

Program







BCIs: Not Getting Lost in Translation

May 21–25, 2018 Asilomar Conference Center Pacific Grove, California

www.bcisociety.org



Brain-Computer Interface & Neurotechnology

g.Nautilus wireless EEG 8/16/32/64 dry or gel-based electrodes + fNIRS

simultaneous measurement of EEG and tDCS/TMS

closed-loop experiments with EEG and non-invasive stimulation

multi-device (g.Nautilus, g.USBamp, g.Hlamp) acquisition on one computer

g.Hlamp, g.USBamp invasive ECoG and Spike acquisition

closed-loop experiments with ECoG and intra-cranial stimulation

MATLAB API, C API and Simulink Interface

g.tec medical engineering GmbH Schiedlberg | Graz | Barcelona | New York www.gtec.at | office@gtec.at



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Program-at-a-Glance



Welcome!

Dear Friends and Colleagues,

For the first time the meeting takes place two years after the previous meeting instead of three, upon a majority vote of the members in 2016, to better capture the developments. The BCI field is witnessing an acceleration of technologies and an increasing interest from the public. Studies reporting on implanted users are published at an increasing pace, and large companies announce plans to

develop disruptive technologies for recreational use. This is the time for BCI researchers to come together and get updated on the latest advances.

The mission of the Society is to foster research leading to technologies that enable people to interact with the world through brain signals, and aims to be all-inclusive of the full variety of disciplines, ranging from engineering to ethics and including non-invasive and implantable technologies and uses, that are involved in BCI research. All disciplines are represented at the 2018 meeting. As in previous meeting, the society endeavors to bring scientists from the different disciplines together by means of a diverse but coherent program aimed at learning and interaction. Many collaborations have found their roots at previous meetings and we expect to see the same happen at the 2018 meeting.

The organizing committee is proud to have put together a very exciting program that revolves around 25 workshops and 3 poster sessions, the hallmark of the BCI meetings of the Society. Moreover, it is enriched with a variety of plenary and parallel sessions addressing the multiple facets of BCI research. For this year, we have expanded sessions aimed at students, such as



didactic sessions on Monday afternoon, and master sessions where students can present their work to, and get extensive feedback from, experienced scientists in a small setting. We encourage other attendants to participate in these and to contribute to lively discussions. We are also very pleased with generous funding from NIDCD, NINDS, NSF, IEEE Brain Initiative and OpenBCI that enables us to offer student awards to 63 students!

These are exciting times for BCI

research, with an increasing public awareness of what BCI can achieve today and can offer in the near future, with EEG caps featuring dry electrodes and being portable, with BCI implants coming of age in enabling sensation and restoring movement and in providing a new means of communication for severely paralyzed users at their home. An increasing number of small and large companies are moving into our field, promising to offer research tools and new BCI solutions for recreational and medical use. The BCI field, more than ever, depends on collaborations between industry and academia, between engineering and neuroscience, and between developers and users.

The 2018 meeting in Asilomar is the place to meet friends and colleagues, to make new friends, and to forge new collaborations. Enjoy the meeting!

Nick Ramsey President of the BCI Society

About the BCI Society

History

At the Fifth International Brain-Computer Interface Meeting in Pacific Grove, California in 2013, the attendees voted for the establishment of a BCI society to oversee future meetings and conduct other BCI-related activities.

The BCI Society was formally established on March 13, 2015 as an international organization that is legally based in the Netherlands. It is led by a board comprising members from Europe, North America, and Asia.

Mission

The purpose of the BCI Society is to foster research and development leading to technologies that enable people to interact with the world through brain signals. To serve this purpose, it will:

- Organize meetings
- Collaborate with other BCI-related organizations and individuals
- Share research and other information among its members
- Provide BCI-related information and advice to scientific, technical, or clinical organizations, governmental or regulatory entities, scientific or popular media, and the general public
- Engage in other activities designed to achieve the central purpose of the Society.

BCI Society Board

Officers

Nick Ramsey, President University Medical Center Utrecht, The Netherlands

José del R. Millán, Vice-President École Polytechnique Fédérale de Lausanne, Switzerland Christoph Guger, Treasurer g.tec, Guger Technologies, Austria

Board Members

Brendan Z. Allison	University of San Diego, USA
Jennifer Collinger	University of Pittsburgh, USA
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Leigh Hochberg	Brown University, USA
Jane Huggins	University of Michigan, USA
Andrea Kübler	University of Würzburg, Germany
Donatella Mattia	Fondazione Santa Lucia, Italy
Marc Slutzky	Northwestern University, USA
Jonathan Wolpaw	Wadsworth Center New York State, Department of Health, USA

2018 Program Committee

Brendan Z. Allison	Publicity
Chuck Anderson	Student Awards, NSF, Sponsors and Exhibitors
Jennifer Collinger	Student Awards, Publicity
Shangkai Gao	Abstracts
Christoph Guger	Workshops, Finances
Jane Huggins	Workshops
Andrea Kübler	Scientific Program
Donatella Mattia	Scientific Program
José del R. Millán	Scientific Program, Abstracts, Student Awards
Nick Ramsey	Chair
Marc Slutzky	Scientific Program, Abstracts, Student Awards, NIH
Jonathan Wolpaw	Abstracts



General Meeting information

Meeting Venue

Asilomar's rich history dates back to its origins as a YWCA Leadership Camp built in 1913. Known as Monterey Peninsula's "Refuge by the Sea," the state park is located on 107 acres of state beach and conference grounds, within the quaint and scenic town of Pacific Grove.

The Asilomar State Beach and Conference Grounds are home to a wide variety of plant and animal life that live in the forests; in rivers, marshes, lagoons, and sloughs; along the sea shore, in the bay and harbors, and, of course, in the Pacific Ocean.

Keep a safe distance from all wild animals, no matter how tame they may appear to be. Please heed any signs requesting that you not enter areas that are sensitive and protected. While on the Asilomar Conference Grounds, please remain on paved pathways and roadways at all times.

These guidelines will ensure that you – and generations to come – may continue to marvel at all the beauty of the site. Do not take anything such as seashells or pinecones. But do feel free to take lots of great photos and bring back many wonderful memories.

Meal Times

Eating together at Crocker Dining Hall is an essential part of the BCI Meeting experience. The daily menu highlights fresh, seasonal, local produce procured directly from regional, organic farmers. Each day menu boards are posted at the dining hall and front desk, showcasing the meal that will be offered for breakfast, lunch and dinner.

Breakfast:	7:30 - 9:00
Lunch:	12:00 - 13:00
Dinner:	18:00 - 19:00

Meal Tickets

Your meal tickets are like cash. Please treat as such. Do not lose them, they will not be replaced.

Name Badges

Kindly wear your name badge at all times as your admission to the sessions, breaks and special functions such as the BBQ Dinner, BCI Award Ceremony and Women in BCI Cocktail Party. At the end of the conference you are encouraged to recycle your badge at any of the recycle stations or at the registration desk.

Registration and Information Desk

The registration/information desk, located in Merrill Hall, is open daily during meeting session hours:

Monday, May 21	13:00 - 19:30
Tuesday, May 22	8:00 - 17:30
Wednesday, May 23	8:30 - 17:30
Thursday, May 24	8:30 - 17:30
Friday, May 25	8:30 - 12:00

Wireless Internet

Complimentary wireless internet is available to the delegates of the BCI Meeting throughout Merril Hall and guest rooms at the Asilomar Conference Grounds. Free WiFi is also available in the main lobby as well as the Phoebe Hearst Social Hall, where a Business Center is also located. Please note the complimentary WiFi is ideal for checking emails and websites but is not strong enough for streaming videos or heavy social media use.

Staff

BCI staff from Podium Conference Specialists can be identified by the orange ribbons on their name badges. Feel free to ask any one of our staff for assistance, or visit the registration desk.

Poster and Exhibitor Demonstration Sessions

Please visit our poster presenters and exhibitors during the three poster and demonstrations sessions. Refreshments will be served during the sessions. Feel free to enjoy your beverage while reviewing the posters. The posters are spread throughout the space in Fred Farr and Kiln meeting rooms. Information on Poster Authors, Poster Numbers and Poster Titles begins on page 23.

Poster Session 1

Set Up: Tuesday, May 22 between 08:00 and 09:00 Session Time: 9:00 – 11:00

Tear Down: 11:00 -- Thanks for removing your poster immediately after the session

Poster Session 2

Set Up: Tuesday, May 22 between 12:00 and 13:00 Session Time: 15:30 – 17:30

Tear Down: 17:30– Thanks for removing your poster immediately after the session

Poster Session 3

Set Up: Wednesday May 23 between 08:00 and 09:00 Session Time: 15:30 – 17:30

Tear Down: 17:30-- Thanks for removing your poster immediately after the session

Asilomar Grounds



Daily Schedule

Sunday, May 20 / Monday, May 21

08:00-14:00+1	The Brain Computer Interface Designers Hackathon
Fred Farr	Presented by BR41N.IO

Monday, May 21

8:45 - 14:45 Scripps	Workshop BCI+ — Hands-on workshop presenting a framework for BCI-related research		
	Presented by Brain Products		
• • • • • • • • • • • • • • •			
15:00 - 16:00	BCI Fundamental Didactic Session 1: Machine Learning		
Heather	BCI: A mutual learning perspective José del R. Millán, Ph.D., École Polytechnique Fédérale de Lausanne, Switzerland		
	Fundamentals of machine learning applied to BCI research		
	Julia Berezutskaya, Ph.D., Brain Center Rudolf Magnus, UMC Utrecht, The Netherlands		
•••••			
16:00 - 17:00	BCI Fundamental Didactic Session 2: Advanced EEG Analysis		
Heather	Basic facts about advanced EEG signal processing: From brain activity to connectivity Donatella Mattia, M.D., Ph.D., Clinical Neurophysiology, Neuroelectrical Imaging and BCI Lab Fondazione Santa Lucia, IRCCS, Rome		
	Basic facts on EEG spectral analysis in relation to models of underlying neural activity and hemodynamic activity		
	Dora Hermes , Ph.D., Brain Center Rudolf Magnus, UMC Utrecht, The Netherlands, and Department of Psychology, Stanford University, USA		
17:00 - 18:00	BCI Fundamental Didactic Session 3: BCI Implant User Needs		
Heather	User priorities for implantable BCIs Jennifer Collinger, Ph.D., University of Pittsburgh and VA Pittsburgh Healthcare System, USA		
	User motivation and outcomes for implantable BCIs Spencer Kellis, Ph.D., T&C Chen BMI Center at Caltech and School of Medicine of USC, USA		
•••••			
18:00 - 19:00	Dinner Croker Dining Hall		
19.30 - 20.30	Onening Plenary Talks		
Merrill Hall	Responsive neuromodulation for a dynamic and distributed mental state		
	David A. Burton , Ph.D., Brown Institute for Brain Science, and Department of Veterans Affairs, Center for Neurorestoration and Neurotechnology, USA		
	Brain-Computer Interfaces for stroke rehabilitation		
	Cuntai Guan, Ph.D., School of Computer Science and Engineering, Nanyang Technological University, Singapore		

Daily Schedule

20:30 - 21:45 Neuroethics Session

Merrill Hall

In association with the International Neuroethics Society



Ethical issues in BCI research and development: Recognition and response Blaise Agüera y Arcas, Machine Intelligence, Google, USA Judy Illes, CM, Ph.D., Neuroethics Canada, University of British Columbia, Canada Jonathan R. Wolpaw, M.D., National Center for Adaptive Neurotechnologies, Wadsworth Center, USA

Tuesday, May 22

7:30 - 9:00	Breakfast Croker Dining Hall	
9:00 - 11:00	Poster & Exhibitor Demonstrations Session 1	
Fred Farr & Kiln	Refreshments	
11:15 - 12:15	BCI Users Forum: The Unmet Need	
Merrill Hall	Coordinated by Theresa M. Vaughan , B.A., National Center for Adaptive Neurotechnologies, Wadsworth Center, NYS Department of Health, USA	
12:15 - 13:00	Lunch Croker Dining Hall	
13:15 - 15:15	Research Oral Presentations Session 1 (Presenter in bold)	
Merrill Hall	Augmenting intracortical Brain-Computer Interfaces in monkeys and humans with neurally driven error detectors Nir Even-Chen, Sergey D Stavisky, Jonathan C Kao, Chethan Pandarinath, Paul Nuyujukian, Stephen I Ryu, Leigh R Hochberg, Jaimie M Henderson, Krishna V Shenoy	
	Controlling high-complexity robotic swarms with low-complexity EEG brain-computer interfaces Gregory H Canal, Yancy Diaz-Mercado, Magnus Egerstedt, Christopher Bozell	
	Brain controlled epidural spinal interface reanimating forelimb function in spinal cord injury Peter Desain, Cristiano Micheli, Pieter Marsman, Jordy Thielen	
	Effects on language ability induced by BCI-based training of patients with aphasia Michael Tangermann, David Hübner, Sarah Schwarzkopf, Cornelius Weiller, Mariacristina Musso	
	Augmenting group decision making accuracy in a realistic environment using collaborative Brain-Computer Interfaces based on error-related potentials Davide Valeriani, Saugat Bhattacharyya, Caterina Cinel, Luca Citi, Riccardo Poli	
15:30 - 17:30	Poster & Exhibitor Demonstrations Session 2	
Fred Farr & Kiln	Refreshments Sponsored by Wearable Sensing / Neuracle	

18:00 - 19:00	Dinner Croker Dining Hall
19:30 - 20:30	Panel of Funding Officers
Merrill Hall	Nick B. Langhals, Ph.D., NIH, National Institute of Neurological Disorders and Stroke Roger Miller, Ph.D., NIH, National Institute on Deafness and Other Communication Disorders
	Al Emondi, Ph.D., DARPA, Biological Technologies Office
20:30 - 21:30	Industry Session
Merrill Hall	Designing a wearable silent speech BCI Mark A. Chevillet, Ph.D., Facebook, USA
	Platform "BCI" research tools and deployment strategies to accelerate translational discovery Timothy Denison, Ph.D., Medtronic, USA
21.30 - 22.00	BCI Society Town Hall
Merrill Hall	Hosted by Nick Ramsey , President, BCI Society

Wednesday, May 23

7:30 - 9:00	Breakfast Croker Dining Hall	
9:00 - 12:00	Workshops Session 1 For presenters see details on page 13.	
	Refreshments	
Heather	WS 1: BCIs for stroke rehabilitation	
Acacia	WS 6: Progress in decoding speech processes using intracranial signals	
Marlin	WS 7: Noninvasive BCI-control of FES for grasp restoration in high spinal cord injured humans	
Merrill Hall	WS 14: Collaborative and competing multi-brain BCI's	
Curlew	WS 15: ECoG based BCIs	
Nautilus East	WS 19: Examining ethical assumptions about neural engineering and BCI development	
Nautilus West	WS 22: Towards the elusive killer app for BCIs	
Triton	WS 23: User-centered design in BCI development: A broad perspective	
Sanderling	WS 25: Lower-limb Brain-Machine Interfaces and their applications	
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12:00 - 13:00	Lunch Croker Dining Hall	
	Descende Avel Presentations Section 2 (Descender in held)	

13:15 – 15:15 **Research Oral Presentations Session 2** (Presenter in **bold**)

Speech synthesis with densely connected 3D convolutional neural networks from ECoG Miguel Angrick, Christian Herrf, Emily Mugler, Marc W Slutzky, Dean J Krusienski, Tanja Schultz

Daily Schedule

	Decoding differences in continuously executed and observed tracking movements from EEG signals	
	Reinmar J Kobler, Andreea I Sburlea, Gernot R Müller-Putz	
	The cortical encoding of kinematics and kinetics during an object grasp task Robert D Flint, Matthew C Tate, Marc W Slutzky	
	Finding the bipolar Error-related Potential (bErrP) in an ALS patient implanted with a daily use communications brain-computer interface (BCI)	
	Zachary V Freudenburg , Khaterah Kohneshin, Erik J Aarnoutse, Mariska J Vansteensel, Mariana P Branco, Sacha Leinders, Max A Van Den Boom, Elmar G Pels, Nick F Ramsey	
	Co-adaptive learning improves efficacy of multi-day EEG-based motor imagery BCI training Oren Shriki, Eyal Zakkay, Lior Shmuelof, Amjad Abu-Rmileh	
	How to train ErrP-based BMIs: A speller application Iñaki Iturrate, Ricardo Chavarriaga, Alessia Colucciello, José del R Millán	
	Simple vs. complex Brain-Computer Interfaces for restoring upper limb function via neuromuscular stimulation	
	Dawn M Taylor, Tyler Johnson, Frank Willett, Harrison Kalodimos, Vishhvaan Gopalakrishnan	
45.00 47.00	Postar 9 Exhibitar Domanstrations Social 2	
15:30 - 17:30	Poster & Exhibitor Demonstrations Session 3	
Fred Farr & Kiln	Refreshments	
•••••		
18:00 - 20:30		
The Meedow	Open Air BBQ giltec	
	Open Air BBQ g.tec Sponsored by g.tec GUGER TECHNOLOGIES	
	Open Air BBQ g.tec Sponsored by g.tec GUGER TECHNOLOGIES	
19:30 - 20:30	Open Air BBQ G. Construction Sponsored by g.tec G. Construction Master Classes Session 1	
19:30 - 20:30	Open Air BBQ G. G	
19:30 – 20:30	Open Air BBQ G. G	

Thursday, May 24

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Nautilus East	WS 4: Turning negative into positives! Exploiting "negative" results in Brain-Machine Interface research	
Nautilus West	WS 2: BCIs for assessment of locked-in and DOC patients	
	Refreshments	
9:00 - 12:00	2:00 Workshops Session 2 For presenters see details on page 14.	
7:30 - 9:00	Breakfast	Croker Dining Hall

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Acacia	WS 8: Eye tracking, vision, and BCI			
Marlin	WS 9: Natural language processing & BCI			
Merrill Hall	WS 11: BCI and augmented/virtual reality			
Curlew	WS 13: Recent developments in non-Invasive EEG sensor technology			
Triton	WS 17: Making use of the future of BCI implant technology			
Heather	WS 18: Clinical applications of Brain-Computer Interfaces in neurorehabilitation			
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12:00 - 13:00	Lunch Croker Dining Hall			
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13:15 - 16:15	Workshops Session 3 For presenters see details on page 15.			
	Refreshments			
Triton	WS 3: ECoG for control and mapping			
Nautilus West	WS 5: Real-time BCI communication for non-verbal individuals with cerebral palsy: Challenges and strategies for progress			
Nautilus East	WS 10: Tools for establishing neuroadaptive technology through passive BCIs			
Curlew	WS 12: Neurofeedback during artistic expression as therapy			
Merrill Hall	WS 16: Unsupervised learning for BCIs			
Heather	WS 20: Perception of sensation restored through neural interfaces			
Acacia	WS 21: From the lab into the wild: Shaping methods and technologies for large-scale BCI research			
Marlin	WS 24: Standards for neurotechnologies and Brain-Machine interfacing			
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16:30 - 17:30	Master Classes Session 2			
	See Master Class list on page 21			
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17:00 - 18:00	Women in BCI Cocktail Party			
BBQ Area & Fire Pit				
• • • • • • • • • • • • • • •				
18:00 - 19:00	Dinner Croker Dining Hall			
19:30 - 20:30	Closing Plenary Talks			
Merrill Hall	EEG-based BCI translation: Easy as one-two-three			
	Theresa M. Vaughan, B.A., National Center for Adaptive Neurotechnologies, Wadsworth Center, NYS Department of Health, USA			
	Intracortical BCIs and functional electrical stimulation: What is necessary for clinical translation?			
	A. Bolu Ajiboye, Ph.D., Case Western Reserve University and Louis Stokes Cleveland VA Medical Center, USA			
	Sponsored by Brain Products BRAIN PRODUCTS Solutions for neurophysiological research			

Daily Schedule

20:30 - 21:30 BCI Meeting Research Awards Ceremony

Merrill Hall Sponsored by Brain Products



Friday, May 25

7:30 - 9:00	Breakfast	Croker Dining Hall
9:00 - 11:00	Boxed lunch pic	ck up
Merrill Hall		

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Notes

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Workshops

Session 1 Wednesday May 23 • 9:00 - 12:00

WS 1: BCIs for stroke rehabilitation • HEATHER

Christoph Guger, g.tec medical engineering Kyousuke Kamada, Asahikawa University Milena Korostenskaja, Florida Hospital for Children David Lin, MGH Harvard José del R. Millán, Swiss Federal Institute of Technology in Lausanne (EPFL) Tetsuo Ota, Asahikawa University Vivek Prabhakaran, University of Wisconsin-Madison Radiology WIMR Michael Tangermann, University of Freiburg

WS 6: Progress in decoding speech processes using intracranial signals • ACACIA

Tonio Ball, University of Freiburg Jon Brumberg, University of Kansas Josh Chartier, UC San Francisco Christian Herff, University of Bremen Phil Kennedy, Neural Signals Inc. Dean Krusienski, Old Dominion University James O'Sullivan, Columbia University Stephanie Ries-Cornou, San Diego State University Efraim Salari, University Medical Center Utrecht Tanja Schultz, University of Bremen Blaise Yvert, University Grenoble Alpes

WS 7: Noninvasive BCI-control of FES for grasp restoration in high spinal cord injured humans • MARLIN

Gernot Müller-Putz, TU-Graz Joana Pereira, TU-Graz Rüdiger Rupp, Heidelberg University Hospital Andreea Sburlea, TU-Graz Alexandra Vuckovic, University of Glasgow

WS 14: Collaborative and competing multi-

brain BCI's • MERRILL HALL Chris Berka, Advanced Brain Monitoring

Fabien Lotte, Inria Tim Mullen, Intheon Anton Nijholt, University of Twente Davide Valeriani, University of Essex Jan van Erp, TNO

WS 15: ECoG based BCIs • CURLEW

Ayse Gunduz, Florida University Dora Hermes, Stanford University Kai Miller, Stanford University Gerwin Schalk, NCAN

WS 19: Examining ethical assumptions about neural engineering and BCI development

NAUTILUS EAST

Jane Huggins, Biomedical Engineering, University of Michigan

Judy Illes, National Core for Neuroethics, University of British Columbia

Paul Tubig, Center for Sensorimotor Neural Engineering, University of Washington

Laura Specker Sullivan, Center for Bioethics, Harvard University

Jonathan Wolpaw, Adaptive Center for Neurotechnology, Wadsworth Center

WS 22: Towards the elusive killer app for BCIs

NAUTILUS WEST

Brendan Allison, University of California San Diego
Christoph Guger, g.tec medical engineering
Jing Jin, East China University of Science and Technology
Angela Vujic, Massachusetts Institute of Technology

WS 23: User-centered design in BCI development: A broad perspective • TRITON

Erik J. Aarnoutse, University Medical Center Utrecht Ray Grott, San Francisco State University and RESNA Katya Hill, University of Pittsburgh Andrea Kübler, University of Würzburg Elmar G. Pels, University Medical Center Utrecht

WS 25: Lower-limb Brain-Machine Interfaces

and their applications • SANDERLING

Ricardo Chavarriaga, Swiss Federal Institute of Technology in Lausanne (EPFL)

José L. Contreras-Vidal, University of Houston

An Hong Do, University of California, Irvine

Kyuhwa Lee, Swiss Federal Institute of Technology in Lausanne (EPFL)

José Pons, Cajal Institute

Session 2

Thursday, May 24 • 9:00 - 12:00

WS 2: BCIs for assessment of locked-in

and DOC patients • NAUTILUS WEST

Damien Coyle, University of Ulster Christoph Guger, g.tec medical engineering Jing Jin, East China University of Science and Technology Kyousuke Kamada, Asahikawa Medical University Donatella Mattia, Fondazione Santa Lucia

WS 4: Turning negative into positives! **Exploiting "negative" results in Brain-Machine** Interface research • NAUTILUS EAST

Laurent Bougrain, LORIA

Ricardo Chavarriaga, Swiss Federal Institute of Technology in Lausanne (EPFL)

Moritz Grosse-Wentrup, Max Planck Institute for Intelligent Systems

Camille Jeunet, Swiss Federal Institute of Technology in Lausanne (EPFL)

Fabien Lotte, Inria

WS 8: Eye tracking, vision, and BCI • ACACIA

Brandon Eddy, Oregon Health & Science University Deniz Erdogmus, Northeastern University Melanie Fried-Oken, Oregon Health & Science University Michelle Kinsella, Oregon Health & Science University Boyla Mainsah, Duke University Betts Peters, Oregon Health & Science University Bruce Wojciechowski, Northwest Eye Care Professionals

WS 9: Natural language processing & BCI • MARLIN

Steven Bedrick, Oregon Health & Science University Shiran Dudy, Oregon Health & Science University Brian Roark, Google David Smith, Northeastern University

WS 11: BCI and augmented/virtual reality • MERRILL

Sergi Bermudez i Badia, University Madeira Josef Faller, Columbia University Christian Herff, University Bremen Dean Krusienski, Old Dominion University Jelena Mladenovic, Inria Bordeaux Tim Mullen, Intheon Felix Putze, University Bremen Hakim Si Mohammed, IRISA Nick Waytowich, US Army Research

WS 13: Recent developments in non-invasive EEG sensor technology • CURLEW

Chuck Anderson, Colorado State University Walter Besio, University of Rhode Island Walid Soussou, Quasar Fenghua Tian, University of Texas, Arlington

WS 17: Making use of the future of BCI implant technology • TRITON

Erik J. Aarnoutse, University Medical Center Utrecht Timothy Denison, Medtronic Luca Maiolo, CNR-IMM Samantha Santacruz, University of California, Berkeley

WS 18: Clinical applications of Brain-Computer Interfaces in neurorehabilitation • HEATHER

An H. Do, University of California Karunseh Ganguly, University of California Spencer Kellis, California Institute of Technology Evgeniy Kreydin, University of Southern California Charles Liu, University of Southern California Zoran Nenadic, University of California Marc Slutzky, Northwestern University



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Session 3

Thursday, May 24 • 13:15 - 16:15

WS 3: ECoG for control and mapping • TRITON

Christoph Guger, g.tec medical engineering
Jing Jin, East China University of Science and Technology
Kyousuke Kamada, Asahikawa University
Milena Korostenskaja, Florida Hospital for Children
Kai Miller, Stanford University

WS 5: Real-time BCI communication for non-verbal individuals with cerebral palsy: Challenges and strategies for progress • NAUTILUS WEST

James A. Blackman, Cerebral Palsy Alliance Research Foundation

Christian Herff, University of Bremen Katya Hill, University of Pittsburgh Jane Huggins, University of Michigan Adam Kirton, University of Calgary

WS 10: Tools for establishing neuroadaptive technology through passive BCIs • NAUTILUS EAST

Lena M. Andreessen, Technische Universität Berlin Olva Krigolson, University of Victoria Laurens R. Krol, Technische Universität Berlin David Medine, Brain Products Martijn Schreuder, ANT Neuro Thorsten O. Zander, Zander Laboratories

WS 12: Neurofeedback during artistic expression

as therapy • CURLEW

Chuck Anderson, Colorado State University Juliet King, Indiana University School of Medicine Grace Leslie, Massachusetts Institute of Technology Rosa Mikeal Martey, Colorado State University Stephanie Scott, Colorado State University

WS 16: Unsupervised learning for BCIs • MERRILL

David Hübner, University of Freiburg
Iñaki Iturrate, Swiss Federal Institute of Technology in Lausanne (EPFL)
Pieter-Jan Kindermans, Google
Michael Tangermann, University of Freiburg

WS 20: Perception of sensation restored through neural interfaces • HEATHER

Luke Bashford, California Institute of Technology Sliman Bensmaia, University of Chicago David Caldwell, University of Washington Jennifer Collinger, University of Pittsburgh Rob Gaunt, University of Pittsburgh Tucker Tomlinson, Northwestern University Dustin Tyler, Case Western Reserve University

WS 21: From the lab into the wild: Shaping methods and technologies for large-scale BCI research • ACACIA

Alexandre Barachant, Ctrl-Labs Moritz Grosse-Wentrup, Ludwig Maximilians Universität München Matthias Hohmann, Max Planck Institute for Intelligent Systems Vinay Jayaram, Max Planck Institute for Intelligent Systems AJ Keller, Push the World Tim Mullen, Intheon Conor Russomanno, OpenBCI

WS 24: Standards for neurotechnologies and Brain-Machine Interfacing • MARLIN

Walter Besio, University of Rhode Island Carole Carey, IEEE EMBC Ricardo Chavarriaga, Swiss Federal Institute of Technology in Lausanne (EPFL) José Contreras-Vidal, University of Houston Tim Mullen, Intheon

Ander Ramos-Murguialday, University of Tübingen

Plenary Talks and Keynote Sessions

All Plenary Talks and Keynote Sessions will take place in Merrill Hall.

Monday, May 21

19:30 - 20:30 **Opening Talks**

David A. Burton, Ph.D., Brown Institute for Brain Science, and Department of Veterans Affairs, Center for Neurorestoration and Neurotechnology, USA

Responsive neuromodulation for a dynamic and distributed mental state

Abstract: Selecting and acting on salient features among a complex, dynamic environment is a critical



skill of all animals, including humans, in order to survive and thrive. The ability to both accumulate sufficient evidence to accurately estimate the probability of success and then to appropriately balance the reward and risks associated with the decision are key features of successful action selection and actuation, and must occur rapidly, within a diverse and changing environment. Although the human nervous system operates at the millisecond timescale, current neuromodulation treatments to nearly all neurological insults and injury are titrated over weeks to months. Electrophysiological interrogation of the nervous system is today limited by our inability to probe the brain at high spatial and temporal precision, and across large spatial and temporal scales. For example, deep-brain stimulation (DBS) treatment for Parkinson's Disease, Essential Tremor, and Obsessive-Compulsive Disorder is set and adjusted through infrequent visits by the patient to a trained physician. Likewise, epidural electrical stimulation of the spinal cord (SCS) for treatment of pain is titrated via infrequent visits to clinics and often utilizing constant rates of stimulation. A more responsive form of DBS and SCS could offer improved therapy by sensing changes in neural activity, or biomarkers of disease, and then adjusting the amplitude, frequency, or pattern of stimulation in response. Such a system should ideally be able to detect the onset of intended movement or pathological network activity and then act within a meaningful timeframe to provide effective titration of treatment. In this talk, I will discuss prior work on developing responsive spinal cord neuromodulation platform for the recovery of lower limb function after spinal cord injury. I will then discuss our more recent efforts to migrate such concepts to the treatment of severe Obsessive-Compulsive Disorder in humans. Finally, I will discuss technological challenges and opportunities we are pursuing that may provide observation of, and interaction with, the nervous system at the cellular level across many areas of the brain simultaneously, paving the way for new neuroscience discoveries and therapeutic opportunities.

Biodata: David Borton received his B.S. in Biomedical Engineering from Washington University in St. Louis in 2006 and his PhD in Bioengineering from Brown University in 2012. David Borton is an Assistant Professor of Biomedical Engineering at Brown University School of Engineering (SOE), the Brown Institute for Brain Science (BIBS), and a Biomedical Engineer at the Providence Veterans Affairs Center for Neurorestoration and Neurotechnology (CfNN). Prof. Borton leads an interdisciplinary team of researchers focused on the design, development, and implementation of novel neural recording and stimulation systems. His research enables basic science innovation through technological integration and implementation of novel devices. Prof. Borton currently focuses on engineering new tools for wireless interrogation of the nervous system with a goal of untangling the underpinnings of neuromotor disease and injury. Prof. Borton was recently awarded the Defense Advanced Research Projects Agency (DARPA) Young Faculty Award in 2015 and the DARPA Director's Award in 2017. His laboratory is currently supported by the U.S. Department of Defense, National Institute of Neurological Disorders and Stroke, the National Institute of Mental Health, the International Research in Paraplegia Foundation, and several industry contracts. His work was featured in the journal Nature demonstrating that through wireless neurotechnology, brain recordings can be used to help spinal cord injury subjects walk again. He performed his postdoctoral research at the Ecole Polytechnique in Lausanne Switzerland (EPFL) under a Marie Curie International Fellowship.

Cuntai Guan, Ph.D., School of Computer Science and Engineering, Nanyang Technological University, Singapore

Brain-Computer Interfaces for stroke rehabilitation

Abstract: Stroke is the leading cause of severe disabilities in many countries. Upper limb weakness and loss of hand function are among the most devastating types of



disabilities. In the past two decades, concerted efforts have been put into the search for effective therapies to help stroke patients to restore their motor functions. Brain-Computer Interfaces (BCIs) have emerged to be one of the promising approaches which have been extensively explored in the past decade or so. In this talk, we first introduce several studies we have conducted in the past years, from system development to clinical trials and neuroimaging analysis. We will try to discuss some further hypotheses for future research in this direction.

Biodata: Prof Cuntai Guan is a Professor in the School of Computer Science and Engineering, Nanyang Technological University and Co-Director of the Rehabilitation Research Institute of Singapore. His research interests are in the fields of Brain-Computer Interfaces, Neural Engineering, Machine Learning, Data Analytics, and Neuro-technologies. He published more than 300 journal and conference papers and holds more than 20 international patents and patent applications. He is an Associate Editor for IEEE Transactions on Biomedical Engineering, IEEE Access, Frontiers in Neuroscience, Brain Computer Interfaces, and Guest-Editor for the IEEE Computational Intelligence Magazine. He is the recipient of the Annual BCI Research Award, the IES Prestigious Engineering Achievement Award, Achiever of the Year (Research) Award, Finalist of President Technology Award, National Infocomm Award and top winner of International BCI Competitions. He is a Fellow of IEEE.

20:30 - 21:45

Neuroethics Session

Blaise Agüera y Arcas, Machine Intelligence, Google, USA **Judy Illes**, CM, Ph.D., Director of Neuroethics Canada, University of British Columbia, Canada

Jonathan R. Wolpaw, M.D., Director of the National Center for Adaptive Neurotechnologies, Wadsworth Center, USA







Blaise Agüera y Arcas Judy Illes

Jonathan R. Wolpaw

Ethical Issues in BCI research and development: Recognition and response

BCIs and other neurotechnologies establish interactions with the brain that are unprecedented in their potential intimacy and precision. They thereby raise difficult, often unique, ethical issues. Blaise Aguera y Arcas will address issues of privacy and consent, including protection of access to one's neural data, prevention of unwanted influences on neural activity, and appropriate rules and procedures for allowing such access or influence. Jon Wolpaw will consider how BCIs modify concepts of identity and agency, how they are likely to affect personal and societal perceptions of identity and agency, and how these concepts and perceptions should influence, and perhaps constrain, BCI research. Judy Illes will discuss the process of integrating ethical principles into BCI research, the progress of this endeavor to date, and the measures that can best ensure effective integration of ethical principles into future BCI research, development, and dissemination.

Tuesday, May 22

11:15 - 12:15

BCI Users Forum: The Unmet Need

Coordinated by **Theresa M. Vaughan**, B.A., National Center for Adaptive Neurotechnologies, Wadsworth Center, NYS Department of Health, USA

A panel discussion of the strengths and limitations of BCI technology including commentary by actual and potential BCI users like Mrs Hanneke de Bruijne, health care providers and BCI researchers focusing on how BCI technology might improve the user's quality of life.

Mrs Hanneke de Bruijne is the first person with Locked-in Syndrome to have a BCI implanted for communication at home, as participant in the Utrecht NeuroProsthesis (UNP) project. She has been using the system, as one of her AT devices, for over 2 years without dependence on expert help. She will talk about her experience with the 'UNP' implant (online connection to the Netherlands).

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19:30 - 20:30

Panel of Funding Officers

Coordinated by **David E. Thompson**, Ph.D., Kansas State University, USA

The panel will start with brief introductions by each funding officer with the top funding priorities for their agencies, the answers to pre-submitted questions and/or a few "I bet you didn't know" facts about their agency.

National Institutes of Health (NIH), National Institute of Neurological Disorders and Stroke (NINDS)

Area of interest: Neural engineering with emphases in neuroprostheses, neuromodulation, brain-computer interface (BCI) devices, prosthetic control, and neural interface technology development

Nick B. Langhals, Ph.D.

Program Director for Neural Engineering Team Lead for BRAIN and SPARC

National Institutes of Health (NIH), National Institute on Deafness and Other Communication Disorders

Areas of interest: Biomedical engineering, neural prostheses, tinnitus

Roger Miller, Ph.D.

Program Director for Neural Prosthesis Development Program Coordinator, Small Business Innovation Research (SBIR)/ Small Business Technology Transfer (STTR)

Defense Advanced Research Projects Agency (DARPA) Al Emondi, Ph.D.,

Program Manager, Biological Technologies Office

Plenary Talks and Keynote Sessions

20:30 - 21:30

Industry Session

Mark A. Chevillet, Ph.D., Research Director, Facebook, USA

Designing a wearable silent speech BCI

Biodata: Mark A. Chevillet is a Research Director at Facebook, directing a portfolio of technology development projects focused on rapidly translating contemporary research results into viable commercial



products. Dr. Chevillet joined Facebook in 2016 as a Technical Project Lead in Facebook's Building 8, where he initiated the project to develop a wearable silent speech interface featured in the 2017 F8 developers conference and recently covered by news outlets including The Economist, IEEE Spectrum, and The Wall Street Journal.

Prior to joining Facebook, Mark was a Program Manager for Applied Neuroscience at The Johns Hopkins University Applied Physics Laboratory. In this capacity, he led teams of scientists and engineers in a diverse array of projects including the development of neural prosthetics, improving our understanding how speech and semantic information is encoded in the human brain, and building data science tools for mapping all the synaptic connections amongst hundreds of thousands of neurons using computer vision. Dr. Chevillet held joint appointments at Johns Hopkins University as Research Assistant Professor in the Departments of Neuroscience and Cognitive Science, was a member of the steering committee for the JHU Science of Learning Institute, and was a member of the Kavli Neuroscience Discovery Institute.

Dr. Chevillet earned his B.S. in Physics with a Minor in Mathematics from Washington State University where he studied optoelectronics and polymer optical waveguides, and his Ph.D. in Neuroscience from Georgetown University where he studied the neural computations underlying speech perception in human auditory cortex. **Timothy Denison**, Ph.D., Vice President, Research & Core Technology, Restorative Therapies Group Medtronic, Inc., USA

Platform "BCI" research tools and deployment strategies to accelerate translational discovery

Abstract: Neurological disease has a significant impact at the personal, economic, and societal levels. Brain



disease alone affects well over 100M people globally and is a major contributor to the cost of healthcare; diseases such as Stroke, Brain Tumor, Parkinson's disease, Epilepsy, Brain Injury, Alzheimer's, and Depression rank among the leading causes of death and disability in the world. While promising in-roads for treatment have been made for some conditions, engineers can help play a key role in developing new therapy concepts and bringing them to the clinical market to address critical unmet needs.

Reflecting on the evolution of medical technology, there are many parallels between the current state of most neuromodulation therapies and early cardiac pacing devices. The first generation of cardiac pacemakers operated as "metronomes," asynchronously delivering fixed-rate stimulation regardless of the intrinsic heart function. In a similar way, the first generation of neuromodulation systems used adapted circuits from cardiac pacers to provide tonic, fixed-rate stimulation to discrete neural circuits, leveraging electrode locations that were derived from established stereotactic neurosurgical targets for radiofrequency lesioning. Technological developments in cardiac systems have since evolved to include onboard diagnostics, programmability, and responsive pacing, which are all supported by a foundational understanding of the heart and its bioelectrical properties. As neuroengineers look to advance the treatment of neurological disease using similar technology concepts, the field needs to establish a similar physiological basis for how the nervous system operates, goes awry with disease, and how interventions might restore function.

For the many neurological diseases, the mechanism of action for therapy is still not yet completely clear, which confounds the optimization of the medical technology. To help bridge translation of devices across these unknowns, teams are creating investigational research tools that can be chronically implanted as part of existing care pathways. These new tools, including bi-directional brain-computer-interface technology, permit the active probing of diseased neural circuits by observing how they respond to both electrical and concomitant pharmaceutical interventions. The platforms are enabled by a system architecture that harnesses an existing neurostimulator's capability to provide instrumentation with chronic access to the nervous system, while seamlessly maintaining the predicate therapy capability. Deployed with clinicianresearcher collaborators, these instrumentation toolkits can bootstrap off existing clinical care pathways to facilitate exploration of novel therapeutic concepts and generate a pipeline of innovations.

This talk will provide a technical perspective on the state-of-theart, promising areas for exploration, and challenges that remain. **Biodata**: Tim Denison is a Technical Fellow at Medtronic PLC and Vice President of Research & Core Technology for the Restorative Therapies Group, where he helps oversee the design of next generation neural interface and algorithm technologies for the treatment of chronic neurological disease. In 2012, he was awarded membership to the Bakken Society, Medtronic's highest technical and scientific honor, and in 2014 he was awarded the Wallin leadership award. In 2015, he was elected to the College of Fellows for the American Institute of Medical and Biological Engineering (AIMBE). Tim received an A.B. in Physics from The University of Chicago, and an M.S. and Ph.D. in Electrical Engineering from MIT. He recently completed his MBA at Booth, The University of Chicago.

Thursday, May 24

19:30 - 20:30

Closing Talks

Theresa M. Vaughan, B.A., National Center for Adaptive Neurotechnologies, Wadsworth Center, NYS Department of Health, USA

EEG-based BCI translation: Easy as one-two-three

Abstract: The National Center for Adaptive Neurotechnologies (NCAN) and Helen Hayes Hospital have developed and translated a portable 8-

channel EEG-based BCI system into daily use by BCI users and their caregivers. We have installed 39 BCI systems in the homes of individuals with ALS. Twenty-two individuals (56%) used their BCI independently. Eight individuals (20%) used BCI as their sole source of autonomous communication and computer control. We now seek to provide tools, training, and support for clinicians interested in providing BCI to their own patients. To date, we have trained clinicians from 10 institutions to perform BCI evaluations and we continue to develop tools that can provide more intuitive access to BCI technology. Our goal is a network of clinicians who can provide BCI technology to their own patients (with tier-two technical support from NCAN), and share data and best practice. The results of this work indicate that: an EEG-based BCI can be effective in independent use by people in their homes; this BCI can be provided to clinicians who then evaluate and train their own patients; and data collected in this manner and shared can yield valuable new insights concerning BCI research and development.

Biodata: Theresa Vaughan is a research scientist at the National Center for Adaptive Neurotechnologies (NCAN) in the Wadsworth Center located in Albany, New York. She has thirty years of experience in clinical research studies, 25 years focused specifically on brain-computer interfaces (BCIs) as new communication channels for people with severe motor disabilities. In 2006, She helped found the Center for Translational Neurological Research, a partnership between the NCAN and the Helen Hayes Rehabilitation Hospital. Since then her work has focused on translating BCI communication and control to the bedside.

A. Bolu Ajiboye, Ph.D,

Assistant Professor of Biomedical Engineering, Case Western Reserve University and Research Scientist, Louis Stokes Cleveland VA Medical Center, FES Center of Excellence, USA

Intracortical BCIs and functional electrical stimulation: What is necessary for clinical translation?



Abstract: Advances in intracortical brain-computer interfaces (iBCls) and neuroprosthetics research have allowed persons with chronic tetraplegia to regain control of functional reaching and grasping, via robotic limbs and now recently using their own paralyzed arm and hand, reanimated through functional electrical stimulation (FES). Previous FES systems for restoring reaching and grasping have relied on variants of state-based command schema to perform multi-dimensional movements of the hand, wrist, elbow, and shoulders. Our recent work shows an individual with chronic tetraplegia commanding continuous multi-dimensional movements of his paralyzed limb, to perform function reaching and grasping tasks such as drinking and selffeeding. This lab-based demonstration, like many others, offer a glimpse into what is possible with iBCIs and neuroprosthetic systems. However, much more needs to be done to move these systems beyond lab demonstrations to be truly ready for athome day-to-day use. In this talk, I will discuss both the clinical benefits of the FES+iBCI system, and scientific and technological advances across the field that are moving these technologies toward viable public adoption.



2018 Student Awards

The following are the recipients of the 2018 BCI Meeting Student Award. The award is sponsored by the National Institutes of Health NIDCD, NINDS and the National Science Foundation with support from IEEE Brain Initiative and OpenBCI.

Miguel Angrick, University of Bremen Yuri Antonacci, Sapienza University of Rome Ruslan Aydarkhanov, Ecole Polytechnique Fédérale de Lausanne (EPFL) Julia Berezutskaya, Brain Center Rudolf Magnus, UMC Utrecht Gregory Canal, Georgia Institute of Technology Maria Cervera de la Rosa, Ecole Polytechnique Fédérale de Lausanne (EPFL) Kuan-Jung Chiang, SCCN / UCSD Sam Colachis, The Ohio State University Emma Colamarino, Sapienza University of Rome Tiffany Corbet, Ecole Polytechnique Fédérale de Lausanne (EPFL) Katie Dhuyvetter, Kansas State University Karen Dijkstra, Radboud University Nir Even-Chen, Stanford University Fatemeh Fahimi, Nanyang Technological University Robert Flint, Northwestern University Mélodie Fouillen, Lyon Neuroscience Research Center Bruna Girvent, Northeastern University Paula Gonzalez Navarro, Northeastern University Bijay Guragain, University of North Dakota Yu Hao, Cornell University Luis Guillermo Hernandez Rojas, Tecnológico de Monterrey Angelica Herrera, University of Pittsburgh Sheng-Hsiou Hsu, UC San Diego David Hübner, Albert-Ludwigs-University Freiburg Christopher Hughes, University of Pittsburgh Sarah Ismail Hosni, University of Rhode Island Zeanna Jadavji, University of Calgary Roohollah Jafari Deligani, University of Rhode Island Eli Kinney-Lang, University of Edinburgh

Reinmar Kobler, Graz University of Technology Koji Koizumi, The University of Tokyo Laurens Krol, Technische Universität Berlin Srdian Lesaja, Old Dominion University Hadar Levi Aharoni, The Hebrew University of Jerusalem Jinling Lian, Beijing Institute of Technology Jeffrey Lim, University of California, Irvine Ravikiran Mane, Nanyang Technological University Jianjun Meng, University of Minnesota Jelena Mladenovic. Potioc Inria Mahta Mousavi, UC San Diego Md Rakibul Mowla, Kansas State University Sebastian Nagel, University of Tübingen Brett Paffrath, Alberta Children's Hospital Elmar G. Pels, Brain Center Rudolf Magnus, UMC Utrecht Yufan Peng, University of Macau Joana Pereira, TU-Graz Nina Petric-Gray, University of Glasgow Léa Pillette, Inria LaBRI Luca Pion-Tonachini, UC San Diego Sriram Ravindran, UC San Diego Sébastien Rimbert. Inria Dylan Royston, University of Pittsburgh Efraim Salari, University Medical Center Utrecht Soshi Samejima, University of Washington Eliana Santos, Federal University of ABC Jan Sosulski, University of Freiburg Sarah Thomas, University of Kentucky Eric Trautmann, Stanford University Federica Turi, Inria Sophia Antipolis Mediterranée Mukta Vaidya, Northwestern University Ceci Verbaarschot, Radboud University Ko Wonjun, Korea University Xiaoqian Yu, University of South Florida Xixie Zhang, Technical University of Berlin



National Institutes of Health Turning Discovery Into Health







Master Classes

We are offering 8 one-hour Master Classes during which two students will present their work to receive constructive comments and discussion from the "master" and the audience. All are welcome to participate as an audience member.

Master Class Session 1

Wednesday, May 23 • 19:30 - 20:30

Master Class 1 ACACIA

Lead by José del R. Millán

Using a convolutional neural network for improved click detection in an implanted BCI setup

Julia Berezutskaya, Brain Center Rudolf Magnus, UMC Utrecht

A comparison of oddball and deterministic paradigms for ERP-based brain computer interfaces Bruna Girvent, Northeastern University

Master Class 2 MARLIN

Lead by Nick Ramsey

Modelling causal connectivity from EEG for BCI with multi-direction hand movements

Tushar Chouhan, Nanyang Technological University

Towards gut-brain computer interfacing: Gastric myoelectric activity as an index of subcortical phenomena Angela Vujic, Massachusetts Institute of Technology

Master Class 3 NAUTILUS EAST

Lead by Andrea Kübler

Dynamic emotion transition detection for affective BCI Yu Hao, Cornell University

Towards generating a task-independent workload classifier with EEG Xixie Zhang, Technical University of Berlin

Master Class 4 NAUTILUS WEST

Lead by Jane Huggins

Exploring mental state changes during hypnotherapy using adaptive mixture independent component analysis Sheng-Hsiou Hsu, University of California San Diego

Finding optimal stimulation patterns for BCIs based on visual evoked potentials

Sebastian Nagel, University of Tübingen

Master Class 5 TRITON

Lead by Donatella Mattia

A novel Brain-Machine Interface for controlling dynamic systems

Jinling Lian, Beijing Institute of Technology

EEG predictors for upper limb motor recovery of stroke patients undergoing BCI and tDCS rehabilitation Ravikiran Mane, Nanyang Technological University

Master Class Session 2

Thursday, May 24 • 16:30 - 17:30

Master Class 6 NAUTILUS WEST

Lead by Christoph Guger

A comparison of tri-polar concentric ring electrodes to disc electrodes for decoding real and imaginary fingers movements

Saleh Alzahrani, Colorado State University

Steps towards sensitizing EEG feature identification in paediatric brain signals for use in BCIs Eli Kinney-Lang, University of Edinburgh

Master Class 7 MARLIN

Lead by Marc Slutzky

Self-paced upper limb movement intention recognition from EEG signals

Luis Guillermo Hernandez Rojas, Tecnológico de Monterrey

Case study: Eye movement related motor activity overlaps with hand-knob area in late stage ALS patient Sacha Leinders, Brain Center Rudolf Magnus, UMC Utrecht

Master Class 8 NAUTILUS EAST

Lead by Jonathan Wolpaw

Development of cognitive Brain-Machine Interface based on visual imagery

Koji Koizumi, The University of Tokyo

Parametric EEG signal model for BCIs with the rapid-trial paradigm

Yeganeh Marghi, Northeastern University

Exhibitor Demonstrations

Session 1	Tuesday, May 22	9:00-11:00
Session 2	Tuesday, May 22	15:30-17:30
Session 3	Wednesday, May 23	15:30-17:30

ANT Neuro

Session 3: Demonstration with a dry-electrode cap of a P300 speller from Inria Sophia Antipolis, using OpenViBE software

Brain Products

At all sessions:

Compare Electrodes for BCI+ applications: The performance and applicability of a BCI largely depends on the hardware setup. At the Brain Products booth, you can hands-on try BCI performance with 6 different electrode types. Choose between the actiCAP (active gel based), actiCAP Twist (active dry), R-Net (water based sponge), CRE medical electrodes (tEEG, gel based concentric ring electrodes), BrainCap (passive gel), or our Hydrogel Headset (passive solid gel). You want even more options? You can combine the electrodes with our 4 different amplifiers and try out the integration in 3 different BCI software packages.

Multi-subject / Hyperscanning with LSL for BCI+: We will demonstrate how to record EEG from 2 subjects simultaneously and synchronise the two data streams online.

Multi-modal recording with LSL for BCI+: Modern BCIs often combine more than one signal modality. We will show you how to easily integrate different signal sources using LSL. As an example, we will demonstrate a multi-modal recording of wireless EEG data from our LiveAmp, combined with eyetracking data from a Tobii eyetracker.

g.tec

Session 1:g.Nautilus 64 channelsSession 2:g.Nautilus-fNIRSSession 3:Closed loop stimulation with FES

Intheon

At all sessions: Building "anytime, anywhere" BCI applications for mobile, AR/VR, and desktop using the Intheon platform Synchronized multi-modal signal processing and state decoding

in real-time

Multi-brain-computer interfacing with the Intheon

Neuromore

Session 1: An introduction to drag and drop visual programming - a short course in Neuromore open source real-time signal processing pipeline

- Session 2: Advanced real-time EEG analysis and visualizations using Neuromore open source
- **Session 3:** Advanced real-time EEG analysis and visualizations using Neuromore open source

OpenBCI

- Session 1: NEBA Health (powered by OpenBCI) The FDA clearance process for EEG (or similar) devices
- Session 2: Using the OpenBCI platform Intro to hardware, software, and more!
- Session 3: Wireless communication of biometric data DOs and DON'Ts

Puzzlebox

At all sessions:

The "Gimmick" is a new hardware technology by Puzzlebox which allows BCIs and other wearables to integrate with AAA video games and control toys and other physical devices for entertainment and therapeutic purposes.

Wearable Sensing / Neuracle

At all sessions:

Wireless Dry Sensor EEG headsets for VR and BCI research Wireless High-Density EEG systems for BCI applications Synchronized MultiModal Wearable Sensor Suite

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The poster board numbers work in the following way: Session - BCI Area - Board number (e.g. **1-A-1**)

Location of individual poster boards indicated on the poster board floor plans at the back of the program.

BCI Areas

- A BCI Implant Control
- B BCI Implant Other
- C BCI Non-Invasive Control
- **D** BCI Non-Invasive Other
- E Signal Acquisition
- F Signal Analysis
- **G** User Aspects: Experience, Ethics
- H 2018 BCI Award Nominees

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Poster Sessions

The BCI Society is pleased to present a wide range of current research through the poster sessions. The posters have been divided over three sessions.

Session 1:	Tuesday May 22:	09:00 - 11:00
Session 2:	Tuesday May 22:	15:30 - 17:30
Session 3:	Wednesday May 23:	15:30 - 17:30

The poster numbers are identified first by session, then by BCI area and finally with a unique number. Session – BCI Area – Board Number (ex. **1-A-1**).

The location of individual posters is indicated on the poster board floor plans at the back of the program.

Session 1 Tuesday, May 22 • 9:00-11:00

A. BCI Implant - Control

1-A-1 Thinking outside the Motor Cortex: Adding prefrontal cortex activity enhances decoding performance of a fully implanted motor cortex BCI

Erik Aarnoutse¹, Anouck Schippers¹, Sacha Leinders¹, Elmar G. M. Pels¹, Mariska Vansteensel¹, Mariana Branco¹, Nick Ramsey¹, Zachary Freudenburg¹

¹Brain Center Rudolf Magnus, University Medical Center Utrecht

1-A-2 Decoding grasps from supramarginal gyrus and ventral premotor cortex in tetraplegic human

Mariusz Furmanek¹, Mathew Yarossi¹, Luis Schettino², Sergei Adamovich³, Eugene Tunik¹

 $^1\!Northeastern$ University, $^2\!Lafayette$ College, 3New Jersey Institute of Technology

1-A-3 Brain controlled epidural spinal interface reanimating forelimb function in spinal cord injury

Soshi Samejima¹, Abed Khorasani¹, Adrien Boissenin¹, Vaishnavi Ranganathan¹, Joshua Smith¹, Chet Moritz¹

¹University of Washington

1-A-4 Using a convolutional neural network for improved click detection in an implanted BCI setup

Julia Berezutskaya¹, Zachary Freudenburg¹, Erik Aarnoutse¹, Mariska Vansteensel¹, Sacha Leinders¹, Elmar G. M. Pels¹, Nick Ramsey¹ ¹Brain Center Rudolf Magnus, University Medical Center Utrecht

1-A-5 Simple vs. complex brain computer interfaces for restoring upper limb function via neuromuscular stimulation

Dawn Taylor 1, Tyler Johnson 2, Frank Willett 2, Harrison Kalodimos 2, Vishhvaan Gopalakrishnan 3

¹Cleveland Clinic & Louis Stokes Cleveland VA Medical Center, ²Cleveland Clinic / Cleveland VA Medical Center /Case Western Reserve University, ³Cleveland Clinic

Please note that posters with an uneven end number (1-A-1, 1-A-3, etc.) will be presented during the first hour of the poster session. Posters with an even end number (1-A-2, 1-A-4, etc.) will be presented in the second hour of the poster session.

BCI Areas

- A BCI Implant Control
- B BCI Implant Other
- C BCI Non-Invasive Control
- D BCI Non-Invasive Other
- E Signal Acquisition
- F Signal Analysis
- **G** User Aspects: Experience, Ethics
- H 2018 BCI Award Nominees

B. BCI Implant - Other

1-B-6 Primary motor cortex encodes a value function consistent with reinforcement learning that can be used for an autonomously updating BMI

Joseph Francis¹, Venkata S Aditya Tarigoppula¹, John Choi², John Hessburg³, David McNiel³, Brandi Marsh³

¹University of Houston, ²NYU, ³SUNY Downstate Medical Center

1-B-7 Injecting instructions into premotor cortex using intracortical microstimulation – implications for cortico-cortical BCI systems

Kevin Mazurek¹, Marc Schieber¹

¹University of Rochester

1-B-8 Augmenting intracortical brain-computer interfaces in monkeys and humans with neurally driven error detectors

Nir Even-Chen¹, Sergey Stavisky¹, Jonathan Kao², Chethan Pandarinath³, Paul Nuyujukian¹, Stephen Ryu¹, Leigh Hochberg⁴, Jaimie Henderson¹, Krishna Shenoy¹

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1-B-9 Retrospective analysis of the effects of nonstationarities on decoding performance in people using an intracortical brain computer interface

David Brandman¹, Thomas Hosman¹, Jad Saab¹, Jessica Kelemen², Brian Franco², Leigh Hochberg¹, John Simeral³

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C. BCI Non-Invasive - Control

1-C-10 Integrating EEG and MEG information to enhance motor imagery classification in brain-computer interface

Marie-Constance Corsi¹, Mario Chavez², Denis Schwartz³, Laurent Hugueville³, Ankit Khambhati⁴, Danielle Bassett¹, Fabrizio De Vico Fallani¹

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1-C-11 A dynamic Chinese character writing based hybrid BCI paradigm for stroke rehabilitation

Cili Zuo¹, Yangyang Miao¹, Jing Jin¹ ¹East China University of Science and Technology

$\ensuremath{\text{1-C-12}}$ Query exploration for intended task state estimation with BCI

Aziz Kocanaogullari¹, Paula Gonzalez -Navarro¹, Tab Memmott², Betts Peters³, Murat Akcakaya⁴, Deniz Erdogmus¹

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1-C-13 A novel detection method of driving emergency situations using EEG and surroundings

Luzheng Bi¹, Huikang Wang¹, Jinling Lian¹

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1-C-14 Reducing calibration time in BCI using transfer learning in classification domain

Ahmed Azab¹, Lyudmila Mihaylova¹, Mahnaz Arvaneh¹

¹University of Sheffield

1-C-15 Co-adaptive learning improves efficacy of multi-day EEG-based motor imagery BCI Training

Oren Shriki¹, Eyal Zakkay¹, Lior Shmuelof¹, Amjad Abu-Rmileh¹ ¹Ben-Gurion University of the Negev

1-C-17 Developing a streaming-based P300 BCI paradigm with auditory and tactile stimuli: Effects of training on efficiency, effectiveness and satisfaction

Philipp Ziebell¹, Jana Stümpfig¹, Sonja Kleih¹, Andrea Kübler¹, Marc Erich Latoschik¹, Sebastian Halder²

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1-C-18 A novel BCI speller combining dot-based visual stimuli and user voluntary sound-imagery task

Hong-Kyung Kim¹, Min-Ho Lee¹, Seong-Whan Lee¹

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1-C-19 Development of cognitive brain-machine interface based on visual imagery

Koji Koizumi¹, Kazutaka Ueda¹, Masayuki Nakao¹

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1-C-20 Answering questions in prolonged disorders of consciousness with a brain-computer interface

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1-C-21 Habituation of P300 in the use of P300-based braincomputer interface (BCI)

Xiaoqian Yu¹, Theresa M Vaughan², Emanuel Donchin¹

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1-C-22 The value-complexity trade-off for reinforcementlearning-based BCI

Hadar Levi Aharoni¹, Michal Moshkovitz¹, Stas Tiomkin¹, Bar Iluz¹, Sarel Duanis¹, Naftali Tishby¹

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D. BCI Non-Invasive - Other

1-D-23 Prediction of individual user's suitability for passive BCI applications using short resting EEG recordings

Ho-Seung Cha¹, Chang-Hwan Im¹

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1-D-24 A new paradigm for movement detection of self-paced movement imagination using movement-related cortical potentials

Joana Pereira¹, Andreea Sburlea¹, Gernot Müller-Putz¹

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1-D-25 Robustness of single-hand classification against other-hand activity in EEG

Christian Niethammer¹, Wolfgang Rosenstiel¹, Martin Spüler¹ ¹University of Tübingen

1-D-26 A new BCI-based rehabilitation possibility: Sensorimotor rhythm amplitude control affects the size of a spinal reflex

Hanna Carruth¹, Rachel Haywood¹, Jeremy Hill², William Sarnacki³, Lynn M McCane⁴, Jonathan R Wolpaw⁴, Dennis J McFarland⁴

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1-D-27 A ternary hybrid EEG-NIRS brain-computer interface for the classification of brain activation patterns during mental arithmetic, motor imagery, and idle state

Jinuk Kwon¹, Jaeyoung Shin¹, Chang-Hwan Im¹

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1-D-28 EEG-based neglect assessment

Murat Akcakaya¹, Aya Khalaf¹, Safaa Eldeeb¹, Jessica Kersey, Gazihan Alankus², Emily Grattan³, Laura Waterstram¹, Elizabeth Skidmore¹

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1-D-29 Brain-computer interface in virtual reality

Reza Abbasi Asl¹, Mohammad Keshavarzi¹, Dorian Yao Chan¹ ¹University of California, Berkeley

1-D-30 Motor imagery classification based on deep convolutional neural network and its application in human-robot interaction

Taochun Zhou¹, Shiwei Cheng¹

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1-D-31 Effects of positive and negative reinforcement on performance accuracy in behavioral and P300 speller-based sound discrimination tasks

Owen Adams¹, Daniele Ortu¹, Traci Cihon¹

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1-D-32 EEG-based visual attentional state decoding using convolutional neural network

Soheil Borhani¹, Reza Abbasi Asl², Jabril Ibrahim Muhammad¹, Yang Jiang³, Xiaopeng Zhao¹

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Poster Sessions

1-D-33 Effect of stimulation frequency band on SSVEP-based BCI

Ga-Young Choi¹, Soo-In Choi¹, Hyung-Tak Lee¹, Hyun-Wook Kim¹, Jae-Hong Jang¹, Han-Jeong Hwang¹

¹Kumoh National Institute of Technology

1-D-34 EEG assisted VR streaming: Reducing delays by predicting head rotation

Anne-Marie Brouwer¹, Jasper van der Waa¹, Hans Stokking¹ ¹TNO

1-D-35 EEG fatigue classifier for distracted driving

Leili Tavabi¹, Nazgol Tavabi¹, Marissa Powers², Bruna Girvent³, Esther Jun Kim⁴, Hector Cordourier Maruri², Olufemi Oluwafemi²

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1-D-36 Fronto-central theta oscillations reflect cognitive monitoring processes in collision avoidance tasks

Ruslan Aydarkhanov¹, Marija Uscumlic², Ricardo Chavarriaga¹, José del Millán¹

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1-D-37 Noise-tag BCI for covert selective attention in different modalities

Sara Ahmadi¹, Marzieh Borhanazad¹, Peter Desain¹

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1-D-38 Towards multiclass brain-computer interface for joint human-computer image analysis

Steven Gutstein¹, Brent Lance¹, Anthony Ries¹, Vernon Lawhern¹, David Slayback¹

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1-D-39 An EEG measure for individual written text difficulty assessment in neuroadaptive learning environments

Lena Andreessen¹, Peter Gerjets², Detmar Meurers³, Thorsten Zander⁴

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1-D-40 Active inference for adaptive BCI: An application to the P300 speller

Jelena Mladenovic¹, Jérémy Frey², Emmanuel Maby³, Mateus Joffily⁴, Fabien Lotte⁵, Jérémie Mattout³

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1-D-41 HAIL: A human-autonomy crowdsourcing approach to image classification

David Slayback¹, Vernon Lawhern¹, Nicholas Waytowich¹, Addison Bohannon¹, Steven Gutstein¹, Brent Lance¹

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1-D-42 Neurofeedback improves SSVEP BCI performance on subjects with both 'high' and 'low' performance

Qi Tang¹, Wenya Nan¹, Feng Wan², Yong Hu³

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1-D-43 Brain functional connectivity associates with fatigue in SSVEP-BCI applications

Chi Man Wong¹, Feng Wan¹, Yong Hu¹, Agostinho Rosa² ¹University of Macau, ²University of Lisbon

1-D-44 Hybrid BCI development based on SSVEP and RSVP for the neurogaming with a purpose

Li-Wei Ko¹, Yun-Chen Lu¹, Yufei Huang², Tzyy-Ping Jung³

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1-D-45 Toward automatized placement of visual stimuli for gaze-independent SSVEP-BCI

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E. Signal Acquisition

1-E-46 Comparison of conventional and tripolar EEG electrodes in BCI paradigms

Charles Anderson¹, Walter Besio², Saleh Alzahrani¹ ¹Colorado State University, ²University of Rhode Island

1-E-47 Acquisition and classification of haptic P300 signals for brain computer interface

Kup-Sze Choi¹, Guanjin Wang¹, Shuang Liang², Zhaohong Deng³

¹Hong Kong Polytechnic University, ²Shenzhen Institutes of Advanced Technology, ³Jiangnan University

1-E-48 Free wally: A game for measuring meaningful motor intentions

Ceci Verbaarschot¹, Pim Haselager¹, Jason Farquhar¹

¹Radboud University; Donders Institute for Brain, Cognition and Behaviour

1-E-49 EEG based emotion classification with cross frequency coupling in music listening with continuous response

Juanli Zhang¹, Amna Ghani¹, Petra Ritter¹, Randy McIntosh² ¹Charite, ²University of Toronto

F. Signal Analysis

1-F-50 A new method for localizing activity in the brain based on empirical mode decomposition and entropy function

Maximiliano Bueno-Lopez¹, Eduardo Giraldo², Marta Molinas¹

¹Norwegian University of Science and Technology, ²Universidad Tecnológica de Pereira

1-F-51 Optimizing the multi-orthogonal-space classifiers separately to get the global optimal EEG classification performance

Qiqi Zhang¹, Ying Liu¹ ¹Beijing Institute of Technology

1-F-52 Towards decoding speech: Effects of prior phonemes on sensorimotor cortex activity during sequential vowel production

Efraim Salari 1, Zachary Freudenburg 1, Mariska Vansteensel 1, Nick Ramsey 1

¹Brain Center Rudolf Magnus, University Medical Center Utrecht

1-F-53 EEG-guided electrotactile stimulation for haptic feedback

Doug Weber¹, Safaa Eldeeb¹, Aya Khalaf¹, Murat Akcakaya¹, Deniz Erdogmus²

¹University of Pittsburgh, ²Northeastern University

1-F-54 Post-hoc labeling of arbitrary EEG recordings for dataefficient evaluation of neural decoding methods

Sebastián Castaño-Candamil¹, Andreas Meinel¹, Michael Tangermann¹ ¹University of Freiburg

1-F-55 Estimating P300 latency and amplitude using LMS adaptive filtering

Md Rakibul Mowla¹, Jane Huggins², Bala Natarajan¹, David Thompson¹ ¹Kansas State University, ²Direct Brain Interface Laboratory, University of Michigan

1-F-56 A data-driven EEG spatial filter for estimating premovement sensorimotor integration signals

Mark Pflieger¹

¹Cortech Solutions, Inc.

1-F-57 Decoding mPFC activity contributes to better prediction of movement intention

Xiang Zhang¹, Shuhang Chen¹, Yiwen Wang¹

¹Hong Kong University of Science and Technology

$\ensuremath{\text{1-F-58}}$ Towards generating a task-independent workload classifier with EEG

Xixie Zhang¹, Laurens Krol¹, Thorsten Zander²

¹Technical University of Berlin, ²Zander Laboratories B.V.

1-F-59 Primitive shape imagery classification from electroencephalography

Attila Korik¹, Laura Hay², Sam Gilbert³, Madeleine Grealy², Alex Duffy², Pei Ling Choo², Damien Coyle¹

¹Ulster University, ²University of Strathclyde, ³University College London

1-F-60 Prediction of subject-specific affective states in music listening using SPoC

Amna Ghani¹

¹Charite

1-F-61 Functional verification of fNIRS probe locations using a generalized SVM classifier model for BCI applications

Michael Lührs¹, Anita Tursic¹, Rainer Goebel¹

¹Maastricht University, Brain Innovation B.V.

1-F-62 Alterations in cortical connectivity during P300-based BCI use by people with amyotrophic lateral sclerosis

Roohollah Jafari Deligani¹, Charles Carmack², Susan M Heckman², Lynn M McCane², Dennis J McFarland², Theresa M Vaughan², Jonathan R Wolpaw², Debra J Zeiltin³, Dean Krusienski⁴, Yalda Shahriari¹

¹Univerity of Rhode Island, ²National Center for Adaptive Neurotechnologies, Wadsworth Center, ³Helen Hayes Hospital, ⁴Old Dominion University

1-F-63 Exploring mental state changes during hypnotherapy using adaptive mixture independent component analysis

Sheng-Hsiou Hsu¹, Ying Wu¹, Tzyy-Ping Jung¹

¹University of California San Diego

1-F-64 Modelling causal connectivity from EEG for BCI with multi-direction hand movements

Tushar Chouhan¹, Kai Keng Ang², Vinod Prasad³, Cuntai Guan¹

¹Nanyang Technological University, ²Institute for Infocomm and Research, Agency of Science, Technology and Research, Singapore, ³Indian Institute of Technology Palakkad

1-F-65 The cortical encoding of kinematics and kinetics during an object grasp task

Robert Flint¹, Matthew Tate¹, Marc Slutzky¹

¹Northwestern University

1-F-66 Automatic artifact rejection using the real-time EEG source-mapping toolbox (REST)

Luca Pion-Tonachini¹, Sheng-Hsiou Hsu¹, Chi-Yuan Chang¹, Tzyy-Ping Jung¹, Scott Makeig¹

¹University of California San Diego

G. User Aspects: Experience, Ethics

1-G-67 A revised sensory/cognitive/communication screen for use with communication BCI study participants

Betts Peters¹, Michelle Kinsella¹, Brandon Eddy¹, Aimee Mooney¹, Melanie Fried-Oken¹

¹Oregon Health & Science University

1-G-68 Icons are not equal: Considerations for use of icons in BCI systems.

Brandon Eddy¹, Betts Peters¹, Shiran Dudy¹, Tab Memmott¹, Steven Bedrick¹, Melanie Fried-Oken¹

¹Oregon Health & Science University

1-G-69 Towards a user-centred BCI design: A survey of preferred mental strategies

Elmar G. M. Pels¹, Mariana Branco¹, Ruben Sars², Erik Aarnoutse¹, Mariska Vansteensel¹, Nick Ramsey¹, Femke Nijboer²

¹Brain Center Rudolf Magnus, University Medical Center Utrecht, ²Faculty of Social and Behavioural Sciences, Leiden University

Poster Sessions

Session 2 Tuesday, May 22 • 15:30-17:30

A. BCI Implant - Control

2-A-1 Dexterous control of seven functional hand movements using cortically-controlled transcutaneous muscle stimulation in a person with tetraplegia

Sam Colachis¹, Marcie Bockbrader¹, Mingming Zhang², David Friedenberg², Nicholas Annetta², Michael Schwemmer², Nicholas Skomrock², Jerry Mysiw¹, Ali Rezai¹, Herbert Bresler², Gaurav Sharma²

¹The Ohio State University, ²Battelle

2-A-2 Adaptive deep brain stimulation: Optimization of treatment in essential tremor using electrocorticography data

Benjamin Ferleger¹, Sebastián Castaño-Candamil², Andrew Haddock¹, Brady Houston¹, Michael Tangermann², Howard Chizeck¹

¹University of Washington, ²University of Freiburg

2-A-3 Control of multiple hand movements using corticallycontrolled, non-invasive muscle stimulation in a tetraplegic person

David Friedenberg¹, Sam Colachis², Nicholas Annetta¹, Mingming Zhang¹, Nicholas Skomrock¹, Michael Schwemmer¹, W. Jerry Mysiw², Ali Rezai², Herbert Bresler¹, Marcia Bockbrader², Gaurav Sharma¹

¹Battelle, ²The Ohio State University

2-A-4 Population-level changes in primary motor cortex induced by the presence of an object

Angelica Herrera¹, John Downey², Delaney Moran³, Aaron Batista¹, Steven Chase⁴, Byron Yu⁴, Michael Boninger¹, Robert Gaunt¹, Jennifer Collinger¹

¹University of Pittsburgh, ²University of Chicago, ³Middlebury College, ⁴Carnegie Mellon University

2-A-5 Proposed strategies for simultaneous cognitive and motor state estimation for an intracortical brain-computer interface with sensors in prefrontal and motor cortices

Chadwick Boulay¹, Alireza Rouzitalab², Adam Sachs¹

¹Ottawa Hospital Research Institute, ²University of Ottawa

B. BCI Implant - Other

2-B-6 Effects of goal-directed sensory information on intracortical hand representations in human sensorimotor cortex

Dylan Royston¹, Stephen Foldes², Jeffrey Weiss¹, Cody Wabiszewski¹, Timothy Verstynen³, Jennifer Collinger¹

¹University of Pittsburgh, ²Phoenix Children's Hospital, ³Carnegie Mellon University

2-B-7 Speech synthesis with densely connected 3d convolutional neural networks from ECoG

Miguel Angrick 1, Christian Herrf 1, Emily Mugler 2, Marc Slutzky 2, Dean Krusienski 3, Tanja Schultz 1

¹University of Bremen, ²Northwestern University, ³Old Dominion University

2-B-8 The impact of intracortical microstimulation frequency on perceived intensity and its relationship to somatosensory processing in human somatosensory cortex

Christopher Hughes¹, Sharlene Flesher², Jeffrey Weiss¹, Michael Boninger¹, Jennifer Collinger¹, Robert Gaunt¹ ¹University of Pittsburgh, ²Stanford University

C. BCI Non-Invasive - Control

2-C-9 3D BCI control through simultaneous overt spatial attentional and motor imagery tasks

Jianjun Meng¹, Taylor Strietz¹, Nicholas Gulachek¹, Bin He¹ ¹University of Minnesota

2-C-10 MoreGrasp - EEG-based non-invasive neuroprosthesis for decoding of multiple natural single limb movements and multipad-electrodes for closed-loop grasp pattern control

Gernot Müller-Putz¹, Andreas Schwarz¹, Joana Pereira¹, Patrick Ofner¹, Andreas Pinegger¹, Matthias Schneiders, Björn Hessing, Andrew Ramsey², Roderick Murray-Smith², Carlos Escolano³, Luis Montesano³, Granit Luzhnica⁴, Eduardo Veas⁴, Jan Loitz⁵, Rüdiger Rupp⁶

¹Graz University of Technology, ²University of Glasgow, ³Bit & Brain Technologies, ⁴Know Center, ⁵MEDEL, ⁶University Hospital Heidelberg

2-C-11 Source localization of pediatric brain-computer interface using electroencephalography

Brett Paffrath¹, Adam Kirton², Ephrem Zewdie²

¹Alberta Children's Hospital, ²Cumming School of Medicine, University of Calgary

2-C-12 Effects of extended relaxation and motor coordination training on SMR BCI performance

Andrea Kübler¹, Loic Botrel¹ ¹University of Würzburg

2-C-13 Mind body awareness training improves performance with sensorimotor rhythm based brain computer interfaces

James Stieger¹, Christopher Cline¹, Christopher Coogan¹, Bhavani Sai Rohit Murakonda¹, Samantha Sherman¹, Andy Huynh¹, Desirae Hammond¹, Kit Breshears¹, Taylor Boyle¹, Mary Jo Kreitzer¹, Stephen Engel¹, Bin He¹

¹University of Minnesota

2-C-14 Transferring shared responses across electrode montages for an SSVEP-based BCI

Masaki Nakanishi¹, Yu-Te Wang¹, Tzyy-Ping Jung¹

¹University of California San Diego

2-C-15 Phase-locked visual stimulation for precise modulation of the amplitude of alpha wave based on real-time decoding of alpha phase

Jia Liu¹, Gan Huang¹, Qianqian Lin¹, Linling Li¹, Chunqi Chang¹, Chuang Lin², Zhiguo Zhang¹

¹Health Science Center, Shenzhen University, ²Shenzhen Institutes of Advanced Technology Chinese Academy of Sciences

2-C-16 A comparison of oddball and deterministic paradigms for ERP-based brain computer interfaces

Bruna Girvent¹, Paula Gonzalez -Navarro¹, Mohammad Moghadamfalahi¹, Lama Nachman², Deniz Erdogmus¹

¹Northeastern University, ²Intel Corporation

2-C-17 Semiautomatic physiologically-driven feature selection improves the usability of a brain computer interface system in post-stroke motor rehabilitation

Emma Colamarino¹, Floriana Pichiorri², Donatella Mattia², Febo Cincotti¹

¹Sapienza University of Rome, ²Fondazione Santa Lucia- IRCCS

2-C-18 Post-stroke rehabilitation training with a braincomputer interface: clinical and neuropsychological study

Guzel Aziatskaya¹, Roman Lyukmanov¹, Olesya Mokienko¹, Nataliya Varako¹, Alexander Frolov², Lyudmila Chernikova¹, Natalya Suponeva¹, Michael Piradov¹

¹Research Center of Neurology, ²Institute of Higher Nervous Activity and Neurophysiology of RAS (IHNA&NPh RAS)

2-C-19 Can the MIQ-RS questionnaire be used to estimate the performance of a MI-based BCI?

Sébastien Rimbert¹, Nathalie Gayraud², Maureen Clerc², Stéphanie Fleck³, Laurent Bougrain⁴

¹Inria Nancy, ²Inria Sophia Antipolis-Méditerranée and Université Côte d'Azur, ³Université de Lorraine - PErSEUs EA 7312, ⁴Université de Lorraine, LORIA, UMR 7503

2-C-20 BCI-based control of pre-movement sensorimotor rhythm amplitude may improve motor performance after stroke

Sumner Norman¹, Dennis J McFarland², Alex Miner¹, Steven Cramer¹, Eric Wolbrecht³, Jonathan R Wolpaw², David Reinkensmeyer¹

¹University of California Irvine, ²National Center for Adaptive Neurotechnologies, Wadsworth Center, ³University of Idaho

2-C-21 An affordable BCI design for robot and wheelchair navigation

Yih-Choung Yu¹, Brandon Smith¹, Ashley Goreshnik¹, Lisa Gabel¹

¹Lafayette College

2-C-22 Evaluation of a congruent auditory feedback for motor imagery BCI

Emmanuel Christophe¹, Jérémy Frey², Richard Kronland-Martinet¹, Jean-Arthur Micoulaud-Franchi³, Jelena Mladenovic⁴, Gaelle Mougin⁵, Jean Vion-Dury¹, Solvi Ystad¹, Mitsuko Aramaki¹

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2-C-23 BCI-based operation of Microsoft Active Accessibility (MSAA) compatible TOBII Dynavox Communicator 5

Theresa M Vaughan¹, Kamilya Gosmanova², Charles Carmack¹, David Goldberg³, Kelly Fitspatrick², Bart Zoltan⁴, Debra Zeitlin⁴, Jonathan R Wolpaw¹

¹National Center for Adaptive Neurotechnologies, Wadsworth Center, ²Wadsworth Center, New York State Department of Health, ³Tobii Dynavox, ⁴Helen Hayes Hospital, New York State Department of Health

D. BCI Non-Invasive - Other

2-D-24 EEG predictors for upper limb motor recovery of stroke patients undergoing BCI and tDCS rehabilitation

Ravikiran Mane¹, Effie Chew², Kok Soon Phua³, Kai Keng Ang³, Cuntai Guan¹

¹Nanyang Technological University, ²National University Hospital, ³Institute for Infocomm and Research, Agency of Science, Technology and Research, Singapore

2-D-25 BCI-based Language training induces changes in ERP responses in chronic post-stroke aphasia patients

David Hübner¹, Sarah Schwarzkopf², Mariacristina Musso², Michael Tangermann¹

¹University od Freiburg, ²University Medical Center Freiburg

2-D-26 Augmenting group decision making accuracy in a realistic environment using collaborative brain-computer interfaces based on error-related potentials

Davide Valeriani 1, Saugat Bhattacharyya 1, Caterina Cinel 1, Luca Citi 1, Riccardo Poli 1

¹University of Essex

2-D-27 Closed-loop stimulus parameter optimization framework for event-related potential paradigms

Jan Sosulski¹, David Hübner¹, Michael Tangermann¹

¹University of Freiburg

2-D-28 Effects on language ability induced by BCI-based training of patients with aphasia

Michael Tangermann¹, David Hübner¹, Sarah Schwarzkopf², Cornelius Weiller², Mariacristina Musso²

¹University of Freiburg, ² University Medical Center Freiburg

2-D-29 Brain-computer interfaces for post-stroke motor rehabilitation: A meta-analysis

María Cervera¹, Surjo Soekadar², Junichi Ushiba³, José del Millán¹, Meigen Liu⁴, Niels Birbaumer⁵, Gangadhar Garipelli⁶

¹Ecole Polytechnique Fédérale de Lausanne (EPFL), ²University Hospital of Tübingen, ³Keio University, ⁴Keio University School of Medicine, ⁵WYSS Center for Bio and Neuroengineering, ⁶MindMaze SA

2-D-30 Mirror-therapy as a way to start BCI robot-assisted rehabilitation: A single case longitudinal study of a patient with hemiparesis

Roman Rosipal¹, Natália Porubcová¹, Barbora Cimrová², Igor Farka²

¹Institute of Measurement Sciences, Slovak Academy of Sciences, ²Faculty of Mathematics, Physics and Informatics, Comenius University in Bratislava

2-D-31 Sensory threshold electrical stimulation a novel feedback modality for BMIs

Tiffany Corbet¹, Iñaki Iturrate¹, José del Millán¹

¹Ecole Polytechnique Fédérale de Lausanne (EPFL)

2-D-32 Application of mental state detection in the context of motor stroke rehabilitation with virtual reality based games

Robert Leeb¹, Claire Lugrin¹, Andrea Serino¹, José del Millán² ¹MindMaze, ²Ecole Polytechnique Fédérale de Lausanne (EPFL)

Poster Sessions

2-D-33 Zero-calibration c-vep BCI using word prediction: A proof of concept

Federica Turi¹, Nathalie Gayraud², Maureen Clerc²

¹Inria Sophia Antipolis Mediterranee, ²Inria Sophia Antipolis-Méditerranée and Université Côte d'Azur

2-D-34 New correlates of motor imagery BCI performance eye-open and eye-closed states

Moonyoung Kwon¹, Hohyun Cho², Sunghan Lee¹, Kyungho Won¹, Jongmin Lee³, Minkyu Ahn³, Sung Chan Jun¹

 $^1 \text{Gwangju}$ Institute of Science and Technology, $^2 \text{Wadsworth}$ Center, New York State Department of Health, $^3 \text{Handong}$ Global University

2-D-35 Probing for information: Towards a BCI that infers semantic content

Karen Dijkstra¹, Jason Farquhar¹, Peter Desain¹

¹Radboud University, Donders Institute for Brain, Cognition and Behaviour,

2-D-36 Classification of attention types in EEG signals

Léa Pillette¹, Aurélien Appriou¹, Andrzej Cichocki², Bernard N'Kaoua³, Fabien Lotte¹

¹Inria, LaBRI (Univ. Bordeaux, CNRS, Bordeaux-INP), France / RIKEN BSI, Wakoshi, Japan, ²RIKEN BSI, Wakoshi, Japan / SKOLTECH, Moscow, Russia, ³Handicap, Activity, Cognition, Health, Univ. Bordeaux, France

2-D-37 Can we predict when you want to move? An educational BCI game for a general public

Anne Gerrits¹, Ceci Verbaarschot¹, Jason Farquhar¹

 ${}^{1}\text{Radboud}$ University Nijmegen, Donders Institute for Brain, Cognition and Behaviour

2-D-38 N-back to the future: Estimating cognitive workload in a virtual reality environment using EEG signals

Christoph Tremmel¹, Christian Herff², Yusuke Yamani¹, Hector Garcia¹, Srdjan Lesaja¹, Krzysztof Rechowicz¹, Saikou Diallo¹, Dean Krusienski¹ ¹Old Dominion University, ²University of Bremen

2-D-39 Clinician awareness of Brain-Computer Interfaces and eligible populations.

Sasha Létourneau $^{\rm 1}$, Ephrem Zewdie $^{\rm 2}$, Lee Burkholder $^{\rm 3}$, John Andersen $^{\rm 3}$, Adam Kirton $^{\rm 2}$

¹School of Medicine, Queen's University, ²Cumming School of Medicine, University of Calgary, ³Faculty of Medicine and Dentistry, University of Alberta

2-D-40 Towards passive BCI based neuroadaptive technology

Laurens Krol¹, Klaus Gramann¹

¹Technical University of Berlin

2-D-41 Classifying confidence from single-trial EEG in memory retrieval tasks

Kueida Liao¹, Eunho Noh¹, Matthew Mollison², Tim Curran², Virginia de Sa¹

¹University od California, San Diego, ²University of Colorado Boulder

2-D-42 Toward a hemicraniectomy-EEG based BMI therapy for the rehabilitation of patients with traumatic brain injury

Mukta Vaidya¹, Robert Flint¹, Po Wang², Alex Barry³, Goran Tomic¹, Emily Mugler¹, Sarah Gallick³, Sangeeta Driver³, Nenad Brkic³, David Ripley³, Charles Liu², An Do², Marc Slutzky¹

 $^1\text{Northwestern}$ University, $^2\text{University}$ of California, Irvine, $^3\text{Shirley}$ Ryan Ability Lab

2-D-43 Mixed results with affective classification of frontal alpha asymmetry and hjorth parameters

David Thompson¹, Rachael Cano¹, Katie Dhuyvetter¹, Md Rakibul Mowla¹ ¹Kansas State University

2-D-44 Recovery of hand function in spinal cord injury patients augmented by BCI-driven afferent nerve stimulation

Sarah Thomas¹, Christopher Schildt¹, Elizabeth Powell¹, Yuvaraj Rajamanickam¹, Matthew Ballard¹, Sara Salles¹, Lumy Sawaki¹, Sridhar Sunderam¹

¹University of Kentucky

2-D-45 Multi-paradigm EEG classification using deep neural networks

Gabriel Ibagon¹, Christian Kothe¹, Nima Bigdely-Shamlo¹, Tim Mullen¹ ¹Intheon

E. Signal Acquisition

2-E-46 Development of a portable intracortical BCI system

Jeffrey Weiss¹, Robert Gaunt¹, Michael Boninger¹, Robert Franklin², Jennifer Collinger¹

¹University of Pittsburgh, ²Blackrock Microsystems

2-E-47 A comparison between spatial filtering techniques based on conventional methods and tripolar concentric ring electrodes

Sarah Ismail Hosni¹, Walter Besio¹, Yalda Shahriari¹ ¹University of Rhode Island

2-E-48 High-gamma activity in tripolar electroencephalography correlates with hand movements

Walter Besio¹, Jason Mercier¹, Brandon Williams¹, Shunan Li¹ ¹University of Rhode Island

F. Signal Analysis

2-F-49 Swallowing related high gamma band oscillatory changes revealed by human electrocorticograms

Hiroaki Hashimoto¹, Masayuki Hirata¹, Kazutaka Takahashi², Seiji Kameda¹, Fumiaki Yoshida³, Takufumi Yanagisawa¹, Satoru Oshino⁴, Toshiki Yoshimine¹, Haruhiko Kishima⁴

¹Global Center for Medical Engineering and Informatics, Osaka University, ²University of Chicago, ³Graduate School of Medical Sciences, Kyushu University, ⁴Osaka University Graduate School of Medicine

2-F-50 Deep convolutional neural network for the detection of attentive mental state in elderly

Fatemeh Fahimi¹, Zhuo Zhang², Tih-Shih Lee³, Cuntai Guan¹

¹Nanyang Technological University, Singapore, ²Institute for Infocomm Research, A*STAR, ³Duke-NUS Graduate Medical School, Singapore

2-F-51 RCSP-based feature extraction and adaboost-based classification for MI-based BCI

Yangyang Miao¹, Ian Daly², Cili Zuo¹, Jing Jin¹

¹East China University of Science and Technology, ²University of Essex

2-F-52 Reading out reinforcement learning strategies underlying trial-by-trial choice behavior

Dongjae Kim¹, Sang Wan Lee¹

¹Korea Advanced Institute of Science and Technology

2-F-53 SimBCI – Tool to simulate EEG and BCI

Jussi Lindgren¹, Adrien Merlini², Anatole Lecuyer¹, Francesco Andriulli³ ¹Univ. Rennes, Inria, IRISA, CNRS, ²IMT Atlantique, ³Inria

2-F-54 A combined linear and deep neural network model for motor imagery classification

Jiahux Xu1, Wu Zheng1, Sabe Bernhard1, Andreas Nuernberger1, Hermann Hinrichs2

¹Otto-von-Guericke-Universität Magdeburg, ²Leibniz-Institut für Neurobiologie

2-F-55 Mental-task BCIs using convolutional networks with label aggregation and transfer learning

Elliott Forney¹, Charles Anderson¹, William Gavin¹, Patricia Davies¹

¹Colorado State University

2-F-56 Histogram of oriented gradients of signal plots applied to BCI

Rodrigo Ramele¹, Juan Santos¹, Ana Villar¹

¹Instituto Tecnológico de Buenos Aires

2-F-57 Can transfer learning across motor tasks improve motor imagery BCI?

Fabien Lotte¹, Andrzej Cichocki²

¹Inria, LaBRI (Univ. Bordeaux, CNRS, Bordeaux-INP), France / RIKEN BSI, Wakoshi, Japan, ²RIKEN BSI, Wakoshi, Japan / SKOLTECH, Moscow, Russia

2-F-58 Noise tagging BCI: A fast and reliable methodology that requires no training

Peter Desain¹, Cristiano Micheli², Pieter Marsman³, Jordy Thielen¹

¹Radboud university, Donders Center for Cognition, ²MindAffect,

2-F-59 Exploring single-trial detection of motor and cognitive imagery tasks with magnetoencephalography based braincomputer interface

Dheeraj Rathee¹, Hubert Cecotti², Girijesh Prasad¹

¹Ulster University, ²California State University, Fresno

2-F-60 Use of EEG source localization to improve the accuracy of a BCI system in a three-task motor imagery paradigm

Eliana Santos¹, Marc-Antoine Moinnereau², Tiago H. Falk², Francisco Fraga¹

 $^1\mbox{Federal University of ABC (UFABC), $^2\mbox{Institut} national de la recherche scientifique (INRS - MuSAE Lab)$

2-F-61 Toward real time estimation of brain connectivity as new feature for BCI application

Yuri Antonacci $^{\rm 1}$, Jlenia Toppi $^{\rm 1}$, Antonio Pietrabissa $^{\rm 1}$, Donatella Mattia $^{\rm 2}$, Laura Astolfi $^{\rm 1}$

¹Sapienza University of Rome, ²Fondazione Santa Lucia IRCCS

2-F-62 Classifier-based source localisation in independent component space: Progress report

Laurens Krol¹, Mahta Mousavi², Thorsten Zander³

¹Technical University of Berlin, ²University of California San Diego, ³Zander Laboratories B.V.

2-F-63 Architectural choices for P300 deep learning models Sriram Ravindran¹, Virginia de Sa¹

¹University of California, San Diego

2-F-64 Improving data quality and noise assessment in EEG signals: Bootstrapped SE as a general and principled method Andrew Stewart¹, Steve Luck¹

¹University of California, Davis

2-F-65 Self-paced upper limb movement intention recognition from EEG signals

Luis Hernandez Rojas¹, Javier Antelis¹

¹Tecnológico de Monterrey

2-F-66 Dynamic emotion transition detection for affective BCI

Yu Hao¹, Lin Yao², Disha Gupta¹, Edward Sorel³, Megan Gelsinger¹, David Matteson¹, Gary Evans¹

¹Cornell University, ²University of Waterloo, ³Psychology Resource Group

G. User Aspects: Experience, Ethics

2-G-67 Patient feedback on self-managed brain computer interface treatment of central neuropathic pain in spinal cord injury: Steps towards service design

Nina Petric-Gray¹, Manaf Al-Taleb¹, Mariel Purcell², Matthew Fraser², Aleksandra Vuckovic¹

¹University of Glasgow, ²Queen Elizabeth University Hospital

2-G-68 Can children use simple brain computer interfaces?

Jack Zhang¹, Zeanna Jadavji¹, Ephrem Zewdie², Adam Kirton²

¹University of Calgary, ²Cumming School of Medicine, University of Calgary

2-G-69 Trends in BCI meeting abstracts on research participant categories and descriptions between 1999 and 2013

Sean Garrett¹, Brandon Eddy², Betts Peters², Sneha Rajen¹, Jane Huggins¹, Melanie Fried-Oken²

¹Direct Brain Interface Laboratory, University of Michigan, ²Institute on Development and Disabilities, Oregon Health & Science University

Poster Sessions

Session 3 Wednesday, May 23 • 15:30-17:30

A. BCI Implant - Control

3-A-1 Finding the bipolar Error-related Potential (bErrP) in an ALS patient implanted with a daily use communications brain-computer interface (BCI)

Zachary Freudenburg¹, Khaterah Kohneshin¹, Erik Aarnoutse¹, Mariska Vansteensel¹, Mariana Branco¹, Sacha Leinders¹, Max van den Boom¹, Elmar G. M. Pels¹, Nick Ramsey¹

¹Brain Center Rudolf Magnus, University Medical Center Utrecht

3-A-2 Simultaneous real-time control of a high degree-offreedom virtual object by a person with paralysis using an intracortical BCI

Sergey Stavisky¹, Paul Nuyujukian¹, Chethan Pandarinath², Beata Jarosiewicz¹, Nir Even-Chen¹, Paymon Rezaii¹, Francis Willett¹, Sharlene Flesher¹, Heidi Peterson¹, Leigh Hochberg³, Krishna Shenoy¹, Jaimie Henderson¹

¹Stanford University, ²Emory University, ³Brown University

3-A-3 An optical brain-machine interface using two-photon calcium imaging in primate motor cortex.

Eric Trautmann¹, Daniel O'Shea¹, Xulu Sun¹, Stephen Ryu¹, Lucas Cofer¹, James Marshel¹, Will Allen¹, Isaac Kauver¹, Gergo Bohner², Charu Ramakrishnan¹, Maneesh Sahani³, Karl Deisseroth¹, Krishna Shenoy¹

¹Stanford University, ²Gatsby, UCL, ³Gatsby

3-A-4 Case study: Eye movement related motor activity overlaps with hand-knob area in late stage ALS

Sacha Leinders¹, Janne Luppi², Mariana Branco¹, Zachary Freudenburg¹, Elmar G. M. Pels¹, Max van den Boom¹, Erik Aarnoutse¹, Mariska Vansteensel¹, Nick Ramsey¹

¹Rudolf Magnus Institute of Neuroscience, University Medical Center Utrecht, ²University of Amsterdam

C. BCI Non-Invasive - Control

3-C-5 Finding optimal stimulation patterns for BCIs based on visual evoked potentials

Sebastian Nagel¹, Wolfgang Rosenstiel¹, Martin Spüler¹

¹University of Tübingen

3-C-7 A novel brain-machine interface for controlling dynamic systems

Jinling Lian¹, Luzheng Bi¹ ¹Beijing Institute of Technology

3-C-8 SSVEP based BCI for 3 dof robot arm control using LabVIEW

Sandesh R S¹, Nithya Venkatesan¹ ¹VIT. Chennai

3-C-9 SSVEP controlled BCI inferring complex tasks from low-level-commands

Matthias Will¹, Tim Pfeiffer¹, Nicolai Heinze², Georg Rose¹ ¹Otto-von-Guericke-Universität Magdeburg, ²Leibniz Institute for Neurobiology Magdeburg

3-C-10 Controlling high-complexity robotic swarms with lowcomplexity EEG brain-computer interfaces

Gregory Canal¹, Yancy Diaz-Mercado¹, Magnus Egerstedt¹, Christopher Rozell¹

¹Georgia Institute of Technology

3-C-11 Effect of custom electrode selection on P300 BCI performance for people with CP, ALS, NMD and controls

Jane Huggins¹

¹Direct Brain Interface Laboratory, University of Michigan

3-C-12 MR-braintap: Mixed reality-brain computer interface for children with disability

Ephrem Zewdie¹, Dennis Dietz², Ehud Sharlin³, Zeanna Jadavji³, Adam Kirton¹

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3-C-13 Online decoding of gait-related lower-limb movement intention

Kyuhwa Lee¹, Tiffany Corbett¹, Ruslan Aydarkhanov¹, Luca Randazzo¹, Ricardo Chavarriaga¹, José del R. Millán¹

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3-C-14 Emotion-inducing imagery versus motor imagery based BCI: Performance, perceived control and imagery preference

Alain Bigirimana¹, Nazmul Siddique¹, Damien Coyle¹ ¹Ulster University

3-C-15 Brain computer interfaces for motor rehabilitation in hemiparetic children with perinatal stroke

Zeanna Jadavji¹, Jack Zhang¹, Ephrem Zewdie², Adam Kirton² ¹University of Calgary, ²Cumming School of Medicine, University of Calgary

3-C-16 A new region-based SSVEP BCI speller

Bijay Guragain¹, Ali Haider¹, Reza Fazel-Rezai¹ ¹University of North Dakota

3-C-17 Data-driven adaptive stimulus selection for the P300 speller

Dmitry Kalika¹, Leslie Collins¹, Boyla Mainsah¹, Chandra Throckmorton¹ ¹Duke University

3-C-18 Command following assessment and communication with vibro-tactile P300 and motor imagery BCIs in patients with disorders of consciousness and (complete) locked-in syndrome

Christoph Guger¹, Rossella Spataro², Frederic Pellas³, Rupert Ortner¹, Woosang Cho¹, Ren Xu¹, Begonya Otal¹, Vincenzo La Bella², Krzysztof Malej⁴, Alexander Heilinger¹, Günter Edlinger¹

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D. BCI Non-Invasive - Other

3-D-19 How to train ErrP-based BMIs: A speller application

Iñaki Iturrate¹, Ricardo Chavarriaga¹, Alessia Colucciello¹, José del Millán¹

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3-D-20 EEG correlates of decision confidence in feedback processing

Tanja Krumpe¹, Peter Gerjets², Wolfgang Rosenstiel¹, Martin Spüler¹ ¹University of Tübingen, ²Leibniz-Institut für Wissensmedien

3-D-21 Similarity representation analysis of human grasps in EMG, kinematics and EEG signals

Andreea Sburlea¹, Gernot Müller-Putz¹

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3-D-22 BciPy: A python framework for brain- computer interface research

Tab Memmott¹, Aziz Kocanaogullari², Deniz Erdogmus², Steven Bedrick¹, Betts Peters¹, Melanie Fried-Oken¹, Barry Oken¹

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3-D-23 Decoding differences in continuously executed and observed tracking movements from EEG signals

Reinmar Kobler¹, Andreea Sburlea¹, Gernot Müller-Putz¹

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3-D-24 Within and across subject analysis for hybrid brain computer interfaces based on electroencephalography and functional transcranial doppler ultrasound

Ervin Sejdic¹, Aya Khalaf¹, Murat Akcakaya¹

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3-D-25 Effect of query length and prospect symbol confidence in EEG-based typing systems

Paula Gonzalez -Navarro¹, Aziz Kocanaogullari¹, Berkan Kadioglu¹, Murat Akcakaya², Melanie Fried-Oken³, Deniz Erdogmus¹

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3-D-26 Longitudinal BCI data acquisition using a tilematching game

Joe Rexwinkle¹, Gregory Lieberman¹, Matthew Jaswa², Derek Netto³, Paul DeGuzman³, Brent Lance¹

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3-D-27 Combining eye tracking and EEG data to predict initial phases of motor imagery

Jingru Xu¹, Shiwei Cheng¹

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3-D-28 Towards a single trial fNIRS-based brain-computer interface for communication

Seyyed Bahram Borgheai1, Mohammadreza Abtahi1, Kunal Mankodiya1, Yalda Shahriari1

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3-D-29 Effects of data sample dependence on the evaluation of BCI performance

Serafeim Perdikis¹, Fabien Bourban¹, Vincent Rouanne², José del R. Millán², Robert Leeb¹

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3-D-30 Association between RSVP task ERP and P300 speller performance

Kyungho Won¹, Moonyoung Kwon¹, Sunghan Lee¹, Jongmin Lee², Minkyu Ahn², Sung Chan Jun¹

 ${}^{1}\mbox{Gwang}\mbox{ju}$ Institute of Science and Technology, ${}^{2}\mbox{Handong}$ Global University

3-D-31 ERP prevalence and effects of stimulus features and attention on MMN and P300

Matthias Eidel¹, Helena Erlbeck¹, Ruben Real², Andrea Kübler¹

¹University of Würzburg, ²Medical University Goettingen

3-D-32 Towards an EEG-based covert attention braincomputer interface (BCI) training procedure for soccer goalkeepers

Camille Jeunet¹, Luca Tonin², Louis Albert³, Ricardo Chavarriaga², Benoît Bideau⁴, Ferran Argelaguet⁴, José del R. Millán², Anatole Lecuyer⁴, Richard Kulpa⁴

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3-D-33 Gaze versus EEG-based control of a visual P300 BCI in healthy children

Mélodie Fouillen¹, Emmanuel Maby², Lucie Le Carrer³, Jérémie Mattout²

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3-D-34 Automated EEG enhancement and recurrent neural networks for lane change prediction during driving

Marc-Antoine Moinnereau¹, Sam Karimian-Azari¹, Tsuyoshi Sakuma², Hidenori Boutani², Lucian Gheorghe², Tiago H. Falk¹

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3-D-35 Error potentials for identifying auto-correction errors during tablet-based text entry

Felix Putze¹, Tanja Schultz¹, Wolfgang Stuerzlinger²

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3-D-36 The factors causing the unstable visual stimulus in portable devices

Kuan-Jung Chiang¹, Wen-Hsuan Chan², Masaki Nakanishi², Yu-Te Wang², Tzyy-Ping Jung²

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3-D-37 High-temporal-resolution estimation of alertness using an EEG-based brain-computer interface

Chun-Shu Wei¹, Kritin Karkare¹, Tzyy-Ping Jung¹

¹University of California San Diego

3-D-38 WOMBATS: Wearable mOdular Multi-modal Biosensing Acquisition and Tracking System

Siddharth Siddharth 1, Aashish Patel 1, Tzyy-Ping Jung 1, Terrence Sejnowski $^{2}\,$

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3-D-39 STRUM: A Task Battery for Neuroergonomics Research

Tim Mullen¹, Scott Makeig² ¹Intheon, ²University of California San Diego

Poster Sessions

F. Signal Analysis

3-F-40 Towards reducing calibration in BCI: Artificial EEGs generation by deep learning

Wonjun Ko¹, Jee Seok Yoon¹, Heung-II Suk¹

¹Korea University

3-F-41 EEG-derived interhemispheric connectivity as a neurophysiological indicator of post-stroke recovery outcome

Donatella Mattia¹, Manuela Petti², Jlenia Toppi², Laura Astolfi², Febo Cincotti³, Floriana Pichiorri⁴

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3-F-42 A fast classifier for somatosensory brain-computer interface

Jiangbo Pu¹, Jianing Li¹, Yong Hu²

¹Institute of Biomedical Engineering, Chinese Academy of Medical Sciences & Peking Union Medical Colle, ²The University of Hong Kong

3-F-43 Real time classification between uni- and bimanual motor imagery task for BCI controlled functional electrical stimulation

Aleksandra Vuckovic¹, Sara Pangaro²

¹University of Glasgow, ²University Campus Bio-Medico di Roma

3-F-44 Steps towards sensitizing EEG feature identification in paediatric brain signals for use in BCIs

Eli Kinney-Lang¹, Loukianos Spyrou¹, Ephrem Zewdie², Abdullah Azeem³, Adam Kirton², Javier Escudero¹

¹University of Edinburgh, ²Cumming School of Medicine, University of Calgary, ³University of Calgary

3-F-45 Enhancing the BCI Performances for steady-state visual evoked potentials around ear

No-Sang Kwak¹, Seong-Whan Lee¹

¹Korea University

3-F-46 EEG data evaluation based on fuzzy clustering for improving classification accuracy

Jianguo Wang¹, Zhifu Deng¹, Zhiduo Cao¹, Banghua Yang¹

¹Shanghai University

3-F-47 A study of the role of attention in classifying covert and overt motor activities

Banghua Yang¹, Jinlong Wang¹, Cuntai Guan², Chenxiao Hu¹, Jianguo Wang¹

¹Shanghai University, ²Nanyang Technological University

3-F-48 Decoding lip movements during continuous speech using ECoG

Srdjan Lesaja¹, Christian Herff², Garett Johnson¹, Jerry Shih³, Tanja Schultz², Dean Krusienski¹

¹Old Dominion University, ²University of Bremen, ³University of California San Diego

3-F-49 Boosting communication speed and accuracy for P300 BCI spellers

Luigi Bianchi¹, Matteo Cosmi², Chiara Liti¹, Veronica Piccialli¹ ¹University of Rome "Tor Vergata", ²"Roma Tre" University

3-F-50 Single-trial target detection with

magnetoencephalography with multiple difficulty levels Hubert Cecotti¹

¹California State University, Fresno

3-F-51 Nine automatic artifact rejection algorithms all decrease P3 speller accuracy

Katie Dhuyvetter¹, Jane Huggins², David Thompson¹

¹Kansas State University, ²Direct Brain Interface Laboratory, University of Michigan

3-F-52 BCPy, an open-source python platform for offline EEG signals decoding and analysis

Aurélien Appriou¹, Léa Pillette¹, Andrzej Cichocki², Fabien Lotte¹

¹Inria, LaBRI (Univ. Bordeaux, CNRS, Bordeaux-INP), France / RIKEN BSI, Wakoshi, Japan, ²RIKEN BSI, Wakoshi, Japan / SKOLTECH, Moscow, Russia

3-F-53 Area-to-area transfer improves single-channel SSVEP classification

Chi Man Wong¹, Ze Wang¹, Ka Fai Lao¹, Feng Wan¹

¹University of Macau

3-F-54 Artifact propagation in electrocorticography stimulation

Jeffrey Lim¹, Po Wang¹, Susan Shaw¹, Michelle Armacost¹, Hui Gong¹, Charles Liu¹, Payam Heydari¹, An Do¹, Zoran Nenadic¹

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3-F-55 Does previous experience with a steady-state visual evoked potential-based BCI for text-entry affect user performance?

James Norton¹, Nisha Patel², Timothy Bretl²

¹Wadsworth Center, New York State Department of Health, ²University of Illinois at Urbana-Champaign

3-F-56 Investigating spatio-temporal aspects of feedbackrelated brain activity in motor imagery brain-computer interfaces

Mahta Mousavi¹, Virginia de Sa¹ ¹University of California San Diego

3-F-57 Between class CCA for SSVEP based BCI

Ze Wang¹, Chi Man Wong¹, Ka Fai Lao¹, Feng Wan¹ ¹University of Macau

H. 2018 BCI Award Nominees

3-H-58 Generating handwriting from multichannel emg

Alexei E. Ossadtchi¹, Elizaveta Okorokova², Joseph S. Erlichman³, Valery I. Rupasov⁴, Mikhail A. Lebedev^{1,5}, Michael Linderman⁴

¹National Research University Higher School of Economics, ²University of Chicago, ³St. Lawrence University, ⁴Norconnect Inc., ⁵Duke University

3-H-59 Real-time EEG control of a dexterous hand exoskeleton embedded with synergies

Martin Burns¹, Dingyi Pei¹, Ramana Vinjamuri¹

¹ Department of Biomedical Engineering, Stevens Institute of Technology.

3-H-60 Neural decoding of attentional selection in multi-speaker environments without access to clean sources

James O'Sullivan², Zhuo Chen¹, Jose Herrero⁴, Guy M McKhann³, Sameer A Sheth³, Ashesh D Mehta⁴, Nima Mesgarani^{1,2}

¹Department of Electrical Engineering, Columbia University, ²Mortimer B Zuckerman Mind Brain Behavior Institute, Columbia University, ³Department of Neurological Surgery, The Neurological Institute, ⁴Department of Neurosurgery, Hofstra-Northwell School of Medicine and Feinstein Institute for Medical Research

3-H-61 BCI-based regulation of arousal improves human performance in a demanding sensory-motor task

J. Faller¹, J. Cummings¹, S. Saproo¹, P. Sajda^{1,2}

¹Department of Biomedical Engineering, Columbia University, ²Data Science Institute, Columbia University

3-H-62 Brain-to-speech: Direct synthesis of speech from intracranial brain activity associated with speech production

Christian Herff¹, Lorenz Diener¹, Emily Mugler³, Marc Slutzky³, Dean Krusienski², Tanja Schultz¹

¹Cognitive Systems Lab, University of Bremen, ²ASPEN Lab, Old Dominion University, ³Departments of Neurology, Physiology, and Physical Medicine & Rehabilitation, Northwestern University.

3-H-63 Restoring functional reach-to-grasp in a person with chronic tetraplegia using implanted functional electrical stimulation and intracortical brain-computer interfaces

Abidemi Bolu Ajiboye^{1,2,6}, Francis R. Willett^{1,2,6},

Daniel R. Young^{1,2,6}, William D. Memberg^{1,2,6}, Brian A. Murphy^{1,2,6}, Jonathan P. Miller^{2,4,6}, Benjamin L. Walter^{2,3,6}, Jennifer A. Sweet^{2,4,6}, Harry A. Hoyen^{5,6}, Michael W. Keith^{5,6}, Paul Hunter Peckham^{1,2,6}, John D. Simeral^{78,9,10}, John P. Donoghue^{8,9,12}, Leigh R. Hochberg^{7,8,9,10,11}, Robert F. Kirsch^{1,2,4,6}

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3-H-64 A BCI-based language training for patients with chronic aphasia

Michael Tangermann^{1,3}, David Hübner^{1,3}, Simone Denzer, Atieh Bamdadian⁴, Sarah Schwarzkopf^{2,3}, Mariacristina Musso^{2,3}

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3-H-65 Neuromotor recovery based on BCI, FES, virtual reality and augmented feedback for upper limbs

Robert Gabriel Lupu¹, Florina Ungureanu¹, Oana Ferche², Alin Moldoveanu²

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3-H-66 A dynamic window SSVEP-based brain-computer interface system using a spatio-temporal equalizer

Chen Yang¹, Xiang Li¹, Shangkai Gao¹, Xiaorong Gao¹

¹Department of Biomedical Engineering, Tsinghua University Beijing

3-H-67 Successful mutual learning with two tetraplegic users: The Cybathlon BCI race experience

S. Perdikis¹, L. Tonin¹, S. Saeedi¹, C. Schneider¹, J. del R. Millán¹ ¹École Polytechnique Fédérale de Lausanne (EPFL)

3-H-68 A wireless sensory interface to inform goaldirected actions

Andrew G. Richardson¹, Yohannes Ghenbot¹, Xilin Liu², Han Hao², Sam DeLuccia¹, Gregory Boyek¹, Solymar Torres-Maldonado¹, Firooz Aflatouni², Jan Van der Spiegel², Timothy H. Lucas¹

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3-H- 69 Longitudinal training and use of non-invasive motor imagery BCI by an incomplete locked-in user

S. Perdikis¹, S. Saeedi¹, J. del R. Millán¹

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