

2020 IEEE Ukrainian Microwave Week (UkrMW 2020)

**Kharkiv, Ukraine
21-25 September 2020**

**Volume 1
Pages 1-225**



**IEEE Catalog Number: CFP20X02-POD
ISBN: 978-1-7281-7314-6**

**Copyright © 2020 by the Institute of Electrical and Electronics Engineers, Inc.
All Rights Reserved**

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

****** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP20X02-POD
ISBN (Print-On-Demand):	978-1-7281-7314-6
ISBN (Online):	978-1-7281-7313-9

Additional Copies of This Publication Are Available From:

Curran Associates, Inc
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: (845) 758-0400
Fax: (845) 758-2633
E-mail: curran@proceedings.com
Web: www.proceedings.com

CURRAN ASSOCIATES INC.
proceedings
.com

2020 IEEE Ukrainian Microwave Week

Volume 1

on 2020 IEEE 12th International Conference on Antenna Theory and
Techniques (ICATT)

Table of contents

Prof. Ya. Shifrin 100th Anniversary

Organizer of Antenna Science in Ukraine

/Invited paper /

N. G. Maksimova, V. Tsypin..... 1

Adaptive Antennas, Smart Antennas

Selection of the Number of Compensation Channels and Location of Receivers with Non-Identical Amplitude-Frequency and Phase-Frequency Responses in Adaptive Antenna Array under Noise Interference

/Invited paper/

V. P. Riabukha, A. Semeniaka, Y. A. Katiushyn..... 7

Adaptive Antenna Array, Shared with Adaptive Equalizer **/Invited paper/**

V. Djigan 11

Least Squares Criterion Adaptive Filtering Algorithms as Tools for Calibration of Arrays with Digital Beamforming

V. Djigan, V. Kurganov..... 16

A Forgotten Technology: Phase Adaptation in Arrays with Digital Beamforming

V. Djigan 20

Dynamic Regularization Parameter Selection in the Problem of Optimization the Parametric Vector of an Adaptive Antenna Array

O. Korkin, V. Skachkov, V. Chepyki, A. Efimchikov, A. Dudush..... 25

The Far-Field Threshold Evaluation of the Frequency Diversity Arrays

A. F. Shevchenko, V. Samokvit, S. Piskunov..... 31

Processing of Wide Band Acoustic Signals During Detection of Unmanned Aerial Vehicles

V. Kartashov, V. Oleynikov, I. Koryttsev, S. Sheiko, O. Zubkov, S. Babkin 35

Threshold Performance Improvement of DOA Estimation using Pseudo-Noise Resampling and Toeplitz Covariance Matrix Approximation

V. I. Vasylyshyn..... 40

Interference Suppression at Cooperative Use of GPS, GLONASS, GALILEO, BEIDOU

Y. Averyanova, V. Konin, O. Kutsenko 44

Adaptive Algorithm for Joint Work of Two Troposcatter Communication Stations of Different Types

V. Rudakov, O. Kovbasiuk, A. Bashkirov, V. Orel, A. Bychkov, O. Kostyna..... 49

Algorithm of formation radio images from aerospace carriers

V. Pavlikov, V. Volosyuk, A. Sobkolov, O. Odokienko, M. Nechyporu, E. Tserne 54

<i>V. I. Vasylyshyn</i>	59
-------------------------------	----

Antenna Arrays

Statistical Characteristics of Cylindrical Antenna Array	
<i>A. F. Shevchenko, S. Piskunov, G. Levagin, A. Dudush, V. Voinov, O. Yasynskyi</i>	63
Technique for tuning a phased array antenna of airborne radars of small-sized aircrafts	
<i>A. Linkova, S. Maltsev, M. Shcherbakov, G. Veselovska-Maiboroda, S. Labazov</i>	67
Synthesis of Plane Arrays taking into Account the Mutual Coupling the Radiators	
<i>M. Andriychuk</i>	71
Wideband wide-angle scanning UHF patch antenna array	
<i>U. V. Keda</i>	76
Design and Optimization of Sparse Planar Antenna Arrays Based on Special Matrices	
<i>Y. Luo, V. Lutsenko, S. Shulga</i>	79
Finding the Set of Branching Points of a Nonlinear Integral Equation Arising in the Synthesis Problem by a Given Power Directivity Pattern	
<i>B. Podlevskyi</i>	85
Impedance Synthesis of Flat Slot Antenna Arrays	
<i>Yu. M. Penkin, V. Katrich, M. Nesterenko, S. L. Berdnik</i>	89
Experimental Investigation of Frequency-Selective Properties of Metal Metasurface Supporting a Trapped-Mode Resonance	
<i>A. Gribovsky, Ye. Antonenko, Yu. Antonenko</i>	93

Antennas for Industrial and Medical Applications

Measurement of Bridges Dynamic Deflections Using Arrays of Secondary Radiators	
<i>O. V. Poliarus, Ye. A. Poliakov, A. V. Lebedynskyi</i>	97
The design of parametric acoustic antenna for horizontal radio-acoustic sounding system for the wind turbine	
<i>V. L. Misailov, Yu. Ulianov</i>	101
Researching the Possibility of Wireless Energy Transmission for the Power Supply Condition Monitoring System of a Car's Suspension	
<i>D. Gretskih, A. Luchaninov, V. Lykhograi, A. Shcherbina, S. Sakalo, R. Lachmayer</i>	105
Modeling the WPT System with the Multistate Transmitting Subsystem	
<i>D. Gretskih, A. Luchaninov, A. Gomozov, V. Katrich, M. Nesterenko</i>	110
Reception of electromagnetic pulses of nanosecond duration by the multi-element ferrite antenna	
<i>T. Ogurtsova, N. Blinova, G. Pochanin, P. Kholod</i>	116
Vivaldi coplanar-antipodal antennas	
<i>M. Kozachuk, V. Naydenko</i>	121

Antennas for Mobile Communications

Hybrid Antennas on the Base of Element Vivaldi	
<i>S. Bukharov, D. Svinarenko, L. Tsytko, L. A. Filins'kyi</i>	126

Antennas for Radioastronomy

Phased Subarray of the Low-Frequency Radio Telescope GURT as a Standalone Instrument for Radio Astronomy Studies /Invited paper/ <i>S. Yerin, et al</i>	130
Compact X-band Stepped-Thickness Septum Polarizer <i>F. Dubrovka, S. Piltyay, O. Sushko, R. Dubrovka, M. Lytvyn, S. Lytvyn</i>	135

General Antenna Theory

Automation of Processing Multichannel Remote Sensing Images Based on Performance Prediction /Invited Paper/ <i>V. V. Lukin, S. Abramov, M. Uss, O. S. Rube, N. Kussul, B. Vozel, K. Egiazarian</i>	139
Optimization of End-fire Antenna Arrays Taking into Account Random Phase Errors <i>L. Kornienko, V. Kovalchuk</i>	145
Dual-Band Combined Vibrator-Slot Radiating Structures <i>Yu. M. Penkin, V. Katrich, M. Nesterenko, S. L. Berdnik, O. M. Dumin</i>	149
Velocity of the fields radiated Hertz dipole excited by Gaussian pulse <i>V. Naydenko</i>	154
Synthesis of a Broadband Ring Antenna of a Two-Tape Design <i>I. Sliusar, V. Slyusar, S. Voloshko, Yu. Utkin, A. Zinchenko</i>	161

Low-Gain, Printed Antennas

Fractal Antenna with Conductive Exciter <i>D. Mayboroda, S. Pogarsky</i>	166
---	-----

Antenna Radomes and Absorbers

Numerical Modelling of Electromagnetic Scattering and Radiation Characteristics of Antenna in Dielectric Radome of Resonant Size <i>G. S. Zalevsky, O. Turinskyi, O. Sukharevsky</i>	170
---	-----

Antenna Measurements

Estimation of the Dispersion of the Error in Measuring the Frequency of a Pack with Correlated Fluctuations in the Initial Phases of Its Radio Pulses <i>O. Lukashuk, O. Kuznietsov, A. Kiyko, A. Karlov, O. Biesov, M. Petrushenko, V. Karlov</i>	174
Cloud thickness measurement with active-passive sounding of water profile <i>T. Tkachova</i>	179
Automatization of Antenna Measurements in the Anechoic Chamber <i>A. Popov, D. Kalimullin</i>	183
Adjustment of the Z-Bench Transmissometer for Biomedical Measurements at 300 GHz Using a 3-D Printed Back-to-Back Horn <i>R. Dubrovka, A. S. Andy, R. C. Jones, M. M. Torrico, R. Donnan</i>	187
Modeling and Creation of a Reference Installation for the Reproduction of the Electromagnetic Field Strength Unit on the Basis of a GTEM –Cell in the Range of Frequency up to 1 GHz <i>E. Vasileva, O.V. Makarov, S. I. Melnik</i>	190

Reflector, Lens and Hybrid Antennas

Circularly Polarised X-Band H11- and H21-Modes Antenna Feed for Monopulse Autotracking Ground Station /Invited paper/	
<i>F. Dubrovka, S. Martunyyuk, R. Dubrovka, M. Lytvyn, S. Lytvyn, Yu. Ovsianyk, S. Piltyay, O. Sushko, O. Zakharchenko</i>	196
Experimental Evaluation of an Accelerating Lens on Spatial Field Structure and Frequency Spectrum	
<i>V. Astapenya, V. Sokolov, D. Ageyev</i>	203
Using Corner Reflectors to Increase Backscattering of Radar Targets	
<i>O. Sukharevsky, S. Nechitaylo, V. Vasilets</i>	207
Circularly Polarized Corrugated Horn Fed Nonuniform Reflectarray Antenna	
<i>A. Çalışkan, F. Gunes, A. Türk</i>	213
Analysis of Directional Properties of Radiation of Impedance Monopole Located on Finite Size Screen	
<i>N. Yeliseyeva, S. L. Berdnik, V. Katrich</i>	217
Symmetrically fed 1–10 GHz log-periodic dipole antenna array feed for reflector antennas	
<i>O. Sushko, S. Piltyay, F. Dubrovka</i>	222

2020 IEEE Ukrainian Microwave Week (UkrMW 2020)

**Kharkiv, Ukraine
21-25 September 2020**

**Volume 2
Pages 226-527**



**IEEE Catalog Number: CFP20X02-POD
ISBN: 978-1-7281-7314-6**

2020 IEEE Ukrainian Microwave Week

Volume 2

on 2020 IEEE 6th International Symposium on Microwaves,
Radar and Remote Sensing (MRRS)

Table of Contents

Active and Passive Radars, Components and Circuits

Providing the Required Accuracy of Measurements of Spatial Coordinates of Aerial Objects <i>O. Kuznietsov, V. Kovalchuk, A. Kovalchuk, D. Karlov, S. Yarovy, V. Vasylyshyn</i>	226
Two-Antenna Method for Characterizing Lower Ionosphere Processes Using Incoherent Scatter Technique <i>L. Emelyanov, Ya. Chepurnyy, I. Domnin, S. Panasenko</i>	230
Deghosting Method for Multistatic Radar Systems with Cooperative Receiving <i>I. Trofymov, V. Tiutiunyyk, A. Dudush, A. Shevchenko, I. Medinets</i>	235
Assessment of Measurement Accuracy by Combined Radio Engineering Systems Using Phase-Manipulated Signals <i>M. Barkhudaryan, B. Chumak, K. Kulahin, I. Nos</i>	239
Features of Noise Characteristics of Frequency-Modulated Autodyne Radars <i>V. Noskov, G. Ermak, A. Vasiliev, K. Ignatkov, K. Shaydurov</i>	245
Signal Processing Method in Frequency Switch Keying Radar Sensors <i>V. Noskov, A. Vasyliiev, K. Ignatkov, G. Ermak</i>	249
Passive Radar for Oblique-Incidence Ionospheric Sounding: Observations of Ionospheric Storms <i>V. Rozumenko, L. Chernogor, K. Garmash, Q. Guo, Yu Zheng</i>	253
Characteristics of Interference to Active-Passive Radar Systems from Emissions of HF and VHF Broadcasting Stations <i>V. Lutsenko, I. Lutsenko, A. Soboliak, I. Popov, N. Anh, Y. Luo</i>	259
Passive-Active Radar with Channels Operating Simultaneously on Common Antenna <i>I. Mytsenko, Yu. Pedenko, V. Kabanov, A. Roenko</i>	263
Use of Radiation of Broadcast Stations of HF Range for Detection of Air Objects <i>V. Lutsenko, I. Lutsenko, I. Popov, A. Soboliak, N. X. Anh</i>	267

Analog and Digital Components of Radar and Electronic

Mathematical Model of Microwave Devices on Resonant Tunneling Diodes for Practical Application in Radar and Electronic Systems <i>A. Semenov, O. Semenova, A. Rudyk, O. Voznyak, B. Pinaiev, R. Kulias</i>	272
---	-----

GPR and TWS radar; SAR and ISAR; Acoustic, Radio-Acoustic and Secondary Radar Systems

Economic Technology for Atmosphere Parameters Distant Recording Using Radio Acoustic Sounding System <i>V. Kartashov, S. Babkin, Ye. Tolstykh, S. Sheiko, M. Kolendovska</i>	282
---	-----

Optimal Method of RCS Estimation in Synthetic Aperture Radar with Linear Antenna Array <i>V. Volosyuk, S. Zhyla, N. Ruzhentsev, E. Tserne, D. Kolesnikov, D. Vlasenko</i>	287
Optimal Signal Processing Method for Synthetic Aperture Radar with Planar Antenna Array <i>V. Volosyuk, S. Zhyla, N. Ruzhentsev, E. Tserne, V. Kosharskyi, O. Inkarbaieva</i>	293
Statistical Optimization of Imaging Technique in Radar Scatterometer with Planar Antenna Array <i>V. Volosyuk, S. Zhyla, N. Ruzhentsev, A. Sobkolov, K. Nezhalskaya, G. Cherepnin</i>	299

Radar applications: Meteorology; Biomedicine, Security and Defense, Automotive, Industrial radars

The Root-MUSIC Method versus the Amplitude Sum-Difference Monopulse Method in Radar Tracking of Low-Elevation Targets over Rough Sea <i>Yu. Pedenko, N. Reznichenko, V. Zuykov, S. Labazov</i>	305
Motion Zone Estimation for Adaptive Radar-System Parameters Selection <i>G. Kriukova, A. Malenko, O. Sudakov, S. Vodopyan, Ye. Volynets</i>	309
Measurement of Elevation Angles Above the Sea Using the Matrix Pencil Method under Multipath Propagation and Thermal Radar Noise <i>Yu. Pedenko, N. Reznichenko, A. Bukin</i>	314

Remote sensing of Land/Atmosphere; Remote Sensing Systems for Light Air Vehicles and UAV

Multi-Channel Reception System for Radiometry Signals <i>D. Litovchenko, V. Kudryashov, O. Filippenkov</i>	318
Doppler Radar Signal Model for Sensing Rotaring Drone Rotors <i>D. Tsyupak, R. Paschenko, V. Ivanov</i>	323
Task-Oriented Selection of Remote Sensing Satellite System under Target Recognition Probability Constraint <i>A. Kondratov, V. Andronov, V. Komarov, M. Gerda, O. Maslenko</i>	328
A Method for Combination and Ranking Hypotheses Under Conditions of Partial Uncertainty <i>M. Popov, O. Zaitsev, A. Andreiev</i>	333
Analysis of the Earth's Surface Type in Remote Sensing Using Fractal Dimension <i>M. Mariushko, R. Paschenko, O. Butenko, A. Topchiy</i>	339
Modelling of Phase Distortions in Astronomical Imaging: Considering Real Conditions <i>S. Skuratovskiy, I. Lyashenko, V. Pugach</i>	343
A Method to Estimate Surface Unevenness for Automatic UAV Landing <i>D. Karlov, M. Pichugin, A. Popov, M. Bortsova, I. Taran, O. Korobetskyi</i>	349
Oblique-Incidence Ionospheric Radio-Sounding: Seismo-Ionospheric Effects <i>L. Chernogor, V. Rozumenko, K. Garmash, Q. Guo, Y. Luo, V. Rozumenko, Yu Zheng</i>	354
Usage of Lidar Systems for Detection of Hazardous Substances in Various Weather Conditions <i>O. Kulakov, A. Katunin, Ya. Kozhushko, S. Herasymov, O. Roianov, T. Gorbach</i>	360
An Experimental Study of Tropospheric Fluctuations Variability Using the Radiosetting of GPS Satellites over Land <i>V. B. Synytskyi</i>	364
A Machine Learning Approach for Image Registration Accuracy Estimation <i>V. A. Dushpa</i>	368

Signal Data and Image processing

A Multifactorial Approach to Building a System for Automated Control of Radar Information Stability <i>V. Kantsedal, A. Mogyla</i>	373
Estimation of the Parameters of the Stochastic Probing Radio Signal Reflected by the Target <i>A. Mogyla, V. Kantsedal</i>	379
Unsupervised Objects Classification in ALOS-2 PALSAR-2 Images <i>I. Vasil'eva, A. Popov</i>	384
Features of Using Synthetic Aperture and Reverse Convolution Algorithms in Georadar Sounding <i>S. Melnyk, O. Drobnaya, V. Karpenko</i>	388
Adaptive Notch Filtration in the Moving Target Detection Tasks <i>I. Prokopenko, A. Dmytruk</i>	392
Generalized Algorithms for Stream Encryption of Signals in Communication Channels with the UAV <i>A. Beletsky</i>	397
Algorithmic Method of Reconstruction of Subsurface Structures in Georadar Studies <i>S. I. Melnyk, S. M. Labazov, S. S. Melnyk</i>	403
Application of Discrete Atomic Compression to Near Lossless Image Compression <i>V. Makarichev, V. Lukin, I. Brysina</i>	408
Atomic Functions $h_a(x)$ in Digital to Analog Conversion <i>K. Budunova, V. Kravchenko</i>	414
Synthesis of Signal Detection Algorithms Under Conditions of Aprioristic Uncertainty <i>I. Prokopenko, I. Omelchuk, M. Maloyed</i>	418
Synthesis of Linear Filters of Smooth Signals <i>I. Prokopenko, V. Denysiuk</i>	424
Advanced Radiometric Analysis of Radar Image Quality <i>A. Gorobets, L. Atroshenko, N. Gorobets, D. Kochkar, O. Kostrikov</i>	429
Blind Evaluation of DCT Domain Spectral Characteristics of Signal-dependent Noise in Images <i>V. Abramova, S. Abramov</i>	433
Accuracy of Model-based and Learning-based Approaches for Image Noise Variance Estimation <i>M. Uss, V. Lukin, B. Vozel, K. Chehdi</i>	438
Improved robust linearized full-reference combined metric for remote sensing imaging <i>O. Ieremeiev, V. Abramova, K. Okarma, K. Egiazarian</i>	443
The Computer Modeling of Aircraft Recognition by the Onboard Radiation Signal Features Based on the Similarity Indices Calculation Algorithm <i>I. Nikolayev, M. Kaliuzhnyi, O. Khriapkin, V. Kolisnyk</i>	449
Hardware Implementation of SHA Algorithms on Different FPGA and Speed Comparison <i>D. Havrilov, A. Volovyk, A. Yarovy, D. Yarovy, D. Kudriavtsev</i>	453
Deep Convolutional Network for Spatially Correlated RAYLEIGH Noise Suppression on TerraSAR-X Images <i>M. Ponomarenko, K. Egiazarian, S. G. Bahnemiri</i>	458
Evaluation of the Dynamic Structure of Turbulent Flows Using Regression Models <i>S. F. Kolomiets, A. L. Gavrik, L. A. Lukanina</i>	464

Scattering and RCS, Parametric and Doppler Techniques

Combined Calculation Method for the Scattering Characteristics of Complex Shaped Objects and Its Application to Model Helicopter Rotor Modulation Spectra

Different Components of the Electromagnetic Scattering of Complex Shape Objects

Mathematical Modeling of Diagrams of Reverse Secondary Radiation of Air-To-Ground Missiles for a Centimeter Wavelength Range

Hertzian Formulation of Scattering by Moving PEC Bodies

Hertzian Dipoles Supporting Directional Currents

Convergence Study for the Method of Analytical Regularization Applied to the E-Plane-Wave Scattering from a PEC Strip Grating on a Dielectric Substrate

Assessment of Reflective Properties of the Object by Electromagnetic Simulation

Skewness of the Signal Envelope Distribution in Kerr-Rice Scattering

Fano-Shape Lattice-Mode Resonances and Near Fields in the E-Polarized Wave Scattering by a PEC Strip Grating on a Dielectric Substrate

Target classification and identification

Automatic Definition of the Number of Planes within an Airdrome over Satellite Images

Evaluation of the Efficiency of Recognition Radio Emitting Objects in Conjunction Signs Radar and Communication by Method of Statistical Tests

2020 IEEE Ukrainian Microwave Week (UkrMW 2020)

**Kharkiv, Ukraine
21-25 September 2020**

**Volume 3
Pages 528-1013**



**IEEE Catalog Number: CFP20X02-POD
ISBN: 978-1-7281-7314-6**

2020 IEEE Ukrainian Microwave Week

Volume 3

on 2020 IEEE 10th International Kharkiv Symposium on Physics and Engineering of
Microwaves, Millimeter and Submillimeter Waves (MSMW)

Table of contents

Artificial Materials: Metamaterials and Composite Structures

Metamaterials, Metasurfaces, FSS and EBG. Analytical Regularization Technique /Invited Paper/	
<i>N. Yashina, P. Melezhhik, A. Poyedinchuck, Yu. Sirenko</i>	528
Physical research of carbon nanomaterials in the microwave range	
<i>O. V. Tanana, Yu. Golubev</i>	531
Creation of radar-absorbing structures based on carbon films	
<i>N. Liubetski, H. Volunets, Ya. Padrez, D. Bychanok</i>	535
Plasmon Resonance of Graphene Strip Placed on Dielectric Rod in the Microwave Range	
<i>S. V. Dukhopelnykov, R. Sauleau</i>	538
Effective Ring Resonators and Diffraction Gratings for THz Quantum Waves of Electron States (QWES)	
<i>Yu. Rapoport, V. Grimalsky, S. Koshevaya, D. Soshilov, F. Yanovsky, O. Bilous</i>	542
Isofrequency Surface Singularities of a Hypercrystal Made of Metamaterials of Different Type	
<i>I. Fedorin, O. Vdovychenko</i>	546
Study of Variations in the Reflection of Electromagnetic Waves from Foam Structures and their Dielectric Permittivity	
<i>L. A. Filins'kyi</i>	550
Topology of a planar-chiral iris as a factor in controlling the “optical activity” of a bilayer object	
<i>Ye. M. Ostryzhnyi, S. Steshenko, A. Kirilenko</i>	555
Polarization states of surface electromagnetic waves on resonant anisotropic metasurfaces: from theory to experimental verification in microwaves	
<i>O. Yermakov, A. Bogdanov</i>	559
Terahertz Sensor Based on All-Dielectric Photonic Crystal	
<i>N. V. Sydorochuk, S. Prosvirnin</i>	564
Metamaterial cell for detection of complex permittivity inhomogeneities	
<i>S. Yu. Polevoy, S. Tarapov, B. Rameev</i>	568
Planar metamaterial with structured substrate	
<i>A. Girich, A. Kharchenko, S. Tarapov</i>	572
Broad-Band Effective Magnetic Response of Two-Component Metaferrite with Spherical Inclusions	
<i>O. Rybin, S. Shulga, M. Raza, O. Bagatska</i>	576

Biomedical Applications

Characteristic Frequencies and Times, Signal-to-Noise Ratio and Light Illumination Studies in Nanowire FET Biosensors /Invited Paper/	
<i>S. Vitusevych</i>	580
Microscopic Changes in the Myocardium of the Heart Wall of Rats under the Influence of Microwave Electromagnetic Radiation under the Conditions of Modeling Hypothyroidism	
<i>V. I. Magro, O. Drobakhin, V. Kosharnyi, V. Rutgaizer, L. Abdul-Ohly</i>	586
Signature Extraction Technologies from Acoustic Noise of the Breathing Process in Lung Pathologies	
<i>V. Lusenko, I. Lusenko, Y. Luo, M. Babakov, A. Nguen</i>	590
A Mathematical Analysis of Immunological Indicator of Biological Objects under Influence of Low-Frequency Electromagnetic Radiation in Conditions of Cold Stress	
<i>I. Perova, O. Litovchenko, I. Zavgorodnii, Ye. Brazhnykova, A. Kovalenko</i>	594
Portable and Non-invasive Blood Glucose Monitoring over a Prolonged Period using Whispering Gallery Modes at 2.4 GHz	
<i>L. W. LIU, et al.</i>	599
Application of Electromagnetic and Ultrasonic Technologies for Creation of Antibacterial Preparations	
<i>O. Kovalenko, S. Kalinichenko, E. Babich, F. Kivva, A. Roenko, T. Antusheva</i>	603
Wheat seeds indirect exposure to microwave radiation through oxygen-enriched water	
<i>O. Kovalenko, F. Kivva, A. Roenko</i>	608
Ex Vivo Effect of 60 GHz MMW radiation on Leech Neuron Intracellular Calcium Alteration	
<i>S. Romanenko, A. R. Harvey, L. Hool, V. P. Wallace</i>	612

Electromagnetic Theory and Numerical Simulations

Full-vectorial polynomial modal method for circular waveguides. Application to reflection and diffraction at the end of radially inhomogeneous cylinders /Invited Paper/	
<i>G. Granet, K. Edee, H. Hyani</i>	617
Atomic Functions Theory: History and Modern Results /Invited Paper/	
<i>K. Budunova, V. Kravchenko, Y. Konovalov, O. Kravchenko</i>	619
Computational simulation of E-waves diffraction on periodic multielement system of impedance strips	
<i>V. D. Dushkin, S. Zhuchenko, O. Kostenko</i>	625
Method of Stopband Expansion for Pseudocombine Bandpass Filters	
<i>S. Litvintsev, S. Rozenko, L. Pinchuk, G. Avdeyenko</i>	630
Surface Plasmon Resonances in the Scattering and Absorption of Visible Light by Core-Shell Bimetal Nanowires	
<i>E. A. Velichko</i>	635
Six-port reflectometer model with accounting on sensors mutual impedance	
<i>O. Zaichenko, P. Galkin, N. Zaichenko</i>	639
Frequency Domain Simulation Method for Electromagnetic Oscillations in Non-concentric Layered Ball Resonator	
<i>Z. Eremenko, I. Volovichev, A. Breslavets</i>	643
Numerical Simulation of Electromagnetic Impulse Deformation during Propagation in Nonlinear Dielectric	
<i>M. M. Rezikina</i>	648

Comparison of the Electromagnetic Fields Distribution for Resonant Frequencies in Cavity Cylindrical Microwave Resonator with Metal Rods	
<i>A. A. Breslavets, Z. Eremenko, E. Ganapolskii</i>	652
Asymptotic Solution for Hybrid Waves in a Circular Waveguide with a Helical Corrugation	
<i>V. Borulko</i>	656
Operator Method in Scattering by Double-Layer Infinite Strip Grating Without One Strip in Every Layer	
<i>M. E. Kaliberda, S. Pogarsky, L. Lytvynenko</i>	660
Operator Method in Scalar Wave Scattering by Circular Slot in Screen in Case of Dirichlet Conditions	
<i>M. E. Kaliberda, S. Pogarsky, L. Lytvynenko</i>	664
Stopband Expansion of Combline BPF	
<i>S. Litvintsev, S. Rozenko, L. Pinchuk, G. Avdeyenko</i>	668
Masking Effect of a Dielectric Inclusion in a Coupling Slotted Cavity Cut in an Infinite Screen	
<i>Yu. M. Penkin, V. Katrich, M. Nesterenko, S. L. Berdnik</i>	672
Sectional Gradient Circular Gratings of Terahertz Range with Phase Step	
<i>V. A. Maslov, M. Dzyubenko, Ye. Odarenko, V. Radionov</i>	676
Rotation of the polarization plane by grooved flanges in a circular waveguide	
<i>Ye. M. Ostryzhnyi, A. Kirilenko, S. Steshenko, V. Derkach</i>	680
Sharp Focused Modes of Metallic and Dielectric Waveguide Resonators of Terahertz Laser	
<i>O. Gurin, A. Degtyarev, M. Dubinin, V. A. Maslov, V. Ryabiyh, K. Muntean, V. Senyuta</i>	684
Numerical simulations of the X-band waveguide partially filled with a dielectric with local inhomogeneity inside	
<i>I. Ivanchenko, N. Popenko, M. M. Khruslov, V. Plakhtii</i>	688
Plane Wave Scattering by Cylindrically Conformal Periodic Finite Array with PEC and Graphene Patches	
<i>A. Svezhentsev, V. Volski, G. Vandenbosch</i>	692
Lattice Resonances in Double Comb Array	
<i>A. Svezhentsev, V. Miroshnichenko, G. Vandenbosch</i>	696
Possibilities of numerical modeling of nonlinear phenomena in HTSC waveguide lines	
<i>S. I. Melnyk, S. Melnyk</i>	700
Energy Balance Laws for Nonlinearly Coupled Fields in Layered, Cubically Polarizable Media	
<i>L. Angermann, V. Yatsyk</i>	704
Diffraction of Electromagnetic Waves on Axisymmetric Periodic and Aperiodic Gratings in Hollow Dielectric Waveguides	
<i>V. A. Maslov, O. Gurin, A. Degtyarev, M. Legenkiy, K. Muntean, V. Ryabiyh, V. Senyuta</i>	708
Numerical Modeling of Multi-Aperture Frequency Selective Surfaces with the Pairs of U Shaped Slots	
<i>L. Mospan, A. Kirilenko, S. Steshenko, D. Kulik</i>	712
Accuracy Evaluation at Calculation of All Metal Insert Filters with Longitudinal Grooves	
<i>D. Kulik, A. Kirilenko, S. Steshenko</i>	716
Diffraction Resonances and Absorption of Electromagnetic Radiation by a Conducting Cylinders	
<i>V. A. Maslov, M. Kalambet, N. Kokodii, K. Muntean</i>	720

Microwave Superconductivity

A coplanar waveguide resonator technique for the characterization of iron-based superconductors /Invited Paper/	
<i>D. Torsello, G. Ghigo</i>	726
On Some Unsolved Problems In Microwave Unconventional Superconductivity: From Authors' Research Experience /Invited Paper/	
<i>N. Cherpak, O. Barannik, R. Prozorov, L. Sun, M. Tanatar, Y. Wu, Y. He</i>	732
Scheme for Flux-Qubit-Based Microwave Single-Photon Counter with Weak Continuous Measurement	
<i>V. Shnyrkov, W. Yangcao, O. Turutanov, V. Lyakhno, A. Soroka</i>	737
Nonlinear properties of superconducting microstrip Hilbert fractal resonators	
<i>A. A. Kalenyuk, T. Golod, A. P. Shapovalov, A. L. Kasatkin, S. I. Futimsky</i>	743

Radio Astronomy and Earth's Environment Study

Diagnosis of radio wave conditions in coastal areas	
<i>B. Zhukov, A. Odnovol</i>	747
Modeling of Phase Distortion in Earth Atmosphere with a Correlated Random Field	
<i>S. I. Skuratovskiy, I. Lyashenko, V. Pugach</i>	751
DDS-based local oscillator for radio telescope receiver	
<i>E. Alekseev, V. V. Zakharenko, V. Budnikov</i>	757
Peculiarities of Microwaves Attenuation Statistics for Ukrainian Region	
<i>A. Merzlikin, V. Pavlikov, N. V. Ruzhentsev, A. Sobkolov, O. Tsopa, S. S. Zhyla</i>	761
Observations of interplanetary and ionospheric scintillations with GURT decameter-meter radio telescope	
<i>N. N. Kalinichenko, N. Kuhai, O. Konovalenko, I. Bubnov, S. Yerin, A. Romanchuk</i>	765
GNSS Signal Use for Sea Waves Monitoring	
<i>V. Lutsenko, I. V. Lutsenko, I. Popov, N. X. Anh, Q. Guo, Y. Luo, Yu Zheng</i>	768
Interpretation of remote sensing data for ecological tasks	
<i>A. S. Greben, O. Trofymchuk, V. Trysnyuk, G. Krasovskiy</i>	772
Calculation of the Radiative Balance in a Tropical Atmosphere at Different Concentrations of Carbon Dioxide	
<i>L. Kniazkov</i>	776
Mutual transformation of geographical and magnetic coordinates by rotations of corresponding rectangular coordinates	
<i>S. V. Grinchenko</i>	781
Theoretical calculation of daytime and nighttime profiles of electron density of F2-region plasma in middle-latitude ionosphere for quiet geomagnetic conditions	
<i>S. V. Grinchenko</i>	786
Jupiter radio emissions research. Data cleaning program.	
<i>V. Y. Kharlanova, V. V. Zakharenko, I. Vasylieva, S. Yerin</i>	793
Parameters and Initial Results of the Second Decameter Pulsar Census at UTR-2 Radio Telescope	
<i>I. Kravtsov, V. V. Zakharenko, A. Shevtsova, I. Vasylieva, S. Yerin, O. Ulyanov, O. Konovalenko</i>	796
Detection of Repetitive Pulses From the Sporadic Decameter Radio Emission Source	
<i>I. Kravtsov, V. V. Zakharenko, I. Vasylieva, O. Ulyanov, S. Yerin, Ye. Vasylykivskiy, O. Konovalenko</i>	800

Ukraine aeronomy station for carbon monoxide monitoring: analysis of measurement errors <i>D. Shulga, A. Korolev, A. Antyufeyev, V. Myshenko, O. Patoka, K. Marynko, Yu. Karelin, D. Chechotkin, V. Shulga</i>	805
Hybrid algorithm of dispersion delay retrieval and removal in radio astronomy <i>O. Ulyanov, A. Shevtsova, S. Yerin, V. V. Zakharenko, A. Konovalenko, J.-M. Griessmeier, P. Zarka, A. Skoryk</i>	809

Radiospectroscopy

High-Sensitivity Emission Spectrometer <i>E. Alekseev, R. Motiyenko, L. Zou, L. Margulès</i>	813
Laser-microwave spectrometer for studying mercury atoms in Rydberg states <i>M. Pogrebnyak, S. Dyubko, E. Alekseev, M. Perepechaj</i>	817
The Microwave Spectrometer at the Institute of Radio Astronomy of NASU: Recent Upgrades <i>E. Alekseev, V. Ilyushin, Ya. Bakhmat, L. Kniazkov, V. Budnikov</i>	821
The third and fourth excited torsional states of acetic acid <i>V. Ilyushin, Ya. Bakhma, E. Alekseev, O. Dorovska</i>	825
About some resonance, structural, and magnetic properties of amorphous and nanocrystalline FeCuNbSiB ribbons <i>Yu. Kobljanskij, A. Sizhuk, M. Semen'ko, R. Ostapenko, S. Zhuo, Z. Zhao, C. Xiaohong, O. Kolesnyk, V. Malyshev</i>	829
Detection of He II Electromagnetic Radiation Induced by a Second Sound Wave <i>A. Rybalko, A. Neonetta, R. Golovashchenko, V. Derkach</i>	833
Photoconductivity of semiconductor materials at low temperatures <i>V. Derkach, R. Golovashchenko, Ye. M. Ostryzhnyi, J. Gradauskas, A. Sužiedėlis, M. Anbinderis, R. Skiba</i>	837
Measuring Complex for Study the Characteristics of Dielectrics in the Submillimeter Wavelength Range <i>O. Kryvenko, I. Popov, B. Lutsenko, B. Gavrikov, A. Nguen, O. Polikarpov, V. Yakovlev, L. Yiang</i>	841
Microwave Nonlinear Magnetolectric Effect in Zn ₂ Y Hexaferrite <i>M. A. Popov, I. Zavislyak, G. Srinivasan, Y. Liu</i>	845
EPR Spectrum Formation Mechanism of the Iron-doped ZnSe <i>K. V. Lamonova, R. Babkin, S. Orel, Yu. Pashkevich, M. Gidulyanov, B. Bekirov, I. Ivanchenko, N. Popenko, D. Savchenko, N. Kovalenko</i>	849
Microwave investigation of greigite nanoparticles magnetic properties <i>A. Kharchenko, T. Kalmykova, S. Tarapov, S. Polevoy, A. Girich, A. Vakula, M. Milyaev, L. Ivzhenko, S. Nedukh, M. Pashchenko, P. Veverka</i>	854
Ferromagnetic Resonance Features in Biological Objects <i>Agaricus bisporus</i> <i>T. Kalmykova, S. Tarapov, A. Vakula, K. Sova, S. Gorobets, O. Gorobets, L. Evzhik</i>	859

Scientific and Industrial Applications

Oversized Waveguides as Quasioptical Antennas for Fusion Plasma Diagnostics: Scale Model Experiment <i>P. Nesterov, S. V. Mizrakhly, V. Bezborodov, I. Nesterov, M. Varavin, J. Zajac</i>	862
Application Features of Pyroelectric Detector for THz Wave Receiving <i>I. Kolenov, P. Nesterov, I. Nesterov, A. Lukash, V. Bezborodov, S. V. Mizrakhly</i>	866
Neural network application to the postal terahertz scanner for automated detection of concealed items <i>M. Kovbasa, A. Golenkov, F. Sizov</i>	870
Review of Iterative Numerical Methods Preferred in Technical Application to Increase Efficiency <i>M. Ozcan, F. Aliew</i>	874

Constructive Principles of Autodyne Sensors for Internal Sizes Measuring in Metallic Products	
<i>A. Fatieiev, G. Ermak, A. Varavin, V. Noskov, K. Ignatkov</i>	880
Autodyne Response Formation in Injection- Locked Microwave Oscillators	
<i>A. Fatieiev, V. Noskov, K. Ignatkov, K. Shaydurov, G. Ermak, A. Varavin</i>	884
Determining the angular frequency of rotating cylinder via microwave	
<i>Y. Siusko, Y. Kovtun</i>	888
Properties of One-Dimensional Metal Gratings at Inclined Incidence of Terahertz Radiation	
<i>M. Dzyubenko, V. Radionov, S. Masalov, Yu. Kamenev, I. Kolenov, V. Pelipenko, N. Dakhov</i>	893
Sensor-Polarimeter Based on Anisotropic Photonic Crystal for Solids and Liquids	
<i>A. Shmat'ko, E. N. Odarenko, A. Vertiy</i>	897
Microwave Oscillator on Transistor Structures with Dielectric Resonators	
<i>I. Osadchuk, O. Osadchuk, V. Osadchuk, A. Semenov, O. Semenova, K. Koval</i>	902

Solid State Devices

Gated Bow-Tie Diode With Selectively Doped 2DEG Active Layer for Microwave Sensing	
<i>M. Anbinderis, S. Ašmontas, J. Gradauskas, A. Sužiedėlis, V. Derkach, R. Golovashchenko</i>	907
Theoretical study of current oscillations in Gunn diodes based on graded III-nitrides operating in submillimeter range: frequency and power	
<i>I. Storozhenko, M. Kaydash</i>	917
Wide Band THz Detectors Based on HgCdTe Epitaxial Films	
<i>J. V Gumenjuk-Sichevska, Z. Tsybrii, F. Sizov, S. Danilov, S. Dvoretzky, S. Bunchuk, V. Zabudsky, N. Mikhailov</i>	921
Graded Band InGaN- Based Diode for Noise Generation in Terahertz Range	
<i>O. Botsula, K. Prykhodko</i>	925

Vacuum Electronics

Linear Theory of Beam-Wave Interaction in Gyrotron Cavities with Mode Conversion	
<i>O. V. Maksimenko, V. Shcherbinin, V. Tkachenko</i>	929
Reflective Orbictron – THz Waves Generator	
<i>V. Yeryomka, I. Nesterov, S. V. Mizrakhy</i>	933
Near Fields of Twin Circular Silver Nanotubes Exited by Electron Beam Moving between Them	
<i>D. Herasymova</i>	937
THz Clinotron Operating in New Regime of Hybrid Surface-Volume Mode with Wide Frequency Tuning Range	
<i>A. Lykhachev, S. Ponomarenko, S. Kishko, Y. Tatematsu, S. Mitsudo, M. Tani, E. Khutoryan, A. Kuleshov, K. Lukin</i>	942
THz Imaging System Based on Frequency-Tunable 140 GHz Clinotron and Quasi-Optical Antenna	
<i>A. Lykhachev, S. Ponomarenko, S. Kishko, Y. Kovshov, S. Vlasenko, E. Khutoryan, A. Kuleshov</i>	946
Low-Voltage Adiabatic Magnetron Injection Gun for 400GHz Gyrotron	
<i>A. Lykhachev, S. Kishko, S. Ponomarenko, E. Khutoryan, A. Kuleshov, M. Glyavin, Y. Tatematsu, S. Mitsudo, T. Idehara</i>	950

Wave Propagation and Remote Sensing

Model of Electromagnetic Manifestations of Nearby Moderate Earthquakes <i>A. P. Nickolaenko, M. Hayakawa, Y. Galuk, I. Kudintseva</i>	954
Double frequency retrieval of rain intensity using solution of the integral equation of scattering <i>A. Linkova, K. Schuenemann, A. Dormidontov</i>	958
Backscattering Calculation of Inflatable Dielectric Lifting-turning Device for Ground Measurement of Radar Object Scattering Characteristics <i>O. Sukharevsky, G. Zalevsky, I. Ryapolov, V. Vasilets</i>	964
Modeling sea waves for radiophysical problems <i>Y. F. Logvinov, I. Deineka, V. Zuykov, V. Gutnik</i>	970
Determination of characteristics of illuminated elements of the sea surface during the propagation of radio waves at small glide angles <i>Y. F. Logvinov, G. Koshovy, V. Gutnik, V. Karpenko</i>	974
Determination of surface parameters when modeling backscattering of radio waves <i>Y. F. Logvinov, A. Bukin, V. Gutnik, N. Reznichenko</i>	978
Computer Simulation of Ejections of Two-dimensional Random Signals and Their Application to Study Rogue-waves <i>V. T. Lysytsya, O. Shmat'ko, Y. Braude</i>	983
Polarization-Frequency Trajectories of Invariant Characteristics of UWB Remote Sensing Objects <i>D. Kalimullin, A. Popov</i>	987
Microwave Research of Water Foams in Biconical Resonators <i>L. A. Filins'ky, A. Chervyakov</i>	991
On Application of Taper Windows for Sidelobe Suppression in LFM Pulse Compression <i>V. G. Galushko</i>	995

Waves in Semiconductors and in Solid-State

Total tunneling electromagnetic waves through a three-layer structure containing a layer with a negative permittivity <i>N. Beletski, S. A Borysenko</i>	1002
Helicons in Solid-State Plasma of Cylindrical Configuration <i>Y. Averkov, Y. Prokopenko, V. Yakovenko</i>	1006
Surface Electromagnetic Wave Resonator on an Oversized Dielectric Substrate <i>V. Yu Malyshev, D. Sharashidze, O. Prokopenko</i>	1010

2020 IEEE Ukrainian Microwave Week (UkrMW 2020)

**Kharkiv, Ukraine
21-25 September 2020**

**Volume 4
Pages 1014-1149**



**IEEE Catalog Number: CFP20X02-POD
ISBN: 978-1-7281-7314-6**

2020 IEEE Ukrainian Microwave Week

Volume 4

on 2020 IEEE 10th International Conference on Ultrawideband and Ultrashort Impulse
Signals (UWBUSIS)

Table of contents

Theoretical Investigations and Numerical Simulations of UWB and Ultrashort Impulse Signals and Processes

Modulation Instability of Terahertz Beams in Paraelectrics in a Wide Temperature Range <i>V. Grimalsky, S. Koshevaya, J. Esobedo-Alatorre, Y. Rapoport, Y. Gomez-Badillo</i>	1014
Amplification of Waves with Broad Frequency Spectrum in FEL with Longitudinal Electrostatic Undulator <i>A. Lysenko, I. Volk, A. Brusnyk, M. Korovai, V. Koval</i>	1018
Correlation Properties of a Composite Chaotic Radio Pulse <i>K. Vasyuta, A. Kashchishin</i>	1022
Calculation Method for High-Resolution Range Profiles of Complex Shape Radar Objects <i>O. Sukharevsky, S. Nechitaylo, V. Vasilets, I. Ryapolov</i>	1026
Landmine detection and classification using UWB antenna system and ANN analysis <i>O. M. Dumin, O. A. Pryshchenko, V. Plakhtii, G. Pochanin</i>	1030
Wideband diffraction properties of axially symmetric gratings situated in hollow dielectric waveguide <i>M. Legenkiy</i>	1036

Electromagnetic Compatibility

Electromagnetic Compatibility of Mobile Telecommunication Systems <i>A. Serkov, K. Trubchaninova, I. Yakovenko, V. Kniaziev</i>	1041
Consideration of antenna pattern by elevation in Recommendation ITU-R P.2001 <i>A. Chernov, V. O Kovshar, M. Kaliuzhnyi, Yu Zheng</i>	1045

Electromagnetic Metrology

Interpretation of the Tests Results on a Scale Model to Determining the Probability of Damage to Ground-Based Constructions by a Direct Lightning Stroke <i>V. Kniaziev, S. Melnik</i>	1049
--	------

Ultra-Wideband Antennas

Radiation of Electromagnetic Field Pulses by Active and Passive UWB Slot Antennas <i>O. A. Orlenko, G. Pochanin, V. Korzh</i>	1056
The Influence of Additional Shielding Elements on a Bandwidth of Fractal Antenna <i>D. Mayboroda, S. Pogarsky</i>	1061

Toroidal coaxial slot radiator <i>V. Dakhov, S. L. Berdnik, V. Katrich, N. V Medvedev</i>	1065
Energy characteristics of a compact waveguide-slot irradiator of a dielectric medium in the microwave range <i>N. Blinova, A. Selutin</i>	1069
Application of UWB Signals and Ultrashort Impulses (communication, medicine, etc.)	
Neural Radio in UWB-SP IoT Applications <i>R. Akhmedov</i>	1073
The Modular Design of M-SIW Wideband Band-stop Filter <i>K. Güvenli, S. Yenikaya, M. Seçmen, C. Türkmén</i>	1079
Noise Immunity of UWB Positioning System on ANN <i>I. Persanov, V. Plakhtii, O. A. Pryshchenko, O. M. Dumin, P. Fomin</i>	1083
In-Home Emergency Detection Using An Ambient Ultra-Wideband Radar Sensor and Deep Learning <i>F. M. Noori, J. Torresen, M. Z. Uddin</i>	1089
Generation and Receiving of UWB Signals and Ultrashort Impulses	
Hyperbolic Magnetophotonic Crystals with Gyrotropic Layers. Dispersion Characteristics <i>A. Shmat'ko, E. N. Odarenko, V. Mizernik</i>	1094
Simulation mathematical modeling of the electronic environment for evaluating of radio monitoring systems effectiveness <i>S. S. Galkyn, V. Ananiev, O. Zadonskiy, V. Kovshar</i>	1099
Sub-THz and THz Noise Generation by Diode Heterostructures under Impact Ionization <i>O. Botsula, K. Prykhodko</i>	1103
Ultra-Wideband Signal Processing	
Automatic Detection of Subsurface Objects with the Impulse GPR of the UGO-1st Robotic Platform <i>V. Ruban, T. Ogurtsova, G. Pochanin, L. Capineri, P. Falorni, L. Bossi, T. Bechtel, F. Crawford</i>	1108
Ultra-Wideband Signals in the Infrasonic Frequency Band <i>L. Chernogor, O. Liashchuk, M. Shevelev</i>	1112
Ultra-Wideband Radar and Ground Penetrating Radar	
Radar Systems for Landmine Detection /Invited Paper/ <i>G. Pochanin, L. Capineri, T. Bechtel, P. Falorni, V. Ruban, F. Crawford, T. Ogurtsova, L. Bossi</i>	1118
Using SFCW GPR to search for buried objects <i>A. Bukin, V. Sugak, N. Reznichenko, O. Drobna, Y. Silaev, I. Deineka</i>	1123
GPR condition survey of the fill slope of the river dam <i>A. Bukin, V. Sugak, N. Reznichenko, O. Drobna, Y. Silaev, I. Deineka</i>	1128
The Effect of Secondary Reflections on the Quality of Layers Thickness Assessment Using UWB GPR Signals <i>D. Batrakov, M. S Antyufeyeva, A. Batrakova, S. Urdzik</i>	1132
High-Resolution Range Profiles of Artillery Shells in UHF and VHF Bands <i>G. S. Zalevsky, M. Surgai, O. Sukharevsky, V. Vasilets, A. Florov</i>	1136

Object classification using artificial neural network processing of data obtained by impulse GPR with 1 Tx + 4Rx antenna system

O. M Dumin, V. Plakhtii, G. Pochanin, D. Shyrokorad..... 1140

Features of Using Simulation - Prognostic Modeling in the Investigation of Complex Layered Media

Y. Maksimovitch, V. Badeev, K. Chugai, K. Gaikovich..... 1145