of information exchange between neurons, discrete time, and space found its explanation within the proposed theory. CRDCD and its basic equations being applied to a neural networks dynamics simulation starts with an initial hypothesis about mechanisms of biochemical reactions that are taking place within individual neurons and a scheme of "information exchange" between neurons. We speculate that specific time–space chemical distributions (patterns) within the brain's neurons networks initiate and are intrinsically responsible for its creativity. For example, before artist starting to paint, the image should appear in a specific part of the brain in a form of the neuron's distributed chemicals. If our theory is correct it should have an ability to generate a variety of creative patterns correlated with natural human brains activity such as artistic patterns in a form of ornaments, music, poems, and all other types of natural brain creative activity. Our basic equations are easily expandable to 3D and to nD neural networks and to any complex schemes of biochemical reactions within the neural networks, which will enable us to simulate extremely complex patterning. This approach for neural networks mathematical modeling should lead to the creation of computerized artificial brain systems with the abilities to simulate basic brain functions with tremendous facilities.

Based on our results, we can expect that the CRDCD theory and resulting mathematical models could be effectively used for simulation of neural networks dynamics and brain creativity in a form of emerged artistic patterns in particular. This proposed approach could contribute to better understanding of brain functioning and explain basic features of living and thinking systems' dynamics, which is quite different from nonliving matter dynamics. Possible applications of CRDCD: new generation of artificial neural networks and "artificial brain" systems, biofeedback systems with the visual stimuli in a form of mandalas, electroencephalography simulation and analysis, mathematical imaging, and signals generators.

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Integrating Neuromarkers for the Era of Brain-Related "Personalized Medicine"

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The talk outlines key drivers (including the Food and Drug Administration [FDA] and the *Diagnostic and Statistical Manual of Mental Disorders* [5th ed.]) for a "Personalized Medicine." Personalized Medicine has been driven by the FDA as finding the best markers of treatment prediction (of which individuals will respond to what drugs). The proof of concept successes in Personalized Medicine and exemplars of neuromarkers were presented in attention deficit hyperactivity disorder, depression, MCI/Alzheimer's dementia, schizophrenia and posttraumatic stress disorder. This context will serve as a frame of reference as to how a Personalized Medicine approach may be effectively implemented in neurofeedback training. Success of this endeavor is contingent on a deeper understanding of mechanisms underpinning electroencephalography and how this insight translates into more valid and personalized protocol selection in neurofeedback training.

EEG-Related Colored Symmetrical Images as Visual Stimuli for Neurofeedback

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Introduction

In this work we propose a new methodology for neurofeedback based on a visual

stimuli generated by biochemical reactions discrete chaotic dynamics (BRDCD; Gontar, 1997). BRDCD is an innovative theoretical approach applied to the simulation of the brain's neural networks dynamics.

Method

Mathematical modeling of neural networks based on BRDCD resulted in a variety of internal neuronal constituents concentrations oscillatory regimes. Individual neuron's internal oscillations occurring within concrete neural networks show similar patterns to experimentally observed electroencephalography (EEG). In the same time, BRDCD mathematical models allow us to present instant network's distributed neuron states (firing) reflecting amplitudes of the neuron's oscillatory regime at "discrete time" t_q in a form of 2D colored patterns. It was shown that simulation of neural networks dynamical activity could result in the variety of oscillatory regimes including chaotic ones and in the variety that corresponded to these oscillatory regimes 2D patterns including "creative" symmetrical ones (mandalas; Gontar, 2000). In this work we intend to correlate oscillatory neural networks regimes with experimental EEG while corresponding 2D symmetrical patterns (colored mandalas) were used as visual stimuli for biofeedback system.

Results

Different oscillatory regimes and corresponding mandala images generated by the BRDCD mathematical models were demonstrated. Mathematically modeled signals and mandalas were compared with experimentally observed EEG signals and mandala images created by Jung's patients. The prototype of the neurofeedback system exploiting proposed method were presented and discussed.

Conclusions

The idea to use mandalas as visual stimuli is inspired by Jung's observation that this kind of images, being created spontaneously by an individual, has a therapeutic effect on their authors (Jung, 1973). We propose to use a patient's EEG data as input for a BRDCD mathematical model to transform EEG signals in real time into mandala images that should reflect personal ongoing brain activity. Therefore we can expect that biofeedback systems based on the proposed methodology will enhance therapeutic impact on the patient.

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Bioaccoustical Utilization Device-Assisted Neurotherapy in the Management of Attention Deficit Hyperactivity Disorder

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Introduction

The use of neurotherapy or electroencephalography output to help a person learn how to affect brain frequencies has been documented for management of attention deficit hyperactivity disorder (ADHD). The primary limitation for this and other self-regulation approaches, however, is a function of the length of time it takes for a person to learn these subtle controls. For these and other logistical issues, the BioAccoustical Utilization Device (BAUD) was developed for treatment of ADHD based on the principles of brain entrainment using acoustical tones. The engineering technology of the BAUD utilizes a stereophonic sound wave of a square pattern for each ear in which interference