES ON AN ARM PROCESSOR**

**N.V. Ryabova (Member IEEE), D.V. Ivanov (Member IEEE),**

**V.A. Ivanov, A.A. Kislitsin**

*Volga State University of Technology, Yoshkar-Ola, Russia*

**METHOD FOR ESTIMATING FEASIBLE ENERGY GAIN OF  
WIDEBAND SATELLITE COMMUNICATION SYSTEM DUE TO  
ADAPTIVE DECONVOLUTION OF INTRAMODE FREQUENCY  
DISPERSION**



**Airat Zh. Sakhabutdinov** (*Member IEEE*), **Ilnur I. Nureev**,  
**Gennady A. Morozov**, **Alexandr A. Ivanov**, **Alina A. Tyazhelova**  
*Kazan National Research Technical University named after A.N. Tupolev-KAI,*  
*Kazan, Russia*

**BRAGG WAVELENGTH TEMPERATURE SHIFT AND THE  
MEASUREMENT ERROR OF THE MICROWAVE SIGNALS  
INSTANTANEOUS FREQUENCY**

**Andrey N. Serov** (*Member IEEE*), **Kirill A. Ivanenko**, **Dmitry A. Chumachenko**  
*National Research University "Moscow Power Engineering Institute", Moscow,*  
*Russia*

**APPLYING A MOVING AVERAGE FILTER TO REDUCE THE  
FREQUENCY MEASUREMENT ERROR FOR THE CASE APPLYING  
BY THE ZERO CROSSING TECHNIQUE**

**A.B. Silantyev**, **A.V. Golubev**, **C.A.G. Fernandu**, **J. F. Olim**  
*P.G. Demidov Yaroslavl State University, Yaroslavl, Russia*  
**A.V. Timoshenko** (*Member IEEE*)

*MIET National Research University of Electronic Technology, Moscow, Russia*  
**TRACK ASSOCIATION IN RADARS WITH ADDITIONAL MULTI-  
SCANNING OBSERVATION CHANNELS**

**Elena A. Spirina**, **Ekaterina A. Petrova**  
*Kazan National Research Technical University named after A. N. Tupolev-KAI,*  
*Kazan, Russia*

**A ROBUST METHOD FOR ESTIMATING THE CHANNEL DATA RATE  
IN SEAMLESS IEEE 802.11AX STANDARD NETWORKS**

**Anton P. Strelnikov**, **Alexey S. Volkov** (*Member IEEE*), **Alexander A. Bakhtin**,  
**Alexey V. Solodkov** (*Member IEEE*)  
*National Research University of Electronic Technology (MIET), Moscow, Russia*

**Aleksandr V. Gorelik**  
*Russian University of Transport (MIIT), Moscow, Russia*

**A CAPACITY MODE ASSESSMENT AND INTERFERENCE  
SUPPRESSION IN MU-MIMO SYSTEMS**

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**CONTROL OF MULTI-SCANNING RADAR MONITORING OF SPACE OBJECTS ON MEDIUM AND HIGH ORBITS**

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**ULTRASONIC UNDERWATER SDR TRANSCEIVER FOR OCEAN OF THINGS**

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**METHOD FOR MANAGING TRANSPORT SDN RESOURCES**

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**CORPORATE INFOCOMMUNICATION NETWORKS RESEARCH BY NEURAL NETWORKS METHOD WITH CALCULATION OF GENERALIZATION**

**Ainur A. Ziganshin, Sergey V. Kozlov** (*Member IEEE*), **Elena A. Spirina**

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**ASSESSING THE EFFECTIVENESS OF THE RAY TRACING MODEL IN PLANNING MIMO SYSTEMS**

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**them. V.A. Solntsev**

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**FOUR- AND FIVE-RESONATOR MICROSTRIP STRUCTURES WITH  
INCREASED FREQUENCY SELECTIVITY**

**Tatiana K. Artemova, Bogdan E. Nazarenko**  
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**Andrei Baikov**  
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**S.Yu. Kazantsev (Member IEEE), P.A. Titovets, A.I. Sattarova,  
A.A.Pishcherkov, N.S. Bekushev**  
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**Anatoliy Yu. Perlov, Aleksander V. Timoshenko** (*Member IEEE*)  
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**Igor B. Zager, Alexey V. Ermakov**

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**A.A. Skuridin, A.A. Yelizarov** (*Member IEEE*), **I.V. Nazarov, E.A. Zakirova,**  
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**A DUAL-BAND WI-FI RECTIFYING ANTENNA FOR RF ENERGY  
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**NARROW-BEAM WAVEGUIDE ANTENNA FOR SURFACE  
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**A.A. Yelizarov** (*Member IEEE*), **A.D. Kuznetsov, A.A. Skuridin,**  
**S.D. Berdnikov and E.A. Zakirova**

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**RESEARCH OF MAIN CHARACTERISTICS AND PARAMETERS OF  
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## **SECTION 5**

# **Photonics and mathematics for moving objects**

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**NON-UNIFORM LOADING CONTROL ON AN ASYMMETRICAL TWO-CONTOURS NETWORK**

**M. G. Gorodnichev, N. B. Sarkisov, R. A. Gematudinov, Kh. A. Dzhabrailov**

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**DEVELOPMENT OF A SYSTEM FOR COLLECTING AND PROCESSING BIG DATA RECEIVED FROM TERMINAL DEVICES**

**M. D. Gromov, M. G. Gorodnichev, R. A. Gematudinov, Kh. A. Dzhabrailov**

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**DEVELOPMENT OF A MODULE FOR CONTROLLING AND PREDICTING THE MOVEMENT OF UNMANNED VEHICLES**

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**DECISION TREES IN THE TASKS OF HUMAN PREDICTION**

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**OPTIMIZATION OF PARKING SPACE BASED ON VIDEO ANALYSIS OF TRAFFIC FLOW CHARACTERISTICS**

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**M.Yu. Karelina, I.V. Kostyuk, T.Yu. Cherepnina, V.R. Rogov**

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**MATHEMATICAL MODELING OF MOTION PARAMETERS OF A  
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**ON KINEMATICS OF CURVILINEAR NONHOLONOMIC MOVEMENT  
OF CARRIAGE IN HORIZONTAL PLANE**

**Alexandr A. Vasilets (Member IEEE), Rinat Sh. Misbakhov (Member IEEE),**

**Lutsia M. Sarvarova, Artem A. Kuznetsov, Vasilya I. Bayazitova**

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**ESTIMATION OF MEASUREMENT ERRORS OF HIGH-Q SYMMETRIC  
FIBER-OPTIC STRUCTURES WITH OPTICAL VECTOR SPECTRUM  
ANALYZERS**

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**SOLVING THE PROBLEM OF FINDING THE LOCALLY OPTIMAL  
PLACEMENT OF CORRIDORS FOR THE POSSIBLE MOVEMENT OF  
TRANSPORT OF LARGE CARRYING CAPACITY**

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**ON-BOARD VIDEO METHOD FOR CORRECTION OF GEOPOSITION  
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