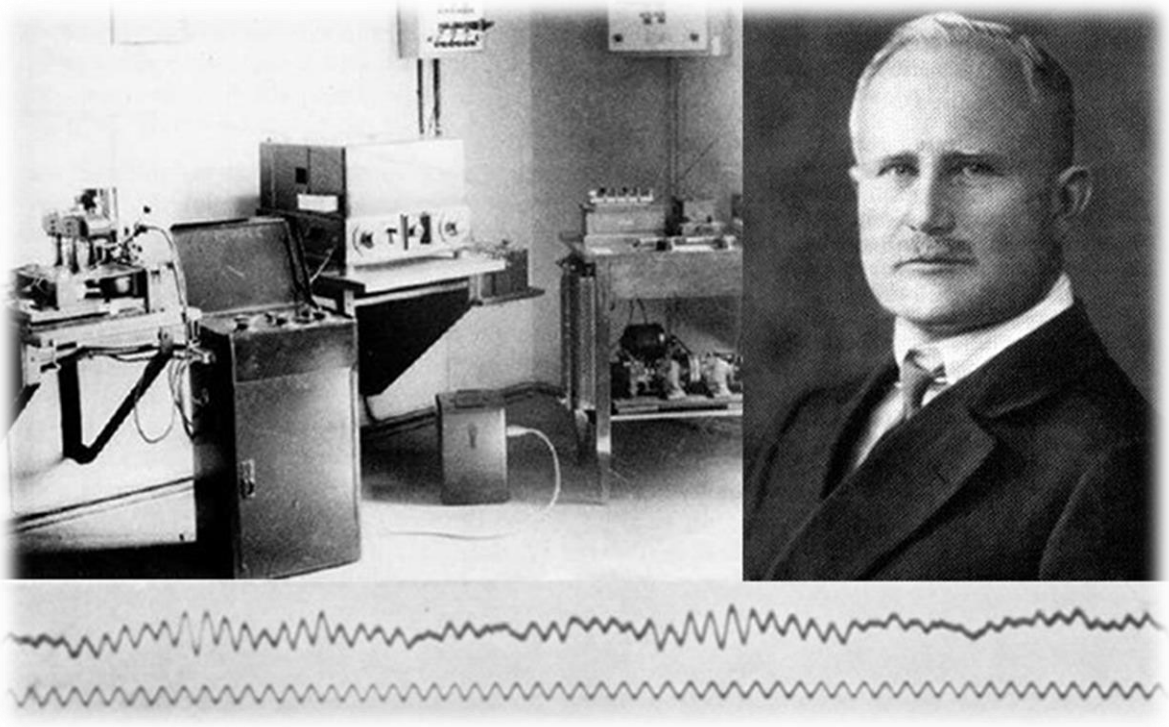
Global Brain Consortium
Annual Assembly

Celebrating 100 Years of EEG

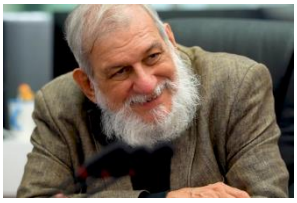
September 6th to 8th 2024 (Online Program)



GBC Board

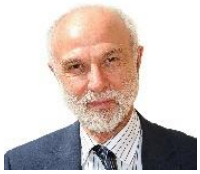
Directors of the GBC

Alan Evans



Pedro Antonio Valdes Sosa

Steering Committee



Paolo Rossini

Katrin Amunts

Paul Thompson

Dezhong Yao

Maryann Martone

Faisal Mushtaq

Jorge Bosch-Bayard

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Ludovico Minati

Maria L.Bringas Vega

György Buzsáki

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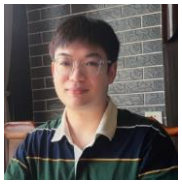

Yu Jin

Shahwar Yasir

Sundas Almas

Program at-a-glance

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<tr><th>Time (Chengdu)</th><th>Friday Sept. 6th</th><th colspan="2">Saturday Sept. 7th</th><th colspan="2">Sunday Sept. 8th</th></tr>
<tr><td>20:00-20:15</td><td rowspan="2">Opening Ceremony</td><td colspan="2">Welcome to Day 2</td><td colspan="2">Welcome to Day 3</td></tr>
<tr><td>20:15-20:30</td><td colspan="2" rowspan="2">Keynote 1: Aina Puce, USA</td><td colspan="2" rowspan="2">Keynote 4: Steven Luck, USA</td></tr>
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<tr><td>21:15-21:45</td><td colspan="2">Keynote 3: Paolo Rossini, Italy</td><td colspan="2">Keynote 6: Mahnaz Arvaneh, UK</td></tr>
<tr><td>21:45-22:00</td><td colspan="2">Break</td><td colspan="2">Break</td></tr>
<tr><td>22:00-23:00</td><td>Symp1: EEG Standardization. Chair: Christine Rogers</td><td>Symp3: The Next 100 Years of EEG. Chair: Faisal Mushtaq</td><td>Symp5: EEG Modelling. Chair: Shiang Hu</td><td>Symp6: Non-linear Brain Science. Chair: Ludovico Minati</td></tr>
<tr><td>23:00-24:00</td><td>Vera Gross Lecture:
Michael Breakspear
Introduction by A. Evans</td><td>Symp2: EEG Preprocessing. Chair: Arnaud Delorme</td><td>Symp4: Neuroimaging and disease. Chair: Mario Parra</td><td colspan="2">Plenary discussions and conclusions
Chairs: Alan Evans & Pedro Valdes-Sosa</td></tr>
</table>

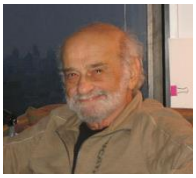
Meeting Hours

Location	Relative to Chinese Standard Time				
Chengdu (UTC +8)	Local Time	8 pm	9 pm	10 pm	11 pm
Montreal (UTC+4)	-12 hrs	8 am	9 am	10 am	11 am
Havana (UTC+4)	-12 hrs	8am	9am	10am	11 am
London (UTC+1)	-7 hrs	1 pm	2 pm	3 pm	4 pm
Madrid (UTC +2)	-6 hrs	2 pm	3 pm	4 pm	5 pm
Buenos Aires (UTC-3)	-11 hrs	9 am	10 am	11am	12 pm
Sydney (UTC+11)	+2 hrs	10 pm	11 pm	12 midnight	1 am

Program Details

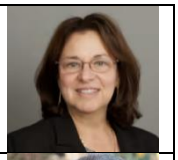
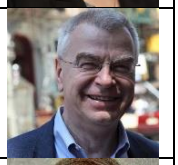
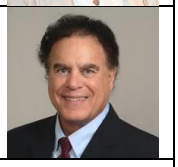
Opening ceremony Sept. 6th, 20:00-20:30, Chengdu Time

Time	Speaker	Title	
20:00-20:15	Alan Evans, Canada	A year of GBC advances	
20:15-20:17	Irving Ludmer, Canada	Greeting	
20:17-20:30	Pedro Valdes-Sosa, China/Cuba	Opening Remarks and Motivation Behind the E. Roy John Symposium	



E. Roy John Memorial Symposium

Sept. 6th, September 20:30-23:00, Chengdu Time

20:30-20:50	Leslie Prichep, USA Subtyping Brain Disorders: E. Roy John's translational vision.	
20:50-21:10	György Buzsáki, USA Endogenous Computation: R. John's Readout from Memory	
21:10-21:30	Mitchell J. Valdes Sosa, Cuba Reading the Mind: R. John and Event-Related Potentials	
21:30-21:40	Break	
21:40-22:00	Pedro A. Valdes Sosa, China/Cuba Statistical Geometry of the Brain: R. John's Neurometrics	
22:00-22:20	Thalia Harmony, Mexico qEEG assessment in neurological patients: E. Roy John's Neurometrics	
22:20-22:40	Robert W. Thatcher, USA Neural Coherence and the Content of Consciousness: In honor of E. Roy John	
22:40-23:00	Questions and comments	

Vera Gross Lecture, 6th September 23:00-24:00, Chengdu Time

Michael Breakspear, Australia

Professor of Systems Neuroscience, University of Newcastle

Presentation Title: The wave-particle theory of brain dynamics

(Introduction by Alan Evans)

Abstract: Despite our substantial understanding of the neuron, we do not understand the systems-level rules of the brain whose disruption yields mental illness. Recent interest in large-scale neural dynamics reveal two apparently contrasting frameworks: A wave-centred view is supported by convergent evidence across modalities and species whereas a network-based approach is supported by the study of structural and functional connectivity. A reconciliation of these views has remained elusive. Drawing on neurobiological and theoretical considerations, we propose a unifying framework whereby recruitment of large-scale networks facilitates rapid transitions between stable spatiotemporal waves. This proposal integrates empirical and computational viewpoints and provides testable hypotheses for the understanding of adaptive and compromised brain function.

Short Bio: Michael Breakspear is a Psychiatrist and Neuroscientist researching the principles of brain function in health and in mental illness. Professor Breakspear leads the Systems Neuroscience Group – a team of psychiatrists, physicists, psychologists and neuroimaging scientists at the University of Newcastle and Hunter Medical Research Institute, Australia. He uses computational modelling to study the generative processes underlying bipolar disorder, schizophrenia, dementia and in healthy ageing.

Professor Breakspear studied medicine at the University of Sydney, combined with degrees in Arts (philosophy and mathematics) and Science (neuroscience and physics). He is a Fellow of the Australian and New Zealand College of Psychiatrists with a weekly clinic at the Awabakal Aboriginal Medical Service.

Online Symposia Details

1. EEG Standardization (Chair: Christine Rogers)	
Christine Rogers	Data Standardization and the open EEGNet data and analytics hub
Dora Hermes	A machine-readable standard for electrophysiology annotations: HED-SCORE
Sandor Benickzy	AI for automated interpretation of routine EEG: score – AI (video)
2. EEG Preprocessing (Chair: Arnaud Delorme)	
Arnaud Delorme, USA	Is EEG better left alone?
Neil Bailey	The promise of non-traditional EEG pre-processing and analysis methods
Amy Bland, UK	Using the #EEGManyLabs Platform to Investigate Emotion Processing
3. The Next 100 years of EEG (Chair: Faisal Mushtaq)	
Faisal Mushtaq, UK	100 years of EEG
Claudio Babiloni, Italy	Hans Berger's dream: global initiatives for the validation of resting-state EEG biomarkers in pathological aging
Gerwin Schalk, USA	Electrical brain recordings: from simple visual observations to detailed insights into brain function
4. Neuroimaging and disease. (Chair: Mario Parra)	
Thomas Yeo, Singapore	Optimizing Scan Time and Sample Size to Improve Individual-Level Prediction
Mario Parra, UK	Are there EEG markers of critical transition points in the continuum from normal aging to Alzheimer's disease?
Stefan Rampp, Germany	From Delta to High Frequency Oscillations: Dynamics of Epileptic Networks

5. EEG Modeling (Chair: Shiang Hu)	
Shiang Hu, China	ξ-π: A Nonparametric Model for Neural Power Spectra Decomposition
Ying Wang, China	Nonlinear Xi–Alpha EEG model
Ronaldo Garcia Reyes, Cuba	Uncovering the sources of EEG models
Anisleidy González, Cuba	Improving Brain Simulation Accuracy: Sensitivity Analysis and Realistic Time Delays in Neural Mass Models
6. Non-linear Brain Science (Chair: Ludovico Minati)	
Ludovico Minati, UESTC	Across neurons and silicon: some ideas about the relationship between unusual electronic circuits and neuroscience
Yuri Antonacci, Luca	Information-theoretical methods to study high-order interactions.
Christophe Letellier	Theory and applications of flatness-based control.

ABSTRACTS & BIOS

E. Roy John's Memorial Symposium Lecturers

Pedro Valdes Sosa, Cuba

Director China Cuba Laboratory for Neurotechnology

Email: pedro.valdes@neuroinformatics-collaboratory.org

Presentation Title: Statistical Geometry of the Brain: R. John's Neurometrics.

Short Bio: Pedro was born in Chicago, Illinois, in 1950. He got his M.D. with a bachelor's in mathematics from the University of Havana in the 1970s. By 1974, he had completed his PhD; in 2011, he earned a Doctor of Sciences degree. Pedro is now an Emeritus Researcher at the Cuban Neuroscience Center (CNEURO) and a Senior Professor at the Superior Institute of Medicine in Havana. He's also a Distinguished Professor of Neuroinformatics at the University of Electronic Science and Technology of China (UESTC) and an Adjunct Professor of Psychiatry at McGill University.
On top of that, he's an Emeritus Academician of the Cuban Academy of Sciences and a member of the Latin American Academy of Sciences. Pedro's neuroscience journey started in 1969 when he was still in medical school. He worked closely with Thalia Harmony and E. Roy Joh, developing EEG software for Cuba's first microcomputer in 1970. He co-authored the influential Neurometrics paper published in Science in 1977. Over time, his research grew to include quantitative MEG/EEG tomography-based source localization methods and fusing that with fMRI data. He also got into statistical modeling with neural mass models. He was crucial in integrating neurotechnology into Cuba's public health system—co-founding the Cuban Center for Neuroscience in 1990. Pedro is a passionate advocate for how brain research can impact global health. In 2015 he set up the Joint China-Cuba Laboratory for Neurotechnology to foster international collaboration. His time is split between CNEURO and UESTC. Since the late 1990s, he's been a leader in the Organization for Human Brain Mapping, where he's a Fellow and currently chairs its Scientific Advisory Board. Pedro co-directs the Global Brain Consortium (GBC) with Professor Alan C. Evans as part of his ongoing efforts to push brain research forward.

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Leslie Prichep, USA

New York University

Email: lprichep@gmail.com

Presentation Title: Subtyping Brain Disorders: E. Roy John's translational vision.

Abstract: To all of us speaking today and for more than a generation of neuroscientists, Roy's theories of brain function and consciousness were his legacy. Roy led the way from basic science to clinical applications defining translational research. His definition of the ground state preceded the DMN by decades and was foundational to Neurometrics quantified deviations from age expected normal state values. Thus, creating a tool for deriving patterns or profiles of dysfunction distinctive of different brain states and different neuropsychiatric disorders. His approach transformed

psychiatric diagnosis from a symptom based (DSM) to a brain based nosology. He believed that through quantification and pattern recognition of EEG signals the state of neuropsychiatric diagnosis and treatment could be revolutionized. Subtyping addressed the heterogeneity of disorders which he believed was fundamental to the poor performance of treatments for neuropsychiatric disorders, and we were the first to demonstrate treatment responsive subtypes within a single diagnostic category.

The last medical device project Roy worked on was a handheld limited montage real time device that could be used from frontlines in battle to sidelines in sports or triage of head injuries in the ED. This talk will focus on subtyping of concussion which evolved from this application. This recent demonstration followed Roy's vision for the potential to optimization treatment by exploring the existence of subtypes within disorders using an algorithm derived from Neurometric qEEG features.

Short Bio: I was on the team that pioneered the use of age regression in the description of characteristics of the EEG signal, which became the foundation of neurometric qEEG analysis. My career has focused on all aspects of translational research, integrating objective measures of brain function into new medical devices, from concept through FDA clearance, including an anesthesia monitor, and a device for the objective identification of structural and functional brain injury. My early and ongoing work using AI/machine learning to develop classification algorithms demonstrated that profiles or biomarkers of qEEG abnormalities could be identified that are distinctive for different neuropsychiatric and neurological disorders. Use of qEEG for identification of outcome and treatment responsive subtypes within a clinical disorder, an approach demonstrated to aid in improved diagnosis, treatment optimization and evaluation and of treatment outcome. Demonstrations of changes in qEEG as a function of severity or cognitive decline in the elderly and prediction of future cognitive decline in normal elderly.

György Buzsáki, USA

New York University, NY, NY
Email: gyorgy.buzsaki@nyulangone.org

Presentation Title: Endogenous computation: R. John's Readout from Memory.

Short Bio: György Buzsáki is Biggs Professor of Neuroscience at New York University. His main focus is "neural syntax", i.e., how segmentation of neural information is organized by the numerous brain rhythms to support cognitive functions. He is among the top 0.1% most-cited neuroscientists, elected member of the National Academy of Sciences USA, Academiae Europaeae and the Hungarian Academy of Sciences. He sits on the editorial boards of Science and Neuron. He is a co-recipient of the 2011 Brain Prize.

Mitchell Valdes Sosa, Cuba

Cuban Center for Neuroscience, Cuban Academy of Sciences, UESTC Academic Station
Email: mitchell@cneuro.edu.cu

Presentation Title: Reading the Mind: R. John and Event-Related Potentials

Abstract: In addition to the centenary of Erwin Roy John's birth, we are approaching the 60th anniversary

of the first article describing the P300 event-related potential (ERP) published in Science, which he co-authored. In contrast to previous work that focused on sensory determinants of ERPs, this article highlighted the dependence of the P300 on stimulus uncertainty (information delivery) and attention. John also pioneered experiments demonstrating the influence of top-down or endogenous factors, such as mental set, on ERPs. This seminal work contributed to the emergence of the dynamic field of cognitive neuroscience, which now utilizes cutting-edge methods beyond electrophysiology, based on Magnetic resonance imaging, such as activation studies, functional connectivity analyses, and encoding and decoding models. It is well known that the new fMRI methods benefited from progress in experimental design gained through prior ERP studies. However, the influence also went in the opposite direction, with methods developed for extracting signal using the general linear model and for decoding encoding models in fMRI now changing human electrophysiology. John's most groundbreaking work was his provocative championing of the role of population representation of information in the brain. Detailed modeling of this approach was not available when John formulated his hypothesis but is now potentially possible with large-scale neural network simulations. These simulations reconcile the mass action of units with their specialization in different layers and locations, avoiding the idea of 'gnostic cells' or isolated single-cell coding against which Roy argued convincingly.

Short Bio: Prof. Mitchell Valdes-Sosa, M.D, Ph.D., is the General Director of the Cuban Center for Neuroscience and Member Emeritus of the Cuban Academy of Sciences. Valdes-Sosa specialises in cognitive neuroscience and neuroimaging, with extensive work in translational neuroscience. He has published over 160 scientific articles, cited 3567 times, with an h-index of 34. Valdes-Sosa coordinates the National Scientific Program for Neuroscience and Neurotechnology of Cuba.

Thalia Harmony, Mexico

Neurodevelopmental Research Unit, Department of Behavioral and Cognitive Neurobiology of the Institute of Neurobiology of the National Autonomous University Mexico Campus Juriquilla, Mexico

Email: thaliaharmony79@gmail.com

Presentation Title: qEEG assessment in neurological patients: E. Roy John's Neurometrics

Abstract: In the seminal John's paper on Neurometrics (Science, 196: 1393-1410, 1977), he described the discriminant analysis performed on qEEG variables (symmetry of waveform and symmetry of energy of EEG) between patients with brain tumors, patients with cerebrovascular lesions, and normal controls. The results showed great accuracy; patients with tumors were identified from controls in 87 %, and cerebrovascular lesions were identified in 80 % from normal controls. However, the most impressive result was the clear discrimination between patients with tumors and patients with cerebrovascular lesions since the abnormal slow waves observed in both groups of patients differed in localization. In contrast, tumors showed focused abnormal slow waves, and cerebrovascular patients had a generalized abnormality. These results were confirmed in a larger group of patients.

Short Bio: Dr. Thalia Harmony, a full professor at the National Autonomous University of Mexico (UNAM) is a distinguished neuroscientist specializing in neurophysiology and brain development. A close collaborator of Dr. Roy John, she co-authored a seminal paper in *Science* on Neurometrics including Drs Pedro Valdes-Sosa and Robert Thatcher, a landmark in Quantitative EEG analysis. Focused on neurodevelopmental disorders for more than 30 years, she

has created one of the most advanced multidisciplinary strategies for neuro-habilitation, which starts the intervention during the first months of the newborn's life, using the Katona approach. Dr. Harmony's research has profoundly impacted cognitive neuroscience, particularly neurodevelopmental disorders.

Robert Thatcher, USA

Applied Neuroscience, Inc. and Applied Neuroscience Research Institute
Email address: rwthatcher2@yahoo.com

Presentation Title: Neural Coherence and the Content of Consciousness: In honour of E. Roy John.

Abstract: Previously, Dr. John helped to show why it is anatomically and functionally helpful to distinguish between the operation of consciousness and the content of consciousness (Thatcher and John, 1977). Also, zero phase locking of coherent neural activity during perception and memory is a topic that Dr. John significantly contributed too. In 1993, as the NIH project manager for the first 128-channel EEG, I was invited to review Dr. John's 1997 publication on consciousness and cognition (John et al, 1997). In the course of the review, I applied a mathematical model to explore both the operation and content of consciousness (Thatcher, 1997). According to this model, phase locking occurs between excited populations of neurons whose frequency of oscillations has increased to some critical value and which are coupled as part of a preferred pathway. For example, in hand movement experiments, the preferred pathways involve the connection systems of the hand region of the motor cortex and the prefrontal, thalamic, and other regions involved in the mediation of hand and finger movements (Thatcher et al. 1994). Phase locking represents a "labelling" process whereby the neural resource most likely to mediate the motor response would be identified and linked. Similarly, according to this model the EEG coherence changes in the 1997 John et al study reflects the action of coupled oscillators in which resource allocation occurs through the rapid spatiotemporal self-organization of neurons involved in the comparison of the present to the past.

Short Bio: Dr. Robert W. Thatcher, with a B.S. in Chemistry and a Ph.D. in biopsychology, is a leading neuroscientist in quantitative EEG (qEEG) and neuroimaging. He collaborated with Roy John and is renowned for his work on EEG normative databases and neuroplasticity models. With over 200 publications, including 8 books and seminal papers on EEG coherence, phase reset, and neurofeedback, Thatcher has significantly impacted clinical neuropsychology and cognitive neuroscience. He developed the NeuroGuide software, for QEEG and Neurofeedback, and is currently the director of the Applied Neuroscience Research Institute.

Online Keynote Speakers

Aina Puce, USA

Indiana University
Email: ainapuce@iu.edu

Presentation Title: EEG, MEG and the Brain-Heart Axis.

Abstract: In the 20th century EEG and MEG provided high-resolution temporal data for both research and clinical applications in an era where we focused on grey matter and a largely disembodied brain. In the 21st century, both methods now provide unique data for functional connectivity for the network science and connectome mill. The current Zeitgeist is that brain-body interactions are important and seeds different types of studies of systems neuroscience. One type of study aims to study brain activity in real-world settings by using new portable technology in recordings based outside of the laboratory. Another type of study consists of high-density multimodal data in the laboratory setting to study functional connectivity and the behavior of brain networks. To that end I will present a high-density multimodal dataset [EEG, MEG, EOG, ECG] that indicates that the cardiac cycle modulates resting state brain activity across some brain networks, but not others. These preliminary data from 4 healthy individuals suggest that we need to consider the brain-heart axis to interpret functional connectivity data in future studies. The results also beg the question about the influence that the brain-gut axis might also have on perception, cognition and emotion.

Short Bio: Aina Puce is the Eleanor Cox Riggs Professor of Social Justice and Ethics in the Department of Psychological and Brain Sciences at Indiana University in Bloomington, Indiana, US. Her research is on the brain basis of understanding the actions of others. She is the coauthor with Riitta Hari of MEG-EEG Primer (Oxford University Press), an introduction to magnetoencephalography (MEG) and electroencephalography (EEG) techniques for studying brain activity noninvasively.

Bradley Voytek, USA

UC San Diego, Department of Cognitive Science and Halıcıoğlu Data Science Institute
Email: bvoytek@ucsd.edu

Presentation title: How we quantify our neural data constrains our models and theories.

Abstract: Neural oscillations are prominent across all scales of measurement, from single-units and invasive local field potentials to non-invasive EEG. These oscillations are embedded within a noisy, non-oscillatory aperiodic background that also includes brief signal transients. However, oscillations are neither tonic nor sinusoidal: they are often infrequent and bursty, and they manifest rich nonsinusoidal features. Here, I will show how we can embrace the richness of our data and take advantage of the variability to better understand human cognition.

Short Bio: Bradley Voytek is a Professor in the Department of Cognitive Science, the Halıcıoğlu Data Science Institute, and the Neurosciences Graduate Program at UC San Diego. He's an Alfred P. Sloan Neuroscience Research Fellow and a Kavli Fellow of the National Academies of Sciences, as well as a

founding faculty member of the UC San Diego Halıcıoğlu Data Science Institute and the Undergraduate Data Science program. After his PhD at UC Berkeley, he joined Uber as their first data scientist—when it was a 10-person startup—where he helped build their data science strategy and team. His research lab combines large-scale data science and machine learning to study how brain regions communicate with one another, and how that communication changes with aging and disease. He is an advocate for promoting science to the public and speaks extensively with students at all grade levels about the joys of scientific research and discovery. In addition to his academic publications, his outreach work has appeared in outlets ranging from Scientific American and NPR to the San Diego Comic-Con. He is currently writing a book with neuroscientist Ashley Juavinett regarding the powerful future of data science in neuroscience discovery, though his most important contribution to science is his book with fellow neuroscientist Tim Verstynen, "Do Zombies Dream of Undead Sheep?", by Princeton University Press.

Paolo Maria Rossini, Italy

Director of Dept. Neurosci. & Neurorehab., IRCCS San Raffaele-Rome

Email - rossini.paolom@gmail.com

Presentation title: 100 years from the discovery of Electroencephalography: evolving technologies reached clinical targets and unmet expectations.

Co-Authors - F. Vecchio, F. Miraglia, C. Pappalettera, L. Nucci, A. Cacciotti

Short Bio: Prof. Paolo Maria Rossini graduated in Medicine and Surgery with honors from the Catholic University of the Sacred Heart and – after a career developed in prestigious Italian and North American academic and clinical centers – has been a full professor of Neurology since 2011 at the Faculty of Medicine of the Catholic University of the Sacred Heart and director of the Neuroscience Area of the Policlinico Foundation A. Gemelli. He has published over 600 articles in international scientific journals on the mechanisms of healthy and diseased brain using highly innovative technologies, including those at the base of the NEUROCONNECT project. He is a world expert in the study of cerebral activity neurodegenerative mechanisms through neurophysiological techniques. He was the first and only Italian president of the International Federation of Clinical Neurophysiology since 1949 (year of IFCN foundation, today it aggregates about 20,000 neurophysiologists from over 60 countries all over the world).

Steven Luck, USA

Center for Mind & Brain, University of California, Davis

Email:sjluck@ucdavis.edu

Presentation Title: Event-Related Potentials: Where We've Been and Where We're Going.

Abstract: In this presentation, I will discuss the history of ERPs, the component-based approach that has dominated the field since the 1960s, and new multivariate pattern analysis approaches that solve many of the problems with the component-based approach.

Short Bio: Steven J. Luck received a PhD in Neurosciences from UCSD in 1993. After postdoctoral work at UCSD and the NIH, he took a faculty position at the University of Iowa in 1994. In 2006, he

moved to the Center for Mind & Brain at the University of California, Davis. Dr. Luck's research focuses on the cognitive and neural mechanisms of attention and working memory, including basic science studies with typical adults and typical infants and translational studies of people with schizophrenia.

Viktor Jirsa

Director of the Institute de Neurosciences des Systèmes in Marseille, France.
Email: viktor.jirsa@univ-amu.fr

Presentation Title: Synergetics of the Brain

Abstract: Synergetics provides a formal framework for mechanisms underlying self-organization in complex systems. In the past twenty years, we have made significant progress in neuroscience by applying concepts of Synergetics to the brain. Combining brain imaging data with mathematical models can predict outcomes more accurately than using each method separately. Our approach has helped us understand normal brain states, their operation, and conditions like healthy aging, dementia, and epilepsy. Using a combination of computational modeling and dynamical systems analysis, we provide a mechanistic description of the formation of a resting state manifold via the network connectivity. We demonstrate that the symmetry breaking by the connectivity creates a characteristic flow on the manifold, producing major data features across scales and imaging modalities. These include spontaneous high-amplitude co-activations, neuronal cascades, spectral cortical gradients, multistability, and characteristic functional connectivity dynamics. When aggregated across cortical hierarchies, these match the profiles from empirical data and explain the brain's microstate organization features. Examples of clinical translation are taken from drug-resistant epilepsy and mental disorders. The digital brain twin augments the value of empirical data by completing missing data, allowing clinical hypothesis testing, and optimizing treatment strategies for the individual patient. Virtual Brain Twins are part of the European infrastructure called EBRAINS, which supports researchers worldwide in digital neuroscience.

Short Bio: Trained initially in Theoretical Physics and Philosophy in the 1990s, Dr. Jirsa has contributed to understanding how network structure constrains the emergence of functional dynamics using methods from nonlinear dynamic system theory and computational neuroscience. Dr. Jirsa has been awarded several international and national awards for his research, including the Francois Erbsmann Prize in 2001, NASPSPA Early Career Distinguished Scholar Award in 2004, and the Grand Prix de Recherche de Provence in 2018. He serves on various editorial boards, has published over 150 scientific articles and book chapters, and has co-edited several books, including the Handbook of Brain Connectivity. Dr. Jirsa is one of the Lead Scientists in the Human Brain Project and The Virtual Brain.

Mahnaz Arvaneh, UK

University of Sheffield, UK
Email: m.arvaneh@sheffield.ac.uk

Presentation Title: EEG-driven BCI for Telerehabilitation after Stroke

Abstract: We have created a groundbreaking telerehabilitation system known as Tele BCI-FES. This

innovative system merges brain-computer interface (BCI) and functional electrical stimulation (FES) technologies to rehabilitate upper limb function following a stroke. Our system pioneers the concept of allowing patients to undergo BCI therapy from the comfort of their homes, while ensuring supervised therapy and real-time adjustment capabilities. In this talk, we will discuss our single-arm clinical trial, which evaluates the feasibility and acceptance of this proposed system as a telerehabilitation solution for upper extremity recovery in stroke survivors.

Short Bio: Mahnaz is a Senior Lecturer (associate professor) at the Department of Automatic Control and Systems Engineering (ACSE), University of Sheffield. Her research is centered on the user-centric design of non-invasive closed-loop neural interfaces and their applications in monitoring and enhancing physical and cognitive performance. As the director of the Brain-Computer Interface laboratory, Mahnaz oversees theoretical, experimental, and translational research aimed at developing therapeutic neuro-technologies. She has made significant contributions to the field, including her involvement in the "Royal Society expert perspective report on neural interface technologies" launched in 2019. Mahnaz also serves as an associate editor for Nature's Scientific Reports and IEEE Transactions on Neural Systems and Rehabilitation Engineering (TNSRE). In recognition of her outstanding contributions, she was awarded the title of best associate editor of IEEE TNSRE in 2023. Mahnaz is a core member of the BCI working group at the British Standardisation Institute, and represents the UK in the International Electrotechnical Commission on the same topic.

Online Symposia Presenters

Christine Rogers, Canada

Managing director of EEGNet
McGill Centre of Integrative Neuroscience (MCIN), Montreal Neurological Institute
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Presentation Title: Data Standardization and the open EEGNet data and analytics hub

Abstract: The EEGNet open data and analytics platform brings together standardized datasets, workflows, tools and computational infrastructure for collaborative annotation, visualization, querying and analysis of multi-modal EEG-BIDS datasets across high-performance computing clusters. EEGNet encompasses lossless ICA pipelines and quantitative EEG toolboxes in addition to facilitating data harmonization with open-source cross-platform utilities designed to reduce barriers to data sharing and transparency in federation of datasets. As an end goal, the growing data collections on the EEGNet platform provide a collaborative basis for applications in machine learning, early identification of biomarkers and translation to applications in global health. In partnership with the Global Brain Consortium (GBC), EEGNet also leverages groundwork by the Canadian Open Neuroscience Platform (CONP) for cross-collaborative models of extensible ethics and data governance in open science.

Short Bio: Christine Rogers, based at the McGill Centre of Integrative Neuroscience (MCIN) at the Montreal Neurological Institute, is managing director of EEGNet.org and part of the Global Brain Consortium core. She leads several open EEG neuroinformatics projects with the LORIS team (Loris.ca) including the *MNI Open iEEG Atlas (mni-open-ieegatlas.research.mcgill.ca) and the Brain Imaging Data Standards maintainers.*

Arnaud Delorme, USA

UCSD
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Presentation Title: Is EEG is better left alone?

Abstract: "Automated preprocessing methods are critically needed to process the large publicly available EEG databases, but the optimal approach remains unknown because we lack data quality metrics to compare them. Here, we designed a simple yet robust EEG data quality metric assessing the percentage of significant channels between two experimental conditions within a 100 ms post-stimulus time range. Because of volume conduction in EEG, given no noise, most brain-evoked related potentials (ERP) should be visible on every single channel. Using three publicly available collections of EEG data, we showed that, with the exceptions of high-pass filtering and bad channel interpolation, automated data corrections had no effect on or significantly decreased the percentage of significant channels. Referencing and advanced baseline removal methods were significantly detrimental to performance. Rejecting bad data segments or trials could not compensate for the loss in statistical power. Automated Independent Component Analysis rejection of eyes and muscles failed to increase performance reliably. We compared optimized pipelines for preprocessing EEG data, maximizing ERP significance using the leading open-source EEG software: EEGLAB, FieldTrip, MNE, and Brainstorm. Only one pipeline performed significantly better than high-pass filtering the

data.

Short Bio: Arnaud Delorme is a research scientist at Paul Sabatier University in Toulouse and at the Swartz Center for Computational Neuroscience at the University of California, San Diego. Dr. Delorme is the main instigator behind the widely used MATLAB toolbox for electroencephalography (EEG) analysis, EEGLAB. He has been acknowledged for his contribution to the field of EEG research by being awarded a Bettencourt-Schueller Young Investigator Award and an ANT EEG Young Researcher Awards.

Neil Bailey, Australia

The Australian National University
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Presentation Title: The promise of non-traditional EEG pre-processing and analysis methods.

Abstract: The analysis of brain activity recorded with EEG has enabled considerable advances in our understanding of brain function and dysfunction over the past 100 years. However, analyses have predominantly focused on event-related potentials or oscillatory power, and independent component analysis (ICA) has been the most common method to reduce artifacts in the last two decades. Our work aligns with prior research showing that while ICA is effective at reducing artifacts, it can also frequently distort neural activity. To address this, we have introduced a open source code that enables the targeted reduction of specific artifact time periods and frequencies within artifact components, which better preserves neural activity mixed into those components due to imperfect decompositions. We have also applied recent advances in travelling cortical wave analyses to show how meditation affects the predictive processing functions of the brain, as well as data-driven highly comparative time-series analysis methods to detect novel signatures that outperform traditional measures at discerning brain activity related to meditation experience and predictors of treatment response. These results, enabled by the use of non-typical EEG methods, provide unique insight into brain activity patterns and treatment mechanisms, highlighting the potential offered by extending beyond traditional methods. Overall, our work motivates future research to further explore novel pre-processing and analytic methods.

Short Bio: Dr Neil Bailey is a Senior Research Fellow at the Australian National University and is Head of Data Science at the Monarch Research Institute. His research applies EEG to explore treatments for mental health. In particular, he examines how brain activity differs in meditators, and whether depression treatment response can be predicted from EEG data. While his priority is mental health, his research involves extensive forays into EEG pre-processing, analysis methods, and machine learning models.

Amy Bland, UK

Manchester Metropolitan University, UK
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Presentation Title: Using the #EEGManyLabs Platform to Investigate Emotion Processing.

Abstract: Since its discovery in the early 20th century, EEG has had a profound influence on our understanding of human cognition, yet there is limited evidence on the replicability of some of the most highly cited discoveries. #EEGManyLabs is a large-scale international collaborative effort to replicate the 27 most influential and continually cited studies in the field. In this talk, Dr Amy Bland will present the replication of Hajcak and Foti's (2008) finding that the ERN is indicative of individual variations in aversive reactions to errors. This has influenced understanding of the ERN being more than a simple error detection mechanism and sheds light on how people differ in their emotional responses to mistakes. We plan to directly test the replicability of this finding in 8 independent laboratories across 5 countries. The data will later be combined to compute global effect sizes of the ERN, startle potentiation, and their interaction. Given that the ERN is an integral part of a broader neural system responding to potentially threatening stimuli, this replication will provide a more solid foundation for our understanding of error processing and its relationship to defensive reactivity.

Short Bio: Dr. Amy Bland earned her PhD in Cognitive Neuroscience, MSc in Psychology, and BSc in Psychology from the University of Leeds. She is an expert grant reviewer for the Medical Research Council and a journal reviewer for top publications like Nature Human Behaviour and Psychological Medicine. Dr. Bland also holds visiting positions at the Department of Psychiatry at the University of Cambridge and the Division of Neuroscience and Experimental Psychology at the University of Manchester.

Sandor Benickzy, Denmark

Danish Epilepsy Centre

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Presentation Title: AI for automated interpretation of routine EEG: score – AI.

Short Bio: Sándor Beniczky received an MD degree from medical school in 1997 and a Ph.D. degree in neuroscience in 2004 from the University of Szeged, Szeged, Hungary. He is a Board Certified Neurologist and Clinical Neurophysiologist (both in Hungary and in Denmark). He is currently with the Danish Epilepsy Centre, Dianalund, Denmark, and the Department of Clinical Neurophysiology, Aarhus University Hospital, Aarhus, Denmark. His main research interests include evoked potentials, source localization, EEG, and epilepsy.

Anisleidy Gonzalez Mitjans, Cuba

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Presentation Title: Improving Brain Simulation Accuracy: Sensitivity Analysis and Realistic Time Delays in Neural Mass Models (Video)

Abstract: "The classical Jansen and Rit Neural Mass Model is essential in computational

neuroscience but often misses the complexities of real neural systems, like conduction delays and parameter sensitivity. We reformulated this model using Algebraic Random Differential Equations and employed the Local Linearization Method for better efficiency and accuracy. By considering axonal properties such as length, diameter, myelination, and g-ratio, we created a more realistic framework for distributed conduction delays, enabling accurate simulation of thousands of interconnected cortical columns.

Our study conducted a comprehensive sensitivity analysis using Machine Learning approaches, focusing on characteristics that define healthy and epileptiform rhythms, such as amplitude, frequency, and peak counts. We identified excitatory and inhibitory postsynaptic potentials (EPSP and IPSP), the inflection points of the sigmoid function (v0), and axonal diameter (diam) as the most influential parameters. These findings validate our modeling approach and highlight areas for further investigation and optimization.

This new approach advances neural mass models and large-scale brain simulations, providing a framework for multiscale analysis and a powerful tool for exploring brain activity and understanding neurological diseases."

Short Bio: Anisleidy Gonzalez Mitjans holds a Bachelor's in Mathematics from the University of Havana and a Master's and Ph.D. in Biomedical Engineering from UESTC, China. Specializing in High-dimensional Neural Mass Modeling under Pedro Valdes-Sosa, she now advances realistic brain modeling at the Montreal Neurological Institute's Alan Evans lab. Her work, integrating biophysical models for the BigBrain Project, aims to revolutionize multimodal data fusion and our understanding of neural interactions.

Claudio Babiloni, Italy

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Presentation Title: Hans Berger's dream: global initiatives for the validation of resting-state EEG biomarkers in pathological aging.

Abstract: On 6 July 1924, the German psychiatrist Hans Berger was the first to record EEG activity in a human being (Jena, Germany). The EEG recording was performed in the condition of resting state with periods of eyes closed and open (rsEEG). Results reveal the characteristic changes in cortical oscillatory rhythms at the alpha frequencies (8-12 Hz) related to the regulation of quiet vigilance. He dreamed that rsEEG activity could represent a major signal to explore the neurophysiological correlates of higher mental functions and dysfunctions.

One hundred years later, some global initiatives have been validating rsEEG biomarkers in patients with Alzheimer's and related diseases causing severe cognitive deficits during aging, such as the Global Brain Consortium (https://globalbrainconsortium.org/), the PDWAVES Consortium (www.pdwaves.eu), and the Eurolad-EEG Consortium and Latin America and the Caribbean Consortia on Dementia (http://lac-cd.org/). It was shown that these rsEEG biomarkers reflect the structural and functional integrity or derangement of subcortical neuromodulatory ascending systems impinging upon thalamocortical-cortical loops responsible for the regulation of cortical neural excitability and vigilance/consciousness level from drowsiness and quiet vigilance to alertness. In the talk, the recent findings of rsEEG studies on Alzheimer's and related diseases from

the mentioned global Consortia will be discussed. Did Hans Berger's dream come true?"

Short Bio: Received a Ph.D. in Biomedical Sciences (Aalborg University, Denmark) in June 2001 and was appointed Associate Professor in Physiology in December 2007 at the University of Foggia (Italy), served as Associate Professor in Physiology from December 2012 to March 2022, and as Full Professor in Physiology from March 2022 onward, at the Sapienza University of Rome (Italy). Investigate the brain rhythms underlying the regulation of vigilance/consciousness level and cognitive functions in aging.

Gerwin Schalk, USA

Fudan University

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Presentation Title: Electrical brain recordings: from simple visual observations to detailed insights into brain function.

Abstract: In this talk, I will describe how increasingly detailed electrical brain recordings improved our understanding about the brain from simple insights to a detailed model that links neurophysiology to behavior.

Short Bio: Dr. Schalk is interested in integrating scientific, engineering, and clinical concepts to advance our understanding of the brain and to use this new understanding to develop novel neurotechnologies that improve people's lives. He authored or co-authored >130 peer-reviewed publications, one book and 17 chapters, has ~28000 total citations and an H factor of 68, has given more than 270 invited lectures world-wide, and is ranked #5 in BCI research world-wide and #23 in neuroscience in China.

Dora Hermes, USA

Associate Professor in Biomedical Engineering at Mayo Clinic in Rochester, Minnesota
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Presentation Title: A machine-readable standard for electrophysiology annotations: HED-SCORE.

Abstract: Standardizing terminology to describe electrophysiological events can improve both clinical care and computational research. When data are enriched by electrophysiological event annotation in standardized terminology that is machine readable, data exploration can be efficiently implemented across software tools and packages. Hierarchical Event Descriptors (HED) provide a framework for describing events in neuroscience experiments. HED library schemas extend the standard HED schema vocabulary to include specialized vocabularies, such as standardized clinical terms for electrophysiological events. The Standardized Computer-based Organized Reporting of EEG (SCORE) defines terms for annotating EEG events, including artifacts. We made the SCORE terms machine-readable by incorporating them into a HED library schema. The HED-SCORE library schema can further be used to annotate events in EEG data stored in the Brain Imaging Data Structure (BIDS), facilitating the annotation and computation of electrophysiology data.

Short Bio: Dora Hermes is an Associate Professor in Biomedical Engineering at Mayo Clinic in Rochester, MN. She did her graduate training at the UMC Utrecht in The Netherlands working in the lab of Prof. Nick Ramsey. Her PhD work focused on understanding the relation between functional MRI and field potentials in the human brain, and understand to what extend fMRI can be used to localize an area to implant electrodes for brain-machine interfaces. For her postdoctoral training Dora Hermes applied these techniques to better understand visual processing at Stanford University and New York University. She received a Veni fellowship from the Netherlands Organization for Scientific Research to translate this work to better understand photosensitivity and epilepsy. Dr. Hermes' current research focuses on understanding the mesoscale signals measured in the living human brain in order to identify biomarkers of neurological disease and develop neuroprosthetics to interface with the brain.

Faisal Mushtaq, UK

University of Leeds, Leeds, UK
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Presentation Title: 100 Years of EEG

Abstract: On July 6th, 1924, Hans Berger performed the first-ever recording of the electroencephalogram from a human (during a neurosurgical operation on a 17-year-old boy performed by Nikolai Guleke). On the centenary of the first human EEG recording, we brought together a meta-consortium representing several major international EEG programmes to develop and distribute a survey asking EEG experts to reflect on the effect that the discovery has had on our understanding of the brain and behaviour and explore what the next 100 years might hold. In this talk, I will summarise the responses of more than 500 experts, with 6,685 years of collective experience who shared their priorities and predictions and call for collective action focusing on validity, democratization and responsibility to realize the potential of EEG in science and society over the next 100 years.

Short Bio: Professor Faisal Mushtaq is a Cognitive Neuroscientist and Director of the Centre for Immersive Technologies at the University of Leeds. He is a former Fellow of the Alan Turing Institute, the UK's National Centre for Data Science and AI and a current member of the British Neuroscience Association's Credibility Advisory Board. Mushtaq co-leads the #EEGManyLabs project, a large international programme involving over 230 laboratories from 32 countries. Mushtaq's team are also developing new methods for large-scale low-cost acquisition of neural data through citizen science.

Mario Parra, UK

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Presentation Title: Are there EEG markers of critical transition points in the continuum from normal aging to Alzheimer's disease?

Abstract: Changes in brain signals occur during the transition from normal ageing to Alzheimer's

disease dementia (ADD). The early stages are accompanied by increases in brain synchronisation and connectivity and followed by a reduction of such patterns. I will present a series of studies to explore whether EEG markers can indicate transition points in the disease continuum. Study 1 (EEG) involved healthy younger and older participants who were assessed with a memory marker for AD. Older adults showed over-recruitment associated with levels of performance like those seen in younger adults. Study 2 (MRI) assessed incidental emotional memory and showed that while behaviourally MCI patients and healthy controls performed alike, MCI patients' hippocampal recruitment exceeded that of controls. A small sample of mutation carriers linked to familial AD who were in the MCI stages were assessed with a memory marker and EEG, and their brain connectivity was measured. Increased connectivity achieved 89% classification accuracy. Finally, a recent study with community-dwelling older adults with and without MCI revealed a pattern of hyper and hypo-synchronization, which did not grant compensatory protection. A switch from increased to decreased neural recruitment/responsiveness is associated with compensatory and non-compensatory behavioural outcomes in the transition from normal ageing to ADD. Several questions remain, which will be discussed in this lecture.

Short Bio: Graduated as MD in 1993 and Clinical Neurophysiologist in 1997. Worked at the Cuban Neuroscience Centre and University Hospitals in Cuba and Colombia investigating neurophysiological aspects of dementias. Completed his PhD in Human Cognitive Neuroscience at the University of Edinburgh followed by 3 Postdoctoral Fellowships. He was an Assistant Professor at Heriot-Watt University and is currently a Professor in Psychology at the University of Strathclyde where he leads the Applied Cognition Lab.

Stefan Rampp, Germany

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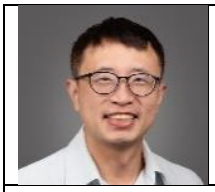
Presentation Title: From Delta to High Frequency Oscillations: Dynamics of Epileptic Networks.

Abstract: Electrophysiology is an essential component for the diagnosis of epilepsy. Planning of epilepsy surgery has utilized ictal onset and rhythmic activity, as well as interictal spikes and sharp waves for many decades. Resulting seizure freedom rates are high and development of more complex analysis techniques such as source analysis has yielded further improvements. In addition, a spectrum of novel markers provides new insights into the dynamic nature of epileptic networks. Such frequency- and connectivity-based markers, e.g. infra-slow fluctuations, focal delta/theta-activity, fast oscillations, cross-frequency coupling and graph-theory show promising clinical value. The presentation provides an overview of current findings, clinical applications and putative interpretations with a focus on EEG/MEG and invasive EEG data.

Short Bio: PD Dr. med. Stefan Rampp is currently chairman of the MEG Laboratory, Department of Neurosurgery, and a scientist at the Department of Neuroradiology, University Hospital Erlangen, Germany. His research covers various topics such as MEG, surface and invasive EEG, as well as MRI analysis and post-processing for epileptic focus localization, functional mapping and neurocognitive research. Other areas of interest include intraoperative monitoring, biosignal analysis and software development.



Thomas Yeo, Singapore

Associate Professor at the National University of Singapore, Singapore
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Presentation Title: Optimizing Scan Time and Sample Size to Improve Individual-Level Prediction

Abstract: I will discuss recent work from my lab on optimizing scan time and sample size to improve individual-level prediction of phenotypic traits from functional MRI.

Short Bio: Thomas Yeo is an Associate Professor from the National University of Singapore. His lab develops machine learning algorithms to generate discoveries from population-level brain MRI data, which are in turn used to develop personalized treatments for brain disorders. Thomas was the winner of the MICCAI Young Scientist Award, the MICCAI Young Investigator Publication Impact Award, and the OHBM Early Career Investigator Award. He is a Fellow of OHBM and sits on its scientific advisory board.

Ying Wang, China

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Presentation Title: Nonlinear Xi–Alpha EEG model

Abstract: Parametrizing EEG in the spectral domain can extract the stochastic process skeleton of the brain. However, we cannot determine from the data whether the power spectrum components obtained by parameterization are contributed by linear or nonlinear processes. We proposed a likelihood-based model for the joint spectrum-bispectrum to parametrize the nonlinearity. With 1772 channels of iEEG data, we found the xi process is linear and Gaussian, but the alpha process is strongly nonlinear. This guides neural model modeling and data analysis.

Short Bio: Ying Wang, a PhD student at the UESTC, specializes in neural dynamics. He developed a fast local polynomial regression algorithm for harmonizing multinational quantitative EEG norms. Wang extended the EEG frequency domain parametric model(the xi-alpha model) to higher-order spectra, allowing for testing the Gaussianity and linearity of components. Additionally, he used source modeling and a linear mixed-effects model to reconstruct group-level whole-brain current density maps with iEEG data.

Ronald Garcia Reyes, Cuba

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Presentation Title: Uncovering the sources of EEG models

Abstract:. The accuracy of estimating connectivity in EEG/MEG analysis is often affected by volume conduction effects and source leakage. This paper presents an approach to improve connectivity estimations by integrating physiological constraints into state-space models, specifically using the Connectivity-to-Connectivity Approach. This method directly converts scalp-level connectivity measures into source space connectivity, bypassing intermediate activation estimations. We

demonstrate the significant impact of physiological constraints on source connectivity estimation, which is often neglected in traditional approaches. Our model is validated through simulations showing high reconstruction accuracy and, in real data, it outperforms traditional methods in constructing developmental surfaces of cross-spectra. By leveraging anatomical connectivity, tract lengths, and dynamic spectral properties, we refine spectral density estimation at the source level, improving both precision and interpretability. These refined methodologies have profound implications, offering potential for enriched scientific inquiry and enhanced clinical applications.

Short Bio: He is a researcher affiliated with the UESTC and a PhD candidate at UESTC and CNEURO. He earned his BSc in Mathematics from the University of Havana in 2021 and was awarded the best young scientific research prize in 2022 at CNEURO. Ronald is involved in the Joint Cuba-China Collaboratory for Neuroinformatic and is a member of the Global Brain Consortium. He has published in journals such as Frontiers and has authored preprints on statistics, probabilistic theory, and neuroscience.

Shiang Hu, China

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Presentation Title: ξ-π: A Nonparametric Model for Neural Power Spectra Decomposition

Abstract: The power spectra estimated from the brain recordings are the mixed representation of aperiodic transient activity and periodic oscillations, i.e., aperiodic component (AC) and periodic component (PC). Quantitative neurophysiology requires precise decomposition preceding parameterizing each component. However, the shape, statistical distribution, scale, and mixing mechanism of AC and PCs are unclear, challenging the effectiveness of current popular parametric models such as FOOOF, IRASA, BOSC, etc. Here, ξ-π was proposed to decompose the neural spectra by embedding the nonparametric spectra estimation with penalized Whittle likelihood and the shape language modeling into the expectation maximization framework. ξ-π was validated on the synthesized spectra with loss statistics and on the sleep EEG and the large sample iEEG with evaluation metrics and neurophysiological evidence. Compared to FOOOF, the simulation presenting shape irregularities and the batch simulation indicated that ξ-π improved the fit of AC and PCs; the sleep EEG revealed that ξ-π produced more distinguishable AC exponents and improved the sleep state classification accuracy; the iEEG showed that ξ-π approached the clinical findings in peak discovery. Overall, ξ-π offered good performance in the spectra decomposition, which allows flexible parameterization. ξ-π is a seminal tool for brain signal decoding in fields such as cognitive neuroscience, brain computer interface, neurofeedback, and brain diseases.

Short Bio: Dr. Hu, associate Prof, the project leader of GBC EEG preprocessing, and committee member of CCF/CSIG/CAAI/CSCS. He published >30 papers in neuroinformatics, proposed rREST, ξ-π and PaLOSi, which won the IOP Top-cited paper award, were linked to the UN-SDG or featured as IEEE research highlight, etc. He has hosted NSFC project and MITACS, and participated in the 2030 Major Project on Brain Science. Research interests include cognition, neural information processing and brain-like intelligence.

Ludovico Minati, China

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Presentation Title: Across neurons and silicon: some ideas about the relationship between unusual electronic circuits and neuroscience.

Abstract: What makes the brain unique, and what exactly is unique about it from a physical perspective, after all? I will try to approach these questions by first highlighting two aspects. One, the profound differences with respect to present-day computers. Two, how Nature has leveraged, to construct brains, some phenomena that are actually universal, pervasive in other systems, and thus possible to replicate electronically at some level. I will discuss how similar emergent behaviors can be observed across rather diverse systems, and how comparing brain activity to some rather unusual electronic circuits could be inspiring, both for neurophysiology and for electronic engineering. I will briefly overview my recent research attempting to "summarize" in simple electronic circuits, mainly so-called chaotic oscillators, some phenomena arising in other biological and physical scenarios, especially in brain dynamics. Firstly, a gallery of these rather unusual circuits will be walked through, surveying some oscillators based on transistors, gas-discharge tubes, and other electronic components. Secondly, simple networks of these circuits will be considered, demonstrating the spontaneous emergence of phenomena commonly observed in neural recordings, such as community structures, remote interdependences, and so on. Thirdly, some applications will be discussed, comprising the creation of physical instead of simulated in-silico disease models, bio-inspired pattern generation, and engineering applications such as in distributed sensing. While by no means a comprehensive introduction to this young multidisciplinary field, this presentation should hopefully provide some ideas regarding how engineering and neuroscience can provide mutually inspire each other.

Short Bio: Ludovico Minati received the Ph.D. degree in Neuroscience from the Brighton and Sussex Medical School, Falmer, U.K., in 2012, the D.Sc. (doktor habilitowany) degree in Physics from the Institute of Nuclear Physics, Polish Academy of Sciences, Kraków, Poland, in 2017, and the M.B.A. degree in Technology Management from The Open University, Milton Keynes, U.K., in 2021. Until 2023, he was a Specially Appointed Associate Professor with the Institute of Innovative Research, Tokyo Institute of Technology, Tokyo, an Affiliate Research Fellow with the Center for Mind/Brain Sciences, University of Trento, Trento, Italy, and a Freelance Research and Development Consultant. He is now a Professor, Outstanding Young Talent and Director of the Interdisciplinary Nonlinear Dynamics Laboratory at the School of Life Science and Technology, University of Electronic Science and Technology of China, Sichuan, China. He has authored more than 160 articles, cited more than 5000 times, and several patents. His research interests include nonlinear dynamical systems, chaotic oscillators, reconfigurable analog and digital computing, analog integrated circuits, advanced techniques for biosignal analysis, brain–machine/computer interfaces, and robotics. He is a European Engineer (Eur. Ing.), a Chartered Engineer (CEng), and a member of the Institution of Engineering and Technology (IET), U.K. He is also a senior member of the Institute of Electric and Electronic Engineers (IEEE), and a member of the Institute of Electronics, Information, and Communication Engineers (IEICE), and the Institute of Electrical Engineers (IEE) of Japan.

Christophe Letellier, France

Rouen Normandie University, France

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Presentation Title: Flat control law for diffusively coupled chaotic systems

Abstract: Controlling dynamical systems and particularly, network, is of a primary interest, when the system (network) is of (nodal) high-dimensionality. Such a problem is intrinsically related to the analysis of the observability from measurements of the corresponding state space and its dual, the controllability of the system (network). An additional constrain can be added in requiring the possibility for getting the system flat, that is, its state and the actuating signal can be expressed in terms of the measurements and a finite number of its derivatives. Starting from the placement of sensors providing a global observability, we address the dual problem of placing the actuators allowing to design a flat input. Since global observability of network can be solved – when the nodes are y-coupled Rössler systems – by pairing the nodes , a first step in controlling network appears to design a flat control law for a pair of diffusively y-coupled Rössler systems. It is solved by inserting a differential delay . The flat control of a random 28-node network of Rössler system is then discussed.

Short Bio: Christophe Letellier received a PhD degree in 1994 from the University of Paris VII, France. It thesis was about the topological characterization of chaotic attractors and global modelling from times series. He is now a full professor at the Department of Physics at Rouen Normandie University. He is the author of five books among which The Symmetry of Chaos (with Robert Gilmore, Drexel University – Oxford University Press, 2007), Chaos in Nature (World Scientific Publishing, 2nd edition, 2019) and Chaos (with Otto E. Rössler, Springer, 2020). He served as the head of the French national group of research DYCOEC in complex sets for 8 years. His research includes topological characterization of chaotic attractors, symbolic dynamics, identification of nonlinear system, observability and controllability of chaotic systems and network, flat control, synchronization and analysis of biomedical data (heart variability, noninvasive mechanical ventilation, follow-up for patients with lung cancer...).

Yuri Antonacci, Italy

Assistant Professor at UNIPA's Department of Engineering
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Presentation Title: Mapping the dynamics of complex physiological systems: An Information Theoretic Perspective with applications to brain dynamics

Abstract: The increasing availability of large-scale and fine-grained recordings of biomedical signals is paving the way for the network representation of complex physiological systems. For instance, in neuroscience, the organizational principles of functional segregation and integration in the human brain are typically studied using the theoretical and empirical tools of Network Neuroscience (NN). Data-driven network inference methods are crucial in NN and are designed to build network models from observed time series, typically represented as graphs where nodes are

connected by edges denoting functional dependencies, including self-effects and pairwise interactions. Additionally, many physiological systems exhibit higher-order interactions involving more than two nodes.

This talk will present several information-theoretic measures across three analytical approaches: i) entropy rate (ER) for characterizing node dynamics and first-order interactions; ii) Mutual Information Rate (MIR) for quantifying second-order, pairwise interactions; and iii) O-Information Rate (OIR) for identifying higher-order synergistic and redundant behaviors. It will be demonstrated how network interactions can be studied by shifting from the time domain to the frequency domain in the presence of activity rich in oscillatory content, and how these domains can be combined to enable time-resolved analysis when transitions between different physiological states are present.

Short Bio: Yuri Antonacci received his M.Sc. degree (cum laude) in Biomedical Engineering in 2016 and his Ph.D. in Bioengineering in 2021, both from the University of Rome "La Sapienza." From June 2020 to February 2022, he was a postdoctoral research fellow in the Department of Physics at the University of Palermo (UNIPA), working on a national project exploring the complexities of systems like the human brain and financial markets. From March 2022 to February 2023, he held another postdoctoral position at UNIPA's Department of Engineering, focusing on information-theoretic and machine learning approaches for detecting physiological states in humans. He is currently an Assistant Professor at UNIPA's Department of Engineering. His teaching activities include biomedical signal processing and methods for bioengineering. His research interests include developing and implementing new methods for biomedical signal processing, particularly for analyzing brain signals in both physiological and pathological conditions. He is a member of the IEEE Engineering in Medicine and Biology Society. He also served on the local organizing committee for "The 11th International Conference on Complex Networks and Their Applications" in Palermo in 2022 and on the technical program committee for the same conference in 2023 and 2024. Additionally, he is a member of the technical program committee for the 2024 International Conference on Information Systems and Computing Technology, Xi'an, China.