frontiers

IPM
INSTITUTE FOR RESEARCH IN FUNDAMENTAL SCIENCES

Liv
Intelligent Technology
Knowledge-based Company

sns.ee.sharif.ir
@SNS_En/@SNS_Fa @SNS_En
sharif.neuro.symposium2022@gmail.com

Sharif Neuroscience Symposium 2022 | March 3,4th

- Systems Neuroscience
- Computational Neuroscience
- Neuroimaging
- Neural Networks
- Human & Machine Vision
- Brain Computer Interface
- Biological & Artificial Intelligence

Registration Deadline: Feb. 15th, 2022
Abstract Submission Deadline: Jan. 25th, 2022

sns.ee.sharif.ir/registration

Sharif Neuroscience Symposium 2022

Symposium Information and Abstracts Booklet

March 2022

Contents

Preface

The fourth Sharif Neuroscience Symposium (SNS 2022) which is being held from 3rd-4th of March 2022 (12-13th of Esfand 1400) is an annual event that covers key advances in cognitive, computational and systems neuroscience as well as neuro-engineering by inviting experts in the fields from across the world to share their new findings and perspectives in a collegial atmosphere.

This year, the symposium consists of a series of 10 invited talks by internationally renowned experts across various research areas including cognitive neuroscience, learning and memory, decision making, sensory processing, vision sciences, motor control and computational neuroscience. In addition, the symposium received abstract submissions from various research groups in Iran and internationally. Following, peer review by the SNS 2022 scientific committee, 17 abstracts were selected for oral presentations.

In addition to the main symposium, four satellite workshops, covering concepts and techniques in fMRI, Human connectome project, EEG and computational neuroscience were scheduled and held in the weeks leading to or following the main symposium. The symposium and the workshops were warmly received by the neuroscience community and attended by more than 400 participants overall.

The current booklet contains comprehensive information about the SNS 2022, including the detailed meeting schedule, the list of symposium sponsors, abstracts of invited speakers, and all accepted abstracts. Special thanks go to the executive committee consisting of student in the electrical engineering department at Sharif University of Technology who worked tirelessly in the months leading to the symposium for making it a reality and a success. Like last year, this year symposium is fully online and thus easily accessible to the research community worldwide. We hope that this symposium enhances the excitement about neuroscience among the researchers here and abroad and would be happy to see its positive scientific impact reverberates for months and years to come among the students and faculty in the field.

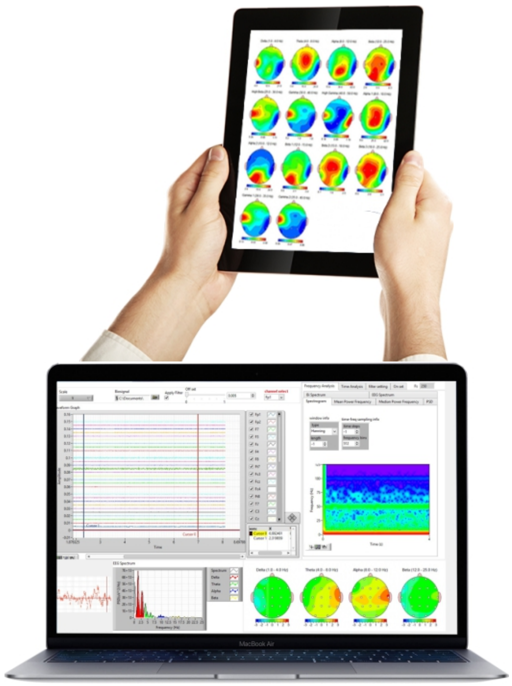
Ali Ghazizadeh, PhD
Symposium Chair, SNS 2022
Faculty, Electrical Engineering Department, Sharif University of Technology
Dean, School of Cognitive Sciences, IPM

Sponsors

Liv Intelligent Technology
Knowledge-based Company

Liv Intelligent Technology

Liv intelligent technology knowledge-based company founded in 2019 has developed advanced medical equipment for clinical and research applications in the field of functional diagnostics and neurophysiology. Liv has also designed and manufactured non-contact infrared thermometer for the first time in Iran during the COVID-19 pandemic since fever was one of the first signs of Corona virus infection. Professional team of electrical engineers, medical engineers, software engineers and programmers in cooperation with medical researchers allows Liv to take leading positions in Iranian market of diagnostics and neurophysiology medical equipment. Our mission is to improve the quality of life through advanced medical technology.



Liv systems are based on customer focused effort within the framework of the Liv family. User friendly and intuitive handling of the recording and review software combined with the outstanding improvement of the functionality are trademarks of the Liv family, providing you with more time that you can then focus on your patient, rather than your machine. EEG, ABR, TDCS, NFB, EMG, ECG, EEG Cap, Software and Thermometer are our main products.

Part I

Essential Information

Schedule

Iran Standard Time (IRST)

IRST	March 3rd - Thursday	March 4th - Friday
9:30 - 10:30		Ilya Monosov
10:30 - 11:00	Opening Ceremony	Panel (Ilya Monosov)
11:00 - 12:30	Oral presentations 1	Oral presentations 2
12:30 - 13:30	Break and Launch	Break and Launch
13:30 - 14:30	Tatjana Tchumatchenko	Peter Zeidman
14:30 - 15:00	Panel (Tatjana Tchumatchenko)	Panel (Peter Zeidman)
15:00 - 16:00	Athena Akrami	Oral presentations 3
16:00 - 16:30	Panel (Athena Akrami)	
16:30 - 17:30	Marlene Behrmann	Carlos Brody
17:30 - 18:00	Panel (Marlene Behrmann)	Break
18:00 - 19:00	Jorn Diedrichsen	Adam Kohn
19:00 - 19:30	Panel (Jorn Deidrichsen)	Panel (Adam Kohn)
19:30 - 20:30	Alex Huk	Mehrdad Jazayeri
20:30 - 21:00	Panel (Alex Huk)	Panel (Mehrdad Jazayeri)
21:00 - 22:00		Closing Ceremony

Eastern Standard Time (EST)

EST	March 3rd - Thursday	March 4th - Friday
1:00 - 2:00		Ilya Monosov
2:00 - 2:30	Opening Ceremony	Panel (Ilya Monosov)
2:30 - 4:00	Oral presentations 1	Oral presentations 2
4:00 - 5:00	Break and Launch	Break and Launch
5:00 - 6:00	Tatjana Tchumatchenko	Peter Zeidman
6:00 - 6:30	Panel (Tatjana Tchumatchenko)	Panel (Peter Zeidman)
6:30 - 7:30	Athena Akrami	Oral presentations 3
7:30 - 8:00	Panel (Athena Akrami)	
8:00 - 9:00	Marlene Behrmann	Carlos Brody
9:00 - 9:30	Panel (Marlene Behrmann)	Break
9:30 - 10:30	Jorn Diedrichsen	Adam Kohn
10:30 - 11:00	Panel (Jorn Deidrichsen)	Panel (Adam Kohn)
11:00 - 12:00	Alex Huk	Mehrdad Jazayeri
12:00 - 12:30	Panel (Alex Huk)	Panel (Mehrdad Jazayeri)
12:30 - 13:30		Closing Ceremony

Central Standard Time (CST)

CST	March 3rd - Thursday	March 4th - Friday
0:00 - 1:00		Ilya Monosov
1:00 - 1:30	Opening Ceremony	Panel (Ilya Monosov)
1:30 - 3:00	Oral presentations 1	Oral presentations 2
3:00 - 4:00	Break and Launch	Break and Launch
4:00 - 5:00	Tatjana Tchumatchenko	Peter Zeidman
5:00 - 5:30	Panel (Tatjana Tchumatchenko)	Panel (Peter Zeidman)
5:30 - 6:30	Athena Akrami	Oral presentations 3
6:30 - 7:00	Panel (Athena Akrami)	
7:00 - 8:00	Marlene Behrmann	Carlos Brody
8:00 - 8:30	Panel (Marlene Behrmann)	Break
8:30 - 9:30	Jorn Diedrichsen	Adam Kohn
9:30 - 10:00	Panel (Jorn Deidrichsen)	Panel (Adam Kohn)
10:00 - 11:00	Alex Huk	Mehrdad Jazayeri
11:00 - 11:30	Panel (Alex Huk)	Panel (Mehrdad Jazayeri)
11:30 - 12:30		Closing Ceremony

Greenwich Mean Time (GMT)

GMT	March 3rd - Thursday	March 4th - Friday
6:00 - 7:00		Ilya Monosov
7:00 - 7:30	Opening Ceremony	Panel (Ilya Monosov)
7:30 - 9:00	Oral presentations 1	Oral presentations 2
9:00 - 10:00	Break and Launch	Break and Launch
10:00 - 11:00	Tatjana Tchumatchenko	Peter Zeidman
11:00 - 11:30	Panel (Tatjana Tchumatchenko)	Panel (Peter Zeidman)
11:30 - 12:30	Athena Akrami	Oral presentations 3
12:30 - 13:00	Panel (Athena Akrami)	
13:00 - 14:00	Marlene Behrmann	Carlos Brody
14:00 - 14:30	Panel (Marlene Behrmann)	Break
14:30 - 15:30	Jorn Diedrichsen	Adam Kohn
15:30 - 16:00	Panel (Jorn Deidrichsen)	Panel (Adam Kohn)
16:00 - 17:00	Alex Huk	Mehrdad Jazayeri
17:00 - 17:30	Panel (Alex Huk)	Panel (Mehrdad Jazayeri)
17:30 - 18:30		Closing Ceremony

GMT+1

GMT+1	March 3rd - Thursday	March 4th - Friday
7:00 - 8:00		Ilya Monosov
8:00 - 8:30	Opening Ceremony	Panel (Ilya Monosov)
8:30 - 10:00	Oral presentations 1	Oral presentations 2
10:00 - 11:00	Break and Launch	Break and Launch
11:00 - 12:00	Tatjana Tchumatchenko	Peter Zeidman
12:00 - 12:30	Panel (Tatjana Tchumatchenko)	Panel (Peter Zeidman)
12:30 - 13:30	Athena Akrami	Oral presentations 3
13:30 - 14:00	Panel (Athena Akrami)	
14:00 - 15:00	Marlene Behrmann	Carlos Brody
15:00 - 15:30	Panel (Marlene Behrmann)	Break
15:30 - 16:30	Jorn Diedrichsen	Adam Kohn
16:30 - 17:00	Panel (Jorn Deidrichsen)	Panel (Adam Kohn)
17:00 - 18:00	Alex Huk	Mehrdad Jazayeri
18:00 - 18:30	Panel (Alex Huk)	Panel (Mehrdad Jazayeri)
18:30 - 19:30		Closing Ceremony

Symposium Links

The forth symposium consists of a main hall in which all invited speeches and selected oral presentations take place. Other oral presentations take place in two parallel online rooms. Panels take place in panel rooms separately after the talk of each invitee. All classes can be accessed using the same username and password provided to each registered participant. Please note that each username is only permitted to login from only one device at a time.

- Main Hall:
  https://vc.sharif.edu/ch/sns2022-mainhall
- Panel:
  https://vc.sharif.edu/ch/sns2022-panel
- Parallel Room I:
  https://vc.sharif.edu/ch/sns2022-parallelroom1
- Parallel Room II:
  https://vc.sharif.edu/ch/sns2022-parallelroom2

Invited Speakers

- Athena Akrami, Group Leader, Sainsbury Wellcome Center, University College London (UCL)
- Marlene Behrmann, Professor of Psychology, Carnegie Mellon University
- Carlos Brody, Professor of Neuroscience and Molecular Biology, Princeton University/Howard Hughes Medical Institute Investigator
- Jorn Diedrichsen, Professor, Western Research Chair for Motor Control and Computational Neuroscience Joint with the Department of Computer Science
- Alex Huk, Professor of Neuroscience and Psychology, University of Texas at Austin/Director, Center for Perceptual Systems
- Mehrdad Jazayeri, Professor of Life Sciences, Department of Brain and Cognitive Sciences, Massachusetts Institute of Technology (MIT)
- Adam Kohn, Professor, Dominick P. Purpura Department of Neuroscience, Department of Ophthalmology and Visual Sciences, and Department of Systems and Computational Biology, Albert Einstein College of Medicine
- Ilya Monosov, Associate Professor of Neuroscience, Associate Professor of Neural Surgery, Department of Neuroscience, Division of Biology and Biomedical Sciences, Washington University School of Medicine in St.Louis
- Tatjana Tchumatchenko, Professor and Deputy head of the Institute for Physiological Chemistry, AG Computational Neuroscience, University of Mainz Medical Center
- Peter Zeidman, Senior Research Fellow, Wellcome Center for Human Neuroimaging, University College London (UCL)

At a Glance


Sharif
Neuroscience
Symposium 2022/March 3,4th
frontiers
Intelligent Technology
Athena Akrami
University College London
Marlene Behrmann
Carnegie Mellon University
Carlos Brody
Princeton University
Jorn Diedrichsen
Western University
Alex Huk
University of Texas at Austin
Mehrdad Jazayeri
MIT
Massachusetts Institute of Technology
Adam Kohn
Albert Einstein Institution
Ilya Monosov
Washington University School of Medicine
Tatjana Tchumatchenko
University of Mainz Medical Center
Peter Zeidman
University College London
Registration Deadline: Feb. 15th, 2022
Abstract Submission Deadline: Jan. 25th, 2022
sns.ee.sharif.ir/registration
@SNS_En
sns.ee.sharif.ir
@SNS_En/@SNS_Fa

Part II

Invited Speeches

Thursday Talks:

Synaptic plasticity controls the emergence of population-wide invariant representations in balanced network models

Thursday, 13:30-14:30 IRST, Main Hall

Tatjana Tchumatchenko
University of Mainz Medical Center
co-affiliation: University of Bonn Medical Center

The intensity and features of sensory stimuli are encoded in the activity of neurons in the cortex. In the visual and piriform cortices, the stimulus intensity re-scales the activity of the population without changing its selectivity for the stimulus features. The cortical representation of the stimulus is therefore intensity-invariant. This emergence of network invariant representations appears robust to local changes in synaptic strength induced by synaptic plasticity, even though: i) synaptic plasticity can potentiate or depress connections between neurons in a feature-dependent manner, and ii) in networks with balanced excitation and inhibition, synaptic plasticity determines the non-linear network behavior. In this study, we investigate the consistency of invariant representations with a variety of synaptic states in balanced networks. By using mean-field models and spiking network simulations, we show how the synaptic state controls the emergence of intensity-invariant or intensity-dependent selectivity by inducing changes in the network response to intensity. In particular, we demonstrate how facilitating synaptic states can sharpen the network selectivity while depressing states broaden it. We also show how power-law-type synapses permit the emergence of invariant network selectivity and how this plasticity can be generated by a mix of different plasticity rules. Our results explain how the physiology of individual synapses is linked to the emergence of invariant representations of sensory stimuli at the network level.

Formation and update of sensory priors in working memory and perceptual decision making tasks

Thursday, 15:00-16:00 IRST, Main Hall

Athena Akrami
University College London

The world around us is complex, but at the same time full of meaningful regularities. We can detect, learn and exploit these regularities automatically in an unsupervised manner i.e. without any direct instruction or explicit reward. For example, we effortlessly estimate the average tallness of people in a room, or the boundaries between words in a language. These regularities and prior knowledge, once learned, can affect the way we acquire and interpret new information to build and update our internal model of the world for future decision-making processes. Despite the ubiquity of passively learning from the structured information in the environment, the mechanisms that support learning from real-world experience are largely unknown. By combing sophisticated cognitive tasks in human and rats, neuronal measurements and perturbations in rat and network modelling, we aim to build a multi-level description of how sensory history is utilised in inferring regularities in temporally extended tasks. In this talk, I will specifically focus on a comparative rat and human model, in combination with neural network models to study how past sensory experiences are utilized to impact working memory and decision making behaviours.

Hemispheric function is distributed, dynamic and plastic

Thursday, 16:30-17:30 IRST, Main Hall

Marlene Behrmann

Carnegie Mellon University

Despite the similarity in structure, the hemispheres of the human brain have somewhat different functions. A traditional view of hemispheric organization asserts that there are independent and largely lateralized domain-specific regions in ventral occipitotemporal (VOTC), specialized for the recognition of distinct classes of objects. In this talk, I will offer an alternative account of the organization of the hemispheres, with a specific focus on face and word recognition. This alternative account relies on three computational principles: distributed representations and knowledge, cooperation and competition between representations, and topography and proximity. The crux of the account is that visual recognition results from a network of regions with graded functional specialization, which is distributed across both hemispheres. Specifically, the claim is that face recognition, which is acquired relatively early in life, is processed by VOTC regions in both hemispheres. Once literacy is acquired, word recognition, which is co-lateralized with language areas, primarily engages the left VOTC and, consequently, face recognition is primarily, albeit not exclusively, mediated by the right VOTC. I will present psychological and neural evidence from a range of studies conducted with normal adults and children, as well as from cases with neuropsychological deficits and from cases with hemispherectomy. Last, I will offer suggestions for future investigations whose findings may further refine this account and enhance our understanding of the functions of the cerebral hemispheres.

Exploring the role of the human cerebellum across functional domains

Thursday, 18:00-19:00 IRST, Main Hall

Jorn Diedrichsen

Western University

The cerebellum has evolved to support basic sensory-motor functions. In the human brain, the cerebellar circuitry has dramatically expanded and contributes to virtually every cognitive function, including working memory, language, and social cognition. Given its uniform cytoarchitecture, it has long been hypothesized that the cerebellar circuit performs a common computation across all these functional domains. But what is this elusive transform? To ultimately answer this question we require a better understanding of the functional diversity of the cerebellum, it's connectivity to the neocortex, and the relationship between cortical and cerebellar processes in each functional domain. I will present results from a number functional neuroimaging studies to characterize cerebellar function across cognitive domains to start to address these questions in a systematic fashion.

Natural vision in primates: V1 activity during locomotion

Thursday, 19:30-20:30 IRST, Main Hall

Alex Huk

University of Texas at Austin

Primate visual circuits have been studied extensively, but almost entirely in the context of highly constrained behavioral paradigms. Meanwhile, work in rodents has revealed exciting effects of behavioral state in less constrained circumstances. For example, when mice and rats actively locomote, the responses of neurons in their primary visual cortex (V1) are modulated substantially— running can double firing rates. This has fundamentally altered conceptions of a brain region previously assumed to be an image-processing stage whose function was to represent the visual input, unaffected by the behavioral state of the animal. Extensive work has followed in rodents, aimed at dissecting the sources, recipients, and functional consequences of these powerful modulations. However, it remains unknown whether this body of work reveals general insights into mammalian primary visual cortex, or instead reflect species- (or order-) specific findings that do not directly generalize to primates, and so my lab is trying to answer this question. In this talk, I will describe our attempts to understand how the primate visual system functions under increasingly unconstrained behavioral contexts and within increasingly naturalistic sensory environments. Our initial results motivate a search for general principles of brain function that transcend strong superficial differences for particular brain areas and behavioral paradigms.

Friday Talks:

The biology of novelty seeking and uncertainty reduction

Friday, 9:30-10:30 IRST, Main Hall

Ilya Monosov

Washington University School of Medicine in St. Louis

Biological and artificial agents are motivated to seek reward. However, biological agents in particular display intrinsic motivation to explore, even when their curiosity does not result in reward. For example, humans and monkeys explore novel objects regardless of their task relevance, and they are often motivated to gain advance information about the future, even in situations in which this information cannot be used for the task at hand. I will discuss the biological mechanisms of these intrinsic drives and outline the circuit mechanisms through which curiosity can impact value-based economic decision making in primates and humans.

Neural circuits and Bayesian inference: the mathematical microscope

Friday, 13:30-14:30 IRST, Main Hall

Peter Zeidman

University College London

Functional neuroimaging typically involves testing hypotheses about biological mechanisms that cannot be directly observed, using downstream measurements such as fMRI, EEG or MEG. This is a technically challenging “ill-posed problem”, because different configurations of neural circuits could give rise to similar data. This is resolved by using statistical methods that quantify uncertainty when making inferences and testing hypotheses. Dynamic Causal Modelling (DCM) is one such approach, which has proven useful for making probabilistic inferences about neural and vascular dynamics. In this talk I will introduce recent developments in this field, with illustrative applications to multi-modal neuroimaging in cognitive and clinical neuroscience.

Individual variability and neural mechanisms of flexible decision-making

Friday, 16:30-17:30 IRST, Main Hall

Carlos Brody

Princeton University

We are using rats to investigate the neural mechanisms underlying flexible, top-down selection of which features of a stimulus are used to drive decisions. For example, if standing at a busy street and you want to flag a taxi, the color of the cars might be the most important feature driving your actions; but if you intend to cross the road, the most important feature might be the motion of the cars. Two broad classes of models are prominent in the literature. In one, top-down signals selectively control, or “gate”, the feedforward pathway from posterior sensory regions to anterior decision-making regions. The gate lets through only information about the selected feature. In the other class of models, no feedforward gating occurs; feature selection is instead instantiated by selectively controlling the nature of recurrent dynamics within frontal regions. Seeking to distinguish between the two types of models, we trained rats to perform a flexible feature-selection task where information is presented in randomly-timed pulses. We developed analyses that use neural responses to such pulses to distinguish between the two main models. Instead of evidence clearly favoring one or the other model, we found that different individuals lay along a continuous spectrum between the two models. Behavioral analysis confirmed the neurally-suggested position on that spectrum for each individual. Our results underscore the importance of recognizing and identifying individual variability in neural mechanisms. The common practice of reporting only findings that are consistent across animals may discard genuine, informative biological variability. This problem may be particularly acute for cognitive processes, where widely differing internal algorithms may produce indistinguishable behavioral responses.

Corticocortical communication

Friday, 18:00-19:00 IRST, Main Hall

Adam Kohn
Albert Einstein Institute

Most brain functions involve neuronal population activity that is distributed across multiple areas. The routing of signals through this distributed network is flexible, changing from moment-to-moment to meet task demands. To determine how flexible cortical communication could be instantiated, we recorded spiking activity of neuronal populations across several stages of the macaque cortical visual stream. Using dimensionality reduction methods, we find that inter-areal interactions occur through a communication subspace: downstream fluctuations are related to a small subset of source population activity patterns. Subspaces for feedforward and feedback interactions appear distinct. We propose that the communication subspace may be a general, population-level mechanism by which activity can be selectively and flexibly routed across brain areas.

Computation through dynamics and its application to the neurobiology of time

Friday, 19:30-20:30 IRST, Main Hall

Mehrdad Jazayeri
Massachusetts Institute of Technology

I will introduce a framework we refer to as "Computation through Dynamics" that has guided our research over the past few years for linking the structure and dynamics of neural activity to behavior. This framework is guided by two key ideas. First, we examine the geometry and structure of neural activity at the appropriate level of abstraction to understand how the brain creates invariant representations needed for flexible cognitive computations. Second, we examine the organization of the latent dynamics (fixed points, vector fields, etc) that inputs to and connections between neurons establish to understand how the brain exerts cognitive control over structured representations. I will highlight the application of this framework in one line of research in my lab focused on the neural basis of timing.

Part III

Accepted Abstracts

Optimizing the Number of Brain Networks Extracted from Resting-State fMRI

Friday, 15:00 IRST, Main Hall

Setareh Shojaei Azad[1], Reza Rajimehr[2], Hamid Soltanian-Zadeh[1,3,4]

[1]School of Cognitive Sciences, Institute for Research in Fundamental Sciences, Tehran, Iran1CIPCE, School of Electrical and Computer Engineering, College of Engineering, University of Tehran, Tehran, Iran

[2]MRC Cognition and Brain Sciences, University of Cambridge, Cambridge, UK

[3]School of Cognitive Sciences, Institute for Research in Fundamental Sciences (IPM), Tehran, Iran

[4]Image Analysis Laboratory, Department of Radiology, Henry Ford Hospital, Detroit, MI, USA

Clustering algorithms are used to find cortical networks and dynamic brain states in resting-state functional Magnetic Resonance Imaging (rsfMRI) datasets. To determine an appropriate number of clusters in a dataset, various cluster validation indices are used. Among these indices, internal validity indices are more appropriate in determining an optimal number of clusters. There are numerous internal validity indices, and various studies used one of them without a specific justification. We hypothesized that a systematical comparison of internal validity indices would determine the most appropriate index. To this end, we evaluated performances of 21 internal validity indices in finding the optimal number of clusters in rsfMRI datasets. We used a three-step approach in our analysis. In the first step, all internal validity indices were tested on benchmark datasets under the circumstances of different noise levels and different sample densities. In the second step, all internal validity indices were tested on simulated rsfMRI data again under different circumstances. From these two steps, we selected the indices which had the best performance in finding the optimal number of clusters. In the third step, these selected indices were evaluated on real rsfMRI data of 100 individuals from Human Connectome Project database to determine whether they capture dynamic brain states properly. From all these steps, we found that two indices, Ray-Turi (RT) and Xie-Beni (XB), had the best performance in properly identifying the number of dynamic brain states.

Neural mechanisms of value-driven object search in macaque ventral lateral prefrontal cortex (vlPFC)

Friday, 11:00 am IRST, Main Hall

Mojtaba Abbaszadeh[1], Mohammad Amin Alemohammad[1], Ali Ghavampour[2], Ali Ghazizadeh[1,2]

[1]School of Cognitive Sciences, Institute for Research in Fundamental Sciences (IPM), Tehran, Iran

[2]Bio-intelligence Research Unit, Electrical Engineering Department, Sharif University of Technology, Tehran, Iran

It is recently shown that well-trained high-value objects are found efficiently during visual search (Ghazizadeh et al., 2016). Nevertheless, the neural mechanism of value pop-out is not understood, yet. Previous studies have shown that the ventral lateral prefrontal cortex (vlPFC) neurons rapidly discriminate the value of objects. Given the known role vlPFC in other forms of visual search, single unit responses of vlPFC neurons in two macaque monkeys were recorded during value-driven search with abstract fractals (n=265). The task consisted of target-present (TP) trials with a high-value (good) object among low-value (bad) objects, and the target-absent (TA) trials with no good objects. Monkeys had to find and gaze at the good object in the TP trials and reject TA trials by coming back to center fixation. Prior to search, subjects learned the object values across multiple sessions. Consistent with previous findings, search for objects with longer reward training became more efficient (changing from serial to parallel). On average, the vlPFC neurons showed a stronger excitation in TP compared to TA trials but this difference was stronger in parallel search and for smaller display sizes. Furthermore, analysis of local field potential (LFP) revealed notable dynamics in alpha, beta and gamma bands time-locked to the display onset. In particular, the gamma-band duration was longer for serial searches, for larger display sizes and for higher number of saccades. These findings implicate spiking and LFP signals in vlPFC not only in value memory but also in value-driven visual search and its efficiency.

The left-handers are faster, but the right-handers are more accurate

Friday, 16:00 IRST, Parallel Room II

Tahmineh A Koosha[1], Abdol-Hosssein Vahabie[1,2,3], Babak Najar Araabi[3]

[1]School of psychology, university of Tehran, Computational and machine learning laboratory

[2]school of ECE, university of Tehran, Computational and machine learning laboratory

[3]School of Cognitive Sciences, Institute for Research in Fundamental Sciences, Tehran, Iran

The present study aimed to examine whether the stop and go processes of the motor response are asymmetrical and whether the asymmetries are related to handedness. The relationship between handedness, laterality, and inhibitory control is a helpful criterion for testing the right-hemispheric inhibition specialization hypothesis. Accordingly, stopping hand movement is sufficient to change the activity of the contralateral hemisphere. Inhibiting a left-hand movement should be faster than inhibiting a right-hand movement. In the latter case, the right hemisphere should send inhibitory commands to the other hemisphere. Moreover, as asymmetries of cognitive functions in left-handers are less pronounced than in right-handers, the inhibitory commands should rely on both hemispheres in the left-handed. We examined these predictions on a large sample of left- and right-handers (n = 123). Each participant completed the stop-signal task, using the right hand and the left. A stop signal was presented after the go cue with a probability of 0.25 in various delays. When the stop cue was presented, the participants withheld the prepared response. A significant advantage of left to right responses was found in stopping movements, which did not differ in handedness. Also, we found that the left-handers had significantly shorter reaction times, and the right-handers were more accurate. These results indicate that both left-hand responses' stop and go processes are completed earlier than right-hand responses. That is, inhibiting a left-hand movement is faster than inhibiting a right-hand movement.

Implementation of the coupling dynamics of astrocytes connected via gap junctions on FPGA

Friday, 11:40 am IRST, Parallel Room II

Fatemeh Azad[1], Saeed Bagheri Shouraki[1]

[1]Electrical Engineering Department, SHARIF University of Technology, Tehran, IRAN

Recent neurophysiological findings indicate that astrocytes (star-shaped glia cells) communicate with each other through gap junctions via intracellular Ca2+ oscillations. In this way, neurotransmitters released by neurons can trigger adjacent astrocytes by affecting Ca2+ dynamics through frequency and amplitude modulation. Accordingly, digital hardware implementation of networks of astrocytes is significant for the development of next generation of bio-inspired systems and neural prosthesis. In this paper, we investigated the calcium oscillations between astrocytes presented by the Li-Rinzel model and the IF model of neuron. Bearing in mind highly nonlinear equations of the astrocyte model and gap junctional connection between them, linear approximation and single constant multiplication (SCM) techniques are employed for efficient digital hardware performance while preserving the dynamics of the biological models. This low-cost hardware architecture for the proposed network can demonstrate the essential characteristics of different types of multimodal coding such as amplitude modulation (AM), frequency modulation (FM), or both modes (AFM). To show good agreement between the results of original models simulated in MATLAB using Euler method and the digital circuits implemented on Vivado simulator, we quantify the network of the astrocytes encoding Ca2+ and IP3 dynamics as a new way of proving how astrocytes participate dynamically in information processing. This new digital neuromorphic circuit of Gap junctional communications between adjacent astrocytes demonstrates calcium signaling on FPGA and can be applied to self-healing systems. In future research, the calcium oscillations of astrocytes can also be used as a subsystem for linking living cells to artificial neural networks.

EEG signal analysis for controlling a computer avatar with motor imagery pattern

Friday, 12:00 pm IRST, Parallel Room II

Mohammad Nemati[1], Alireza Taheri[1]

[1]Mechanical Engineering Department, Sharif University of Technology, Tehran, Iran

Translating someone's intentions through his/her brain activity is among the Brain-Computer Interface's (BCI) ultimate goals. Analyzing EEG signals to obtain control commands is challenging due to low temporal resolution and low Signal-to-Noise-Ratio (SNR), especially in Motor Imagery (MI) patterns (i.e., because of the close spatial representation of imaginary movements in the brain). The main goal of this study is to develop a platform in which one can control a computer avatar to move by just imagining the direction. The Command generation procedure consists of four steps: Pre-processing, Feature Extraction, Feature Selection, and Classification. We used a 64-channel EEG headset to record our data, and a 32-inch LED monitor to visualize the commands; the requested task was to imagine moving left or right hand when instructed. Appropriate notch and bandpass filters were used to increase the SNR in the pre-processing step. We used the time and frequency domain for feature extraction to extract features including band power, log power, root power, mean, and skewness. Then, we used a feature selection algorithm to choose features that can make our classes as distinct as possible. Finally, we classified selected features with five classic classifiers (LDA, SVM, KNN, GNB, and DT) to compare which is more suitable for the subject. The best accuracy obtained was 75%. After generating the control command, one of the subjects was asked to control a computer avatar designed via Unity software with the imagination of left/right movements. The subject was intrigued after the test and had an entertaining experience.

Rule of β oscillation in representation of saccade target in various layers of visual cortex during eye movements

Thursday, 11:40 am IRST, Parallel Room II

Maryam Ahmadi[1], Erfan Barzegar-Golmoghani[1], Zahra Bahmani[2], Behrad Noudoost[3]

[1]School of Electrical & Computer Engineering, Tarbiat Modares University, Student Research Committee, Tehran, Iran

[2]School of Electrical & Computer Engineering, Tarbiat Modares University, Assistant Professor, Tehran, Iran

[3]Department of Ophthalmology & Visual Sciences, University of Utah, Associate Professor, Salt Lake City, UT

During eye movements (known as saccades), images shift on the retina, which challenges the continuity of visual perception. Traveling oscillatory waves in visual areas assist the visual system in processing visual data during saccades [Zanos and Mineault (2015)]. We hypothesized that local and global oscillations can be helpful in processing saccade targets. We recorded spiking activity and local field potentials (LFPs) from neurons in extrastriate visual area V4 and Frontal Eye Field (FEF) of two macaque monkeys during a visually guided saccade task. By implementing the spike-triggered averaging (STA) method, we found that the phase difference between the V4 and FEF LFP oscillations ascertain a strong contribution to saccade target representation and there is a strong discrimination between four probes around saccade target. To quantify this discrimination, the windowing implemented at the four-probe STAs. By considering the phase, entropy, and mean of STA as features and using random forest classification, we tried to classify the four saccade target probes. We used 5-fold cross validation and implemented accuracy which was a quantification criterion for this discrimination. Accuracy was higher prior to saccade, it indicates that V4 oscillations can convey information regarding the saccade target, when compared to ongoing FEF LFP oscillations. According to accuracy, in source layers, the stimulus triggers a 50 ms delayed spike, while this delay is around 95ms in sink layers. This study provides a more detailed understanding of the neural phase-code and the role of different layers for an enhanced processing of saccade targets during eye movements.

Encoding modeling in the human visual cortex using a generalized recurrent convolutional neural network for fMRI scans and natural images

Thursday, 12:00 pm IRST, Parallel Room I

Amin Ranjbar[1], Amir Abolfazl Suratgar[1], Mohammad Bagher Menhaj[1], Reza Abbasi-Asl[2,3]

[1]Department of Electrical Engineering, Amirkabir University of Technology, Tehran, Iran
[2]Department of Neurology, Department of Bioengineering and Therapeutic Sciences, University of California, San Francisco, United States
[3]UCSF Weill Institute for Neurosciences

The human visual system is the primary source of information about the environment. There have been many attempts to mimic the hierarchical structure of the human visual cortex to facilitate a wide variety of complex regular tasks. In this regard, convolutional neural networks (CNNs) have demonstrated significant advances in predicting cortical activities across ventral and dorsal streams. Such models can use different biological connections to reach the desired performance. Therefore, as part of the present study, we incorporate different biological brain inter-communications such as lateral and feedback connections into traditional feedforward configuration to produce a reliable model of human visual encoding. This module is a multi-layer recurrent CNN and acts as a feature extractor in the brain encoding model to exploit multi-level visual information. Moreover, this module integrates high-level information into low-level information and provides enhanced feature representation in most visual areas. Next, we propose a response generation module that considers simultaneous temporal and spatial information from all regional voxels to predict brain responses accurately. The regularization hyperparameters in the encoding model are then explicitly optimized for each brain area to achieve excellent prediction performance. All experiments are conducted on the PURR dataset from Purdue University [Wen et al. 2017], including naturalistic images captured from publicly-available movies and the fMRI scans. The results show remarkable performance compared to traditional single voxel-wise models evoked by a sequence of images and fMRI counterparts.

Emotion Recognition Using EEG Signals: Accuracy Comparison Between Methods and Frequency Bands

Thursday, 11:40 am IRST, Parallel Room I

Hamed Nazemi[1], Alireza Taheri[1], Ali Meghdari[1], Ali Ghazizadeh[2]

[1]Mechanical Engineering Dept., Sharif University of Technology, Azadi St., Tehran, Iran
[2]Electrical Engineering Dept., Sharif University of Technology, Azadi St., Tehran, Iran

To improve the quality of Human-Robot Interactions, emotion recognition has received lots of attentions so far. EEG signals are among the applicable ways to recognize the emotions. The main purposes of this research are: 1- Finding best frequency band for emotion recognition, 2- Comparing the performance of classic classifiers, and 3- Implementing a Graph Neural Network (GNN) and examining its advantage over Multi-Layer Perceptron network architectures. In this study, the multi-modal ASCERTAIN dataset which includes EEG signals, was used for emotion recognition. Dimensional method was used to express different emotions. Time Domain statistical features were used to divide the ASCERTAIN dataset into four classes: High Arousal–High Valence (HAHV), High Arousal–Low Valence (HALV), Low Arousal–High Valence (LAHV), and Low Arousal–Low Valence (LALV). Accuracies of the K-Nearest Neighbors (KNN), Support Vector Machine (SVM), Decision Tree (DT), Discriminant Analysis (DA), and Naive Bayes (NB) were calculated and compared. In addition, a GNN and an MLP network have been employed to perform binary classifications (including Arousal and Valence classes). Accuracies were calculated using the K-fold Cross Validation method (with K=10). Based on the findings of this study, using Alpha and Theta frequency bands gave us the most accurate results for emotion recognition. The most accurate frequency band detection is important for online emotion recognition applications (due to the reduction of computational complexity). We observed that DA had the highest performance among the classic classifiers. Moreover, we indicated that the GNN performed about 10% better than the MLP network in classification.

Comparing the ventral and dorsal streams based on encoded fMRI data evoked by natural images

Friday, 16:00 IRST, Parallel Room I

Mehran Maleki[1], Amin Ranjbar[1], Amir Abolfazl Suratgar[1], Mohammad Bagher Menhaj[1], Reza Abbasi-Asl[2,3]

[1]Department of Electrical Engineering, Amirkabir University of Technology, Tehran, Iran
[2]Department of Neurology, Department of Bioengineering and Therapeutic Sciences, University of California, San Francisco, United States
[3]UCSF Weill Institute for Neurosciences

The visual information received by the eyes is processed in the brain through two separate yet related pathways, the ventral and dorsal streams. Both streams consist of different areas, each contributing to visual perception performing a particular task. It is known that these two pathways interact with each other somehow, but the mechanism is yet undetermined. However, many questions are close to being answered with the advances in measuring brain activities, like fMRI. In this study, we will construct an encoding model of the human visual pathway using fMRI data and also use this model to investigate potential relations between different areas in the ventral and dorsal streams. The dataset we use in this study is a video-fMRI dataset published at Purdue University. Further, recent techniques that have shown promising results in neural encoding are convolutional neural networks. Therefore, the popular deep CNN model, AlexNet, has been used for extracting features from raw videos. The extracted features go through a series of cascading post-processing stages, including PCA and convolution with a hemodynamic response function. We use a linear regression submodel to predict the fMRI data for each visual voxel using the processed features. Using the verified model for each voxel, we investigate the cohesive functionality by examining how the intercorrelation between different regions of the ventral and dorsal streams changes for different natural images at the input. The results of this study demonstrate the effectiveness of this method in modeling the relationship between visual areas.

Hippocampal neurons encode behavioral space

Friday, 12:00 pm IRST, Parallel Room I

Mohammad Yaghoubi[1,2], Andrés Nieto-Posadas[1], Coralie-Anne Mosser[1], Émmanuel Wilson[1], Thomas Gisiger[1], Sylvain Williams[1,2], Mark P. Brandon[1,2]

[1]Department of Psychiatry, Douglas Hospital Research Centre, McGill University, 6875 Boulevard LaSalle, Verdun, QC H4H 1R3, Canada

[2]Integrated Program in Neuroscience, McGill University, 1033 Pine Ave. W., Montreal, Quebec H3A 1A1

The central dogma of the cognitive map theory of hippocampal function is to map the allocentric spatial dimensions of one's external world [O'Keefe and Dostrovsky 1971]. However, more recent evidence points to a broader role of the hippocampus in coding the non-spatial features of the environment [Aronov et al 2017]. Beyond encoding allocentric space, we ask if the hippocampus would map an animal's own behavioral repertoire after they become an expert in a delayed non-match to location task. We specifically explore whether the hippocampus encodes behavioral sequences used to solve the task (behavioral space) over allocentric space. We record the activity of hundreds of hippocampal neurons as well-trained mice perform the task. In the task, a white square is presented in one of five positions on a touchscreen. A nose poke to this square makes it disappear and starts a delay period (2-8 sec). Following the delay, two white squares are displayed, and the mouse must choose the non-matching square to receive reward. In contrast to prior works that describe behavior with a few variables such as position, reaction time, etc, here we develop a deep-learning-based approach to quantify the transition statistics between sequences of egocentric body movements. This pipeline is subtle enough to reveal individual differences between mice. CA1 neurons were spatially tuned yet, our analysis shows hippocampal neurons code egocentric behavioral information as well. In fact, egocentric behavioral neuronal tuning is better correlated with mouse performance than allocentric spatial tuning. Together, our results suggest that, in well-trained animals, the hippocampus encodes behavioral space at the top of allocentric space. This may function to support memory-guided behavior to solve the task.

EEG-based Motor Imagery Decoding via Graph Signal Processing on Smooth Learned Graphs

Thursday, 11:00 am IRST, Main Hall

Maliheh Miri[1], Vahid Abootalebi[1], Hamid Behjat[2],

[1]Department of Electrical Engineering, Yazd University, Safayieh, Yazd, Iran
[2]Department of Biomedical Engineering, Lund University, Ole Römers väg 3, 22363 Lund, Sweden

Graph signal processing (GSP) [Orthega et al. 2018] has provided novel means for dealing with data defined on irregular domains such as the human brain. Effective use of GSP-based algorithms relies on using an appropriate graph that can capture subtle intrinsic signal features. However, such graphs are not available directly in many applications. Graph learning (GL) techniques aim to reveal an embedded graph structure hidden in the data. The GL framework proposed in [Kalofolias 2016] learns a graph based on the assumption that graph signals have a smooth representation. In this paper, using electroencephalography (EEG) signals acquired during motor imagery (MI) tasks, a GSP-based approach is presented for decoding the MI task via deriving task-specific discriminative features. First, we used the Kalofolias GL framework to learn subject-specific graphs from EEG signals. Second, by diagonalizing the normalized Laplacian matrix of each subject's graph, we obtained orthonormal bases that we consequently used to compute the graph Fourier transform (GFT) of the EEG signals for each subject. Third, by mapping the GFT coefficients of the graph signals on an extension of Fukunaga-Koontz transform (FKT) [Fukunaga 1990], we obtained a discriminative GFT subspace within which MI classes could be differentiated. The proposed method was evaluated on Dataset IVa from BCI Competition III. Experimental results indicate the superiority of the proposed method, which combines GL, GSP and FKT, in comparison to a recently proposed method that uses an extension of FKT [Cherloo et al. 2021] as well as a GSP-based method [Georgiadis et al. 2021].

Improving performance of BCI speller using novel hybrid de-noising approach based on wavelet transform and canonical correlation

Friday, 15:20 IRST, Main Hall

Seydeh Nadia Aghili Kordmahale[1], Sepideh Kilani[1], Sadaf Sazesh[1], Mohammad Reza Daliri[1]

[1]Department of Electrical Engineering, Iran University of Science and Technology, Tehran, Iran

A brain-computer interface (BCI) speller based on electroencephalogram (EEG) is the most developed rehabilitation application that helps patients to improve their communications. The SSVEP and P300 signals are widely used for hybrid speller-based BCI to improve performance and speed. However, high eye fatigue and low information transfer rate (ITR) are crucial challenges in SSVEP and P300 based speller, respectively. This study develops new approaches for both SSVEP and P300 signals in the state-of-the-art hybrid speller dataset presented in the 4th Iranian BCI competition (iBCIC2021). In one flicker SSVEP, strong de-noising algorithms have an essential role to recognize the gaze, thus we introduced a new combination that applied discrete wavelet transform (DWT) to modify EEG signal by canonical correlation between multivariate EEG signals and harmonics of 15 Hz as references, afterward, the linear discriminant analysis (LDA) was used for target recognition for the classification approach. In the P300 signal processing, feature extraction and classification play an important role to achieve a high ITR. Therefore, the spatial-temporal discriminant analysis (STDA) was utilized to extract the P300 features, it can extract optimal spatial and temporal features that are based on fisher criterion. These features then were classified by the support vector machine (SVM) to detect the target and non-target classes. The proposed approach here achieved the first Place among the other participants with 92.5% and 75% in five and three repetitions, respectively. High improvement in compared to other teams is in line with the overall goal of the competition and BCI rehabilitation applications.

The Causal Role of the Lateral Intraparietal Area in Object Long-Term Value Memory

Friday, 11:40 am IRST, Parallel Room I

Leila Noorbala[1,3], Reza Khosrowabadi[3], Omid Sharafi[1], Sara Pourtakdoost[4], Ali Ghazizadeh[1,2]

[1]Bio-Intelligence Unit, Sharif Brain Center, Electrical Engineering Department, Sharif University of Technology, Tehran, Iran

[2]School of Cognitive Sciences, Institute for research in fundamental sciences, Tehran, Iran

[3]Institute for Cognitive and Brain Sciences, Shahid Beheshti University, Tehran, Iran

[4] Institute for Cognitive Science Studies, Tehran, Iran

Our lives are cluttered with loads of information; however, we are still able to attend to cues that signal future rewards. Previous studies have implicated the lateral intraparietal cortex (LIP) in encoding objects' reward history (Yang and Shadlen 2007; Ghazizadeh et al. 2018). Here, we investigated the causal role of LIP in long-term value memory of objects by creating virtual lesions using theta-burst stimulation (cTBS) in human subjects. 18 healthy subjects were trained to assign monetary values to 32 abstract visual stimuli (fractals). Fractals were randomly assigned to high and no reward groups (good and bad objects, respectively) and were presented exclusively on the right or left hemifields. During value training, subjects were trained with two sets of objects before and two sets after LIP lesion. A day later, during the value retrieval task, subjects had to judge the value of each object as good or bad (single object choice). For the sets that were trained prior to LIP lesion, the performance was above 70% and slightly better for good compared to bad. Interestingly, for the post lesion sets, there was a better memory for bad compared to good objects on the contralateral side, with stronger effect size for the right side suggesting an asymmetry in the role of LIP. Notably, the performance of sets pre and post lesion during the learning were not different. These results show a selective effect on wiping object's long-term memory by LIP lesion and pave way for disrupting maladaptive object reward memories observed in cue-driven addictive behaviour.

Discrimination of cognitive, emotional and physical distractions based on functional connectivity between thermal and physiological signals during driving

Thursday, 11:20 am IRST, Main Hall

Nilufar vosugh[1], Zahra Bahmani[2], Amin mohammadiyan[3]

[1]Master student of medical engineering, Faculty of Electrical and Computer Engineering, Tarbiat Modares University, V.nilufar@modares.ac.ir, Tehran, Iran

[2]Assistant Professor of Medical Engineering, Faculty of Electrical and Computer Engineering, Tarbiat Modares University, zbahmani@modares.ir, Tehran, Iran

[3]Research Assistant Professor, Research Center of Developing of Advanced Technoligies, mohammadian@rcdat.ir, Tehran, Iran

Automatic distraction detection is essential to ensure safety and well-being of drivers in today's world. The driving simulator can be used to study distraction [Taamneh and Tsiamyrtzis 2017]. In this study, thermal video was used to record the temperature of different areas of the face. Besides, the heart rate, respiration rate and drivers' behavioural signals were recorded. Various kinds of distractions were applied to the subject during driving [Pavlidis and Dcosta 2016]. New features in the field of directional and non-directional functional connectivity were used in order to detect and classify types of distractions. Granger causality between quantified signals around the nose, extracted from facial thermal images, and physiological variables of heart rate, respiration rate, and behavioural variable of lane offset were considered as directional connectivity features. Also, non-directional functional connectivity including correlation coefficient, covariance, cross-correlation and dynamic time warping between mentioned signals were extracted. Finally, different classifiers were trained to detect distraction. The results showed that adding these features achieves an accuracy of 99.89% in distraction detection which shows 30% improvement compared to using classical features (two-class problem including existence of distraction and no-distraction). We also obtained an accuracy of 74.22% to classify different types of distractions including cognitive, emotional, sensory-moor and no-distraction (four-class problem). Furthermore, two types of cognitive distractions including computational and analytical mental activity were discriminated with an accuracy of 91.95%. These results indicate that there is important and complementary information on the connectivity between facial temperature signal and physiological variables for classification of distraction.

Multiple sclerosis clocks fly; a clinical study of how time perception is altered in multiple sclerosis patients

Friday, 15:40 IRST, Parallel Room II

Mina Echreshavi[1], Narges Shakerian[2,3], Hassan Kiani Shahvandi[4], Mohammad Momeni[5], Asieh Mehramiri[6], Samireh Ghafouri[7,8]

[1]Student Research Committee, Faculty of Medicine, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran

[2]Student Research Committee, School of Rehabilitation, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran

[3]Musculoskeletal Rehabilitation Research Center Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran

[4]Apllied Health Science, School of Medical Sciences, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran

[5]Advanced Diagnostic and Interventional Radiology Research Center, Tehran University of Medical Sciences, Tehran, Iran

[6]Department of Neurology, School of Medicine, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran

[7]Department of Physiology, Faculty of Medicine, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran

[8]Persian Gulf Physiology Research Center, Medical Basic Sciences Research Institute, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran

Time perception is described as the ability to mentally discern the time. Despite having a complicated nature, there are several models to describe temporal information processing in the brain, as well as several areas of the brain involved in this function. Time perception alteration is reported in several neurological conditions, however the effect of Multiple Sclerosis (MS) as a neurodegenerative disease remains unclear. In this study, we aimed to investigate the domains of temporal processing involved in the MS and the probable factors affecting it, such as location of brain plaques. Two groups of participants (MS: n = 27 (8 men, 19 women), mean age = 33.85; control: n = 30 (10 men, 20 women), mean age = 28.46) were asked to perform quadruplet time perception tasks (prospective time estimation, duration discrimination, temporal reproduction, and paced motor timing) designed in Inquisit 5 Lab (free 30-day trial) software. The scores in time estimation (p¡0.01) and duration discrimination (p¡0.001, in 100 milliseconds interval; p¡0.05, in 1000 milliseconds interval) and tempo matching of sensory-motor synchronization in paced motor timing test were significantly higher in MS group. This study showed that patient with MS (PwMS) have impaired temporal processing, with higher scores than healthy individuals in the tasks, particularly in prospective time estimation, duration discrimination, and several aspects of paced motor timing, that is. While Overestimation of time is caused by a fast-ticking internal clock according to the internal clock hypothesis (Mauk and Buonomano, 2004).

Bifrontal transcranial direct current stimulation effects on large-scale brain network connectivity during drug cue exposure: A randomized and sham-controlled clinical trial

Friday, 11:20 am IRST, Main Hall

Ghazaleh Soleimani[1], Farzad Towhidkhah[1], Hamed Ekhtiari[2]

[1]Department of Biomedical Engineering, Amirkabir University of Technology, Tehran, Iran

[2]Department of Psychiatry, University of Minnesota, Minneapolis, USA

Transcranial direct current stimulation (tDCS) has shown potentials to modulate cue-induced craving in addiction. However, the neural mechanism underlying tDCS during a cue-reactivity task is still an open question. Here, we aimed to evaluate tDCS effects on functional connectivity between and within three large-scale networks; frontoparietal (ECN), default mode (DMN), and ventral attention (VAN) during cue exposure in a group of participants with methamphetamine use disorders (MUDs). In a randomized, double-blinded, sham-controlled, cross-over trial, fifteen abstinent male participants with MUDs were randomized to receive active and sham stimulation (with one week washout period). Before and after tDCS (anode/cathode over F4/F3 with 20 minutes of 2 mA stimulation) participants were scanned using structural and functional MRI while performing a cue-reactivity task. Computational head models were generated, and main network nodes with the highest electric fields were extracted for the seed-to-whole-brain psychophysiological interaction (PPI) analysis. ROI-to-ROI PPI was also performed between the main nodes of ECN, DMN, and VAN. Our results showed that craving score was significantly decreased after active stimulation compared to sham (P¡0.05). Time by intervention interaction analysis was used for gPPI results. Our findings showed increased PPI connectivity within and between ECN and VAN while connectivity between ECN and DMN was decreased. This study, generally gives an insight into how bilateral DLPFC stimulation can modulate task-based connectivity in large-scale networks and specifically provides preliminary evidence for the importance of network-level connectivity during cue exposure in MUDs that facilitates our understanding of the neural underpinnings of behavioural dysfunction in addiction.

Prediction of the Activity of Face-selective Areas from the Activity of Other Brain Regions employing Artificial Neural networks

Friday, 15:40 IRST, Parallel Room I

Bahareh Mortazi[1], Gholamali Hosseinzadeh[1], Elahe Yargholi[2]

[1]University of Tehran, Tehran, Iran

[2]Institute for Research in Fundamental Sciences, Tehran, Iran

Faces are one of the most important visual stimuli that human being are able to understand and identify. Neurological studies of fMRI show occipital-temporal cortex (FFA and OFA), superior temporal sulcus (STS), anterior temporal lobe, posterior temporal cortex (MFA) are parts of facial recognition network. In this study, the aim is to study the connection and interaction of the face selective areas with each other while watching natural images. For this purpose, we predict the activity of face-selective areas based on the activity of other areas. Our tool is artificial neural networks for regression models and movie watching dataset of the Human Connectome Project (HCP) database. The results are as follows: face-selective areas are in two categorizes, the first category is related to predict the average activity of FFA in the left hemisphere and OFA, FFA and mSTS in the right hemisphere by the same areas and second category is related to predict the average activity of MFA in the right and left hemisphere and pSTS in the right and left hemisphere by the same areas. In addition we compared the prediction performance of two methods of partial least squares method and Multi Layers Perceptron to investigate these correlations.

Part IV

People

Scientific Committee

Scientific Chairs:

- Dr. Ali Ghazizadeh, Assistant professor, Electrical Engineering Department, Sharif University of Technology, School of Cognitive Sciences, Institute for Research in Fundamental Sciences (IPM), Systems and Computational Neuroscience
- Dr. Safura Rashid Shomali, Resident Researcher, Institute for Research in Fundamental Sciences (IPM), School of Cognitive Sciences, Cognitive Neuroscience
- Dr. Mehdi Sanayei, Assistant Professor of Cognitive Neuroscience, School of Cognitive Sciences, Institute for Research in Fundamental Sciences (IPM), Cognitive Neuroscience

Reviewers:

- Dr. Saeed Behzadipour, Associate professor, Mechanical Engineering Department, Sharif University of Technology, Neuro-Rehabilitation
- Dr. Ali Motie Nasrabadi, Professor, Biomedical Engineering Department Shahed University, Computational Neuroscience, Chaos Theory
- Dr. Mohammadreza Daliri, Professor, Electrical Engineering Department, Iran University of Science and Technology (IUST), Cognitive neuroscience
- Dr. Reza Ebrahimpour, Professor of Cognitive Neuroscience, Shahid Rajaee University (SRTTU), School of Cognitive Sciences, Institute for Research in Fundamental Sciences (IPM), Cognitive Neuroscience
- Dr. Emad Fatemizadeh, Associate Professor, Department of Electrical Engineering, Biomedical Engineering Group, Medical Image Analysis and Machine Learning
- Dr. Babak Hossein-Khalaj, Professor of Electrical Engineering, Sharif University of Technology, Brain and Biological Dynamic Models
- Dr. Mehran Jahed, Associate Professor, Department of Electrical Engineering, Sharif University of Technology, Bio-robotics, Sensory and Motor Neuroscience
- Dr. Alireza Taheri, Assistant Professor, Mechanical Engineering Department, Sharif University of Technology, Social and Cognitive Robotics
- Dr. Bijan Vosoughi-Vahdat, Professor of Electrical Engineering, Sharif University of Technology, Modelling of the Nervous System

Executive Team

SNS is organized by the students in the electrical engineering department at Sharif University of Technology. Below is the list of undergraduate and graduate students who organized the forth symposium (SNS 2022):

- **Executive Heads:**
  Ali Ghavampour, Maryam Maghsoudi Shaghaghi
- **Workshops:**
  Omid Sharafi
- **Technical Team:**
  Mohammad Amin Alamalhoda, Arsalan Firoozi
- **Graphic Designer:**
  Yasin Moosavi
- **Branding:**
  Danial Ayati, Parnian Taheri, Amirreza Hatamipour