Four Recent (4) Papers of TETRAD Institute work (involving IRI and Oasis subsidiary/affiliates) (Abstracts only, here)

These have been submitted but this document is not to be distributed or released. It is a preview.

Primary Contact persons (overall):
martinjoseph@tdyn.org Dr. Martin Dudziak, PhD
rachelcereth@tdyn.org Rachel Cereth RN
+1 505-926-1399, +1 231-492-8301

[1]

Integrative Reflexive Information using NfL and fMRI with phenomenological monitoring for optimization of therapeutics in multiple sclerosis and related neurological diseases

Authors: M Dudziak, R Roman, P Cadet

Abstract

The role of nutrition, physical fitness and cognitive exercise as both prophylactic and therapeutic aids pertinent to neurological diseases, including those of autoimmune characteristics, has been demonstrated but has generally been inadequately studied in the context of patients outside of strict control groups, often undergoing a history of varying treatments and often subject to variations in medication and lifestyle changes. Correlation of environmental and behavioral factors, both in etiology of disease and in treatments leading to comparative cures, long-term remissions and/or reduced progressions, needs closer monitoring of both direct neurological function and patient-interactive behaviors. Limitations on types and frequencies of significant observation, such as offered in particular by neurofilament light (NfL) and functional MRI (fMRI) testing, has contributed to the current deficit in understanding how certain modalities of lifestyle, diet, and exercise affect progressions of diseases such as multiple sclerosis, dementia, and Parkinson's. A program involving coordination and control of frequent multi-sensor diagnostic imaging and chemical analysis in conjunction with lifestyle and activity monitoring using wearable and telepresence technologies has been designed for inclusion with pharmaceutical regimens within both clinical trials and sustained patient practice. This program is conducted in combination with nutrition, physical fitness, and psychological practices that complement administration of pharmaceutical treatments. The initial phase is focused upon incorporation of monthly and bimonthly examination using NfL and fMRI in addition to conventional MRI. Non-pharmaceutical therapeutics introduced include transcranial magnetic stimulation (TMS) and photobiomodulation (PBM) in addition to exercise and dietary practices previously shown to have bearing on both avoidance and mitigation of neurological disorders of these types. Initial patient populations are within RRMS and SPMS multiple sclerosis groups and with long-term engagement underway for next-phase studies.

[2]

Topological Connectome and the Etiology of Neurodegenerative and Neurorestorative Processes with implications for Autoimmune Disease and Traumatic Injury

M Dudziak, E Deli

Abstract

The 50 Brodmann areas of the cerebral cortex is divided into around 500 smaller cortical patches, made up of macro columns, mini-columns, layers, and finally neurons. A fractal structure is characteristic of both the structural and functional organization of the brain. While active neurons give rise to extracellular fields, feedbacks to the neurons can alter their behavior, even without a physical connection between the neurons. Changing the synaptic weight between neurons changes the global character of the neural system, the ability to respond to future stimuli. Many levels of feedback loops, such as the cortico-thalamic loop, give rise to a complex regulation. At every organizational level, the topology of the electric activities is characteristic of the neuronal regulation and complexity. Network topology measures represent the best computational method for the grading of levels of consciousness [1]. Memory loss in dementia contributes to disorientation in space, time, and identity, leading to insecurity, and anxiety, which only intensify cognitive disturbances. For example, repetitious thoughts indicate susceptibility to anxiety, and depression. In multiple sclerosis, Parkinson's, Alzheimer's, and other psychological and interpersonal disorders, disturbances in spatial orientation have also been noted [2,3]. Disturbances in navigation altered neurogenesis and significantly reduced neural stem cell production [4], indicating the close relationship between conceptual and spatial deficiencies. The possible connection between spatial deficiencies and topological alterations might offer early diagnostic markers and novel targets for mental diseases.

[3]

The Other Half of Clinical Trial Data Acquisition and Intelligent Assimilation into Useful Information for Pharmaceutical Regimen Planning

M Dudziak, R Roman, P Cadet

Abstract

Disorders and diseases that often significantly impair behaviors in basic lifestyles including employment, personal activities, residence, mobility, and other aspects of daily and regular life, have often not been subject to studies, particularly when new pharmaceutical treatments are being tested and introduced, which adequately and deeply make use of changes in those types of behaviors. The availability of a large and open-ended class of technologies, including those available and accessible for laboratory and clinical testing on more frequent and ad hoc basis, and especially those that may be used in at-home, at-work and diverse indoor/outdoor settings by patients and care-givers, now offers very rich and powerful data sets which can be rapidly and easily transformed into useful knowledge for determining effectiveness, comparative values, contraindications, side-effects, and many significant qualitative factors for determining the optimal use of both established and new pharmaceuticals in patient therapy programs. The OASIS Programs for Neurophysiological Wellness comprise a long-term multi-dimensional study that introduce information monitoring and gathering that meets criteria for patient acceptance, familiarity, privacy, and “commonplace universality” of uses, in home-based, workplace, outdoor, social, and other environments. Extensive use is made with conventional and easily-understood technologies that include wearable and remote devices including audio, imaging and video capabilities for gathering more extensive and higher-relevance information regarding movement, speech, writing, spatial recognition and distortion, falls and other movement and safety challenges, and cognitive functions. This data is acquired in a manner that preserves anonymity and privacy and that is easily assimilated and integrated with existing clinical imaging and testing.

[4]

Topological Information Processes in Viral-Host Interaction and Membrane Penetration: common natural biocomputation processes underlying certain contagious and autoimmune diseases and adaptive mutation

M Dudziak, E Deli, O Ori, R Roman, G Vattay

Abstract

A model incorporating principles of topological order and efficiency shows utility for demonstration of a mechanism present in both viral entries for certain agents including coronavirus, influenza and filovirus types such as ebola, and also in non-infectious disorders and diseases associated with autoimmune reactions, particularly within the brain and central nervous system. This process can be described as a type of natural biocomputation involving extensive molecular surfaces. It appears to fit with observations of surface protein changes within viral envelopes and primary structures involved in entry to target host cells, and it involves an iterative changes within viral protein conformation and surface topography that can be associated with underlying mutations within the viral strain. Similar processes appear to be present in the phenomenologically distinct and non-viral initial inflammatory stages of neurons affecting axons, both myelin sheaths and interior microtubule chains, leading to neuronal degeneration that triggers subsequent normative engagement of the immune system response. The apparent computational process is similar to certain non-Turing quantum computing models and leads to consideration of an underlying common mechanism within certain biological structures that involves the interaction among non-smooth manifolds and the optimization of surface-fitting that is consistent with Ricci Flow models for deformation and maintainability of topological consistency.

[5]
Brain is not a Turing Machine and AI is a limit-case of adaptive logic

M Dudziak, E Deli, O Granichin, G Vattay

Abstract
Thermodynamics is a rapidly changing field that promises the development of novel techniques and applications. The brain's synaptic network displays a topological character, which is related to psychology. Cortical activation compresses information and builds an evoked potential. The frequencies of the brain's evoked cycle reflect the energy need of synaptic changes. Deep learning can also be divided into phases that consist of compression of information and relaxation, which culminates in representation. Just as backpropagation in current neural networks, feedback loops in the brain improve performance. The brain's biggest loop is the evoked cycle. It is centered on the resting state, which is maintained by self-regulation. Self-regulation is an essential quality of neural systems that perform computations with thermodynamic efficiency in orders of magnitude greater than current supercomputers. Subjective perception of stimulus is an appropriate Fourier transform of the input. The resulting temporal organization orients the mental world orthogonally to the physical environment. Temporal orientation allows biological systems to form memory, learning, and evolution. As material systems observe the principle of least action when moving in space, intelligent systems might balance their action repertoire between the past and the future. Thus, generalization is a type of memory that boosts the ability to handle future challenges. The resting state permits the gradual evolution of the system in time and engenders the brain's temporal orientation. In a temporal system, quantum phenomena such as, entanglement forms in time and therefore is resistant to spatial disturbance. The later quality is perhaps the most essential advantage of brain-like quantum systems. A self-regulating system herein that can change and learn in response to the environment, and it may be suitable as the evolvable elements for future for thermodynamic computers.

[6]

Generalized Heterogeneous Computing Machine – Quantum Non-Turing Computing based upon Biology and the Brain

Abstract

This report presents the fundamental architecture of the GCM (hardware and software), a design for a computing system encompassing topological cortical columns using physical microdevices and circuits and incorporating simultaneous perturbation stochastic approximation (SPSA) models. The architecture employs PPC (protein (peptide) polymer conjugates), conformally arranged, in topological ordering that on the macro scale resembles origami, quipu and other knotted string-like structures, within graphene layers for conductive logic and for i/o connectivity to "heterogeneous" Turing-machine computing devices (bit-based and qubit-based). The implementation of this architecture involves multi-material multi-layer 3D printing (graphene, silicon, metals, and PPC).

The primary logic employed within the GCM is derived from network dynamics of the neural connectome and involves the autonomous formation of resonant patterns of activation and deactivation with topological deformations, employing SPSA and the emergence of chreodic topological features that maintain persistence over time and are "eigenstructured" topologies, resistant to variations in spatial deformations and resistant to noise introduced both internal and external to the GCM system.

The GCM is capable of learning and introducing self-critical, self-adjusting innovations through exposure to diverse and widely-varied stimuli forms. Decoherence problems as in quantum Turing-machine computers is not a problem but a necessary ingredient for cognitive invention and memory (reconstruction) retention. The formal basis for the GCM is consistent with observed neurobiology and with fundamental RTD (Reflexive topological Dynamics) physical theory and principles of emergency of order and structure from randomness.

Applications for the GCM include tasks in drug design, n-body cybernetics and control, and other challenges in pattern discovery within physical and life sciences, robotic navigation, and the study of psychosocioeconomic dispositions and trends for behavior of large populations.