

# **2022 6th Scientific School Dynamics of Complex Networks and their Applications (DCNA 2022)**

**Kaliningrad, Russia  
14 – 16 September 2022**



**IEEE Catalog Number: CFP22O96-POD  
ISBN: 978-1-6654-6175-7**

**Copyright © 2022 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:	CFP22O96-POD
ISBN (Print-On-Demand):	978-1-6654-6175-7
ISBN (Online):	978-1-6654-6174-0
ISSN:	2770-7431

**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](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

CURRAN ASSOCIATES INC.  
**proceedings**  
.com

## CONTENTS

<b>Alimuradov Alan, Tychkov Alexander, Churakov Pyotr, Dudnikov Dmitry</b> A Novel Approach to Speech Signal Segmentation Based on Time-Frequency Analysis	8
<b>Andreev Andrey</b> Macroscopic dynamics prediction by reservoir computing	14
<b>Andreeva Natalia, Ryndin Eugeny, Luchinin Victor, Mazing Dmitry</b> Switching between electronic and ionic-driven synaptic functionality in non-volatile memristors	17
<b>Antipov Vladimir</b> Upper limb exoskeleton for neurorehabilitation with control via brain-computer interface	21
<b>Antipov Vladimir, Badarin Artem, Grubov Vadim</b> Investigation of brain activity characteristics during working memory activation for multimodal stimuli	24
<b>Avilov Vadim, Tominov Roman, Vakulov Zakhar, Polupanov Nikita, Fedotov Aleksandr, Smirnov Vladimir</b> Forming-free titanium oxide neuromorphic crossbar array for robotics and AI systems	27
<b>Babbysh Nikolay</b> Data classification using interferential neural network model	31
<b>Borovkova Ekaterina, Hramkov Alexey, Dubinkina Elizaveta, Karavaev Anatoly, Bezruchko Boris, Prokhorov Mikhail</b> Changes in the Interaction Between Brain Structures and Elements of the Autonomic Control of Blood Circulation During the Solution of Cognitive Tasks	34
<b>Brovkova Marina, Torgashova Olga, Ushakova Olga, Martynov Vladimir, Solomin Maksim</b> The cutting force signal identification of the milling machine spindle assembly for monitoring equipment wear	38
<b>Brovkova Marina, Ushakova Olga, Sokolov Aleksey, Torgashova Olga, Martynov Vladimir, Solomin Maksim, Bolshakov Andrei</b> Intelligent Monitoring Platform for Digital Manufacturing Based on the Concept of Event-Driven (Streaming) Event Processing Akin to Middleware Command Router	42
<b>Brusinskii Nikita, Badarin Artem, Hramov Alexander</b> Eye movement features in solving Sternberg Memory Task	46
<b>Brzhozovskii Boris, Martynov Vladimir, Zinina Elena</b> The results of the correlation analysis of the relationship between indicators characterizing the surface layer properties and signals reflecting the process of low-temperature plasma treatment of metal products	49
<b>Brzhozovskii Boris, Martynov Vladimir, Zinina Elena, Permyakov Sergey</b> Analysis of the low-temperature plasma treatment stability	52
<b>Bugakova Aleksandra, Muraveva Anna, Kuzmina Ekaterina, Nikolaeva Varvara, Gorin Aleksei, Lebedev Mikhail</b> EEG during Motor Imagery under Different Postural Conditions	55
<b>Bukina Tatyana, Khramova Marina</b> Prevalence of neuromyths among pre-service teachers	58

<b>Bukvarev Evgeny, Fomina Ksenya, Shabalin Semen, Shchanikov Sergey</b> Programming Resistive States of Memristive Devices via Current Control	61
<b>Butorova Anastasia, Naizagarinova Aigerim, Tarasov Dmitriy, Sergeev Aleksandr</b> The vOICe Visual-Auditory Sensory Substitution Technology in the Depth Perception Task	65
<b>Chernov Andrey, Len Irina, Amelina Natalia, Ivanskiy Yury</b> Network Traffic Load Balancing Protocol for Different Priority Traffic	69
<b>Chvanova Marina, Bakalets Ilya</b> Neural network technology for quality control of the milk packaging process	73
<b>Devyashin Herman, Syrov Nikolay, Yakovlev Lev, Novitskiy Mikhail, Shusharina Natalia</b> The EEG Study of Tattoo Induced Pain	75
<b>Dubinkina Elizaveta, Borovkova Ekaterina, Hramkov Alexey, Karavaev Anatoly, Kurbako Alexander, Prokhorov Mikhail</b> Changes in the Perfusion Index After Psycho-emotional Stress	79
<b>Ershova Anastasia, Suleymanova Elena, Grishchenko Anastasia, Vinogradova Lyudmila, Sysoev Ilya</b> Quantitative analysis of spike-wave discharge patterns in pentylenetetrazole rat model	82
<b>Fradkov Alexander, Semenov Aleksandr</b> Functional identification of the parameters of the multispecies Lotka-Volterra model	86
<b>Franovic Igor, Eydam Sebastian, Semenova Nadezhda, Zakharova Anna</b> Solitary states in arrays of excitable FitzHugh-Nagumo units	89
<b>Furtat Igor, Gushchin Pavel, Huy BaNguyen</b> Experimental Study of Robust Control Law Designed for Synchronization of Electrical Generator Network	93
<b>Grishchenko Anastasia, Sysoev Ilya, Sysoeva Marina</b> Testing approaches to statistical evaluation of connectivity estimates in epileptic brain based on simple oscillatory models	97
<b>Grubov Vadim, Afinogenov Sergey, Maximenko Vladimir, Utyashev Nikita</b> Epileptic EEG marking with machine learning approach	101
<b>Guio German</b> Analysis of EEG signals using multiresolution wavelet analysis and its extensions	106
<b>Guleva Valentina</b> Node Correlation Effects on Learning Dynamics in Networked Multiagent Reinforcement Learning	110
<b>Hramkov Aleksey, Borovkova Ekaterina, Dubinkina Elizaveta, Ponomarenko Vladimir, Ishbulatov Yuri, Prokhorov Mikhail</b> A system for diagnosing the psychophysiological state of a person based on the control of nonlinear characteristics of cardiorespiratory interaction	114
<b>Kapustnikov Anton, Sysoeva Marina, Sysoev Ilya</b> Studying response to external driving in a model of thalamocortical system with specialized neuron equations	116
<b>Karavaev Anatoly, Ishbulatov Yurii, Bibicheva Tatiana, Gridnev Vladimir, Prokhorov Mikhail, Ogneva Marina, Kiselev Anton</b> Role of the Bidirectional Cardiorespiratory Coupling in the Nonlinear Dynamics of the Cardiovascular System	119

<b>Kastalskiy Innokentiy</b> CPG-based control of robotic fish by setting macro-commands with transient parameters	122
<b>Khorev Vladimir</b> Brain activity diagnostics system for exoskeleton control	125
<b>Khorev Vladimir, Kurkin Semen, Paunova Rositsa, Simeonova Denitsa, Kandilarova Sevdalina, Stoyanov Drozdostoy</b> Brain activity functional analysis of the fMRI in healthy subjects between Stroop and emotion tests	129
<b>Kipelkin Ivan, Gerasimova Svetlana, Guseinov Davud, Pavlov Dmitry, Vorontsov Vladislav, Mikhaylov Alexey, Kazantsev Victor</b> Memristive model of the Fitzhugh-Nagumo neuronal oscillator	132
<b>Kirsanov Artem, Vervevko Darya, Brazhe Alexey, Lukin Pavel, Verisokin Andrey</b> Realistic modeling of astrocyte-axon interaction sites	136
<b>Kornilov Maksim, Sysoeva Marina, Matrosov Valery, Sysoev Ilya</b> Integrated equations reconstruction from scalar time series of periodically driven phase-locked loop system	140
<b>Koronovskiy Alexander, Pavlov Alexey</b> Extended version of detrended cross-correlation analysis	144
<b>Koryazhkina Maria, Okulich Evgeniya, Ryabova Margarita, Belov Alexey, Antonov Ivan, Kotomina Valentina, Shchanikov Sergey, Mikhaylov Alexey, Filatov Dmitrii, Angelo Carollo, Davide Valenti</b> Effect of pulse amplitude on depression and potentiation of ZrO <sub>2</sub> (Y)-based memristive synaptic device	147
<b>Kovalchukov Aleksandr, Fradkov Alexander</b> Speed-Gradient approach to Hindmarsh-Rose model identification based on membrane potential measurements	151
<b>Kovalev Alexander, Zaitsev Anatoly, Kamashev Gleb</b> Development of the index of optimal physical activity	155
<b>Kovaleva Natalia, Matrosov Valery, Mishchenko Mikhail</b> Working memory capacity of spiking neural network model	158
<b>Kuc Alexander, Batmanova Alisa, Maksimenko Vladimir</b> Training Artificial Neural Network to Classify Correct and Erroneous Interpretations of Visual Stimuli before Behavioral Response	160
<b>Kulminskiy Danil, Ishbulatov Yurii, Kurbako Aleksandr</b> Changes in Statistical Measures of Cross-Recurrence Quantification Analysis of EEG after Sound Exposure	163
<b>Kurbako Aleksandr, Skazkina Victoria, Borovkova Ekaterina, Karavaev Anatoly</b> Development of Real-Time Methods for Calculating Cardiointervalograms for Estimating the State of the Cardiovascular System Using a Single Photoplethysmogram Signal	166
<b>Kuzmina Ekaterina, Kriukov Dmitrii, Lebedev Mikhail</b> Further observations on the rotational structure in neural data	168
<b>Kuznetsov Mikhail, Vrazhevsky Sergey, Kopysova Eseniya</b> Quadrotor Control under Prespecified State-Space Bounds	172

<b>Lavrova Anastasia, Artem Veselsky, Zarya Valeriya, Tabanakova Irina, Torkatyuk Elena, Gavrilov Pavel</b> Evaluation of different decision tree-based methods applied to assessment of bronchial blocking success in patients with destructive forms of tuberculosis	176
<b>Makovkin Sergey, Ivanchenko Mikhail, Gordleeva Susanna</b> Neuronal intermittent synchronization enhanced by astrocytes	179
<b>Maksimenko Vladimir, Gordleeva Susanna, Grigorev Nikita, Savosenkov Andrey, Kuc Alexander, Udoratina Anna, Kolchina Anna, Kurkin Semen, Grubov Vadim, Kazantsev Victor, Hramov Alexander</b> Anterior TMS Speeds up Responses in Perceptual Decision-making Task	182
<b>Markova Galiya, Bartsev Sergey</b> Decoding the Neural Activity of Recurrent Neural Network Playing a Reflexive Game	185
<b>Mikhaylov Alexey</b> Complex dynamics and applications of memristive devices and systems	189
<b>Miroshnikov Andrei, Yakovlev Lev, Berkmush-Antipova Artemiy, Syrov Nikolay, Kaplan Alexander, Shusharina Natalia</b> Source localization during tactile stimulation and imagery of the upper limbs	193
<b>Mirzaeva Kseniya, Badarin Artem, Antipov Vladimir, Grubov Vadim, Hramov Alexander</b> Experimental design for studying brain activity and behavior of a child in the process of solving elementary cognitive tasks	197
<b>Mishchenko Mikhail, Kovaleva Natalia, Bolshakov Denis, Matrosov Valery</b> The role of connections topology on synchronization in neural network	200
<b>Mortin Konstantin, Shamshin Maksim</b> Development of methods and algorithms of technical vision for detecting the defect longitudinal crack on sheet metal	202
<b>Nasybullin Albert, Maksimenko Vladimir, Kurkin Semen</b> How Long short-term memory artificial neural network, synthetic data, and fine-tuning improve the classification of raw EEG data	210
<b>Petukhov Alexandr, Polevaia Sofia, Polevaia Anna</b> Measuring Cognitive Potential in People while Performing Tasks with Varying Complexity	214
<b>Piljugin Oleg, Badarin Artem, Antipov Vladimir, Grubov Vadim, Belousova Yana, Tynterova Anastasia, Rafalskiy Vladimir, Shusharina Natalia, Hramov Alexander</b> Analysis of eye-tracking data during the Sternberg working memory task in subjects with asthenic syndrome	219
<b>Pitsik Elena, Kurkin Semen, Hramov Alexander, Paunova Rositsa, Simeonova Denitsa, Kandilarova Sevdalina, Stoyanov Drozdostoy</b> A graph convolutional network for classification of resting-state fMRI data	223
<b>Pospelov Nikita, Levchenko Egor, Tiselko Vasilii, Safronova Raisa, Zakharov Ilya, Sotskov Vladimir, Anokhin Konstantin</b> Network entropy analysis reveals high heterogeneity of human functional networks	226
<b>Prokhorov Mikhail, Navrotskaya Elena, Kulminskiy Danil, Ponomarenko Vladimir</b> Estimation of periodic force parameters using a spiking neural network	230
<b>Rogozhnikova Olga, Ivashkina Olga, Toropova Ksenia, Plusnin Victor, Solotenkov Maxim, Fedotov Ilya, Zheltikov Alexei, Anokhin Konstantin</b> Calcium activity of	232

basolateral amygdala and CA1 field of hippocampus in mice with normal and impaired memory	
<b>Semenov Danila, Plotnikov Sergei, Fradkov Alexander</b> Controlled synchronization in regular delay-coupled networks of Hindmarsh-Rose neurons	236
<b>Semenova Nadezhda</b> The impact of uncorrelated noise on echo state networks	240
<b>Sergeenko Anna, Granichin Oleg, Erofeeva Victoria</b> Accelerated Online Distributed Optimization for Parameter Estimation Under Uncertainties	244
<b>Shagniev Oleg, Fradkov Alexander</b> Discretization Effects in Speed-Gradient Two-rotor Vibration Setup Synchronization Control	248
<b>Shanarova Nadezhda, Pronina Marina, Lipkovich Mikhail, Kropotov Juri</b> Machine learning based diagnostics of schizophrenia patients	252
<b>Shchanikov Sergey, Bordanov Ilya</b> The Concept of Neuromorphic Vision Systems based on Memristive Devices	256
<b>Skazkina Viktoriia, Popov Konstantin, Kurbaka Aleksandr</b> Dynamics of connections between autonomic regulatory circuits of the cardiovascular system in patients with Covid-19	260
<b>Smirnov Dmitry</b> Dynamical Causal Effects in Bidirectionally Coupled Stochastic Damped Oscillators	262
<b>Stankevich Nataliya, Bagautdinova Elmira</b> The simplest neuron models with bistability occurring as a result of accounting new ion channels	266
<b>Stepasyuk Vasilisa, Makarov Valeri, Kazantsev Victor, Lobov Sergey</b> Synaptic scaling as an essential component of Hebbian learning	270
<b>Talanov Max</b> Neuropunk revolution: preliminary results	274
<b>Telminov Oleg, Gornev Eugeny</b> Possibilities and Limitations of Memristor Crossbars for Neuromorphic Computing	278
<b>Tychkov Alexander, Chernyshov Denis, Bofanova Natalia, Milykh Ilya, Alimuradov Alan</b> Development of "City of the Future" Scene to Assess the User Experience in a Virtual Reality environment	282
<b>Ushakov Illarion, Mishchenko Mikhail, Matrosov Valery</b> Self-organized criticality in a neural network with the small-world topology	286
<b>Ushakova Olga, Martynov Vladimir, Brovkova Marina, Torgashova Olga, Bolshakov Andrei, Kamalov Akmal</b> Development of Visual Analytics of Monitoring Results Using Augmented Reality Tools Based on the IIoT (Industrial Internet of Things) Platform	288
<b>Verisokin Andrey, Verveiko Darya, Brazhe Alexey, Prudkin Maxim</b> Broadcasting to noisy boosters: modulation of astrocytic calcium activity and gliotransmitter release by norepinephrine	292
<b>Verveiko Darya, Verisokin Andrey, Postnov Dmitry</b> Stable wave segments in a discrete-continuous medium	296
<b>Vlasov Danila, Rybka Roman, Sboev Alexander, Serenko Alexey, Minnekhanov Anton, Demin Vyacheslav</b> Reinforcement learning in a spiking neural network with memristive plasticity	300

<b>Vrazhevsky Sergey, Kopysova Eseniya, Kuznetsov Mikhail</b> Nonlinear Suboptimal Robust Control for Twin Rotor MIMO System	303
<b>Zaitceva Iuliia, Andrievsky Boris</b> Real-time Reinforcement Learning of Vibration Machine PI-controller	307
<b>Zakharov Oleg, Ivanova Tatiana, Pugin Konstantin</b> Variable asymmetric morphological profile filter for roughness analysis	312