Seventh International BCI Meeting

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
Schiedberg | Graz | Barcelona | New York
www.gtec.at | office@gtec.at
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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

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Marc Slutzky Northwestern University, USA
Jonathan Wolpaw Wadsworth Center New York State, Department of Health, USA

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Chuck Anderson Student Awards, NSF, Sponsors and Exhibitors
Jennifer Collinger Student Awards, Publicity
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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
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 Merrill 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
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  Workshop BCI+ — Hands-on workshop presenting a framework for BCI-related research
Scripps  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  Opening 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

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**  

**Controlling high-complexity robotic swarms with low-complexity EEG brain-computer interfaces**  
**Gregory H Canal**, Yancy Diaz-Mercado, Magnus Egerstedt, Christopher J Rozell

**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

12:00 – 13:00 Lunch  Croker Dining Hall

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
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 Coluciello, 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

15:30 – 17:30 Poster & Exhibitor Demonstrations Session 3
Fred Farr & Kiln

18:00 – 20:30 Open Air BBQ
The Meadow

19:30 – 20:30 Master Classes Session 1
See Master Class list on page 21

20:30 – 22:00 2018 BCI Award Ceremony
The Meadow

Thursday, May 24

7:30 – 9:00 Breakfast Croker Dining Hall

9:00 – 12:00 Workshops Session 2 For presenters see details on page 14.
Refreshments

Nautilus West WS 2: BCIs for assessment of locked-in and DOC patients
Nautilus East WS 4: Turning negative into positives! Exploiting “negative” results in Brain-Machine Interface research
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

12:00 – 13:00  Lunch  Croker Dining Hall

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

16:30 – 17:30  Master Classes Session 2
See Master Class list on page 21

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
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 pick up**
Merrill Hall

Notes
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 Kostoskajka, 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 Sburlaeu, 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
David 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 Ergogmus, 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 Maioolo, 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
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
Katy 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)
Pietro-Jan Kindermans, Google
Michael Tangermann, University of Freiburg

WS 20: Perception of sensation restored through neural interfaces • HEATHER
Luke Bashford, California Institute of Technology
Silman 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 Burton 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 Burton 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. Burton 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. Burton 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. Burton 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 post-doctoral 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

**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).

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
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 clinician-researcher 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-the-art, 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 (iBCIs) 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 self-feeding. 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 at-home 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 Comalmarino, 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
Méthode 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
Rooollah Jafari Deligani, University of Rhode Island
Eli Kinney-Lang, University of Edinburgh
Reinmar Kobler, Graz University of Technology
Koji Kozumi, The University of Tokyo
Laurens Krol, Technische Universität Berlin
Srdjan 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
Efrain 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
Xiaqian Yu, University of South Florida
Xixie Zhang, Technical University of Berlin
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.

**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

**g.tec**  
**Session 1**: g.Nautilus 64 channels
**Session 2**: g.Nautilus-fNIRS
**Session 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
# Poster Author Index

## Poster Sessions

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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.

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**

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

¹Northeastern University, ²Lafayette 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 Moritz²

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 Taylor¹, Tyler Johnson², Frank Willett³, Harrison Kalodimos², Vishvhaan Gopalakrishnan³

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

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 Hessburg², 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 Hochberg³, Jaimie Henderson¹, Krishna Shenoy¹

¹Stanford University, ²UCLA, ³Emory University, ⁴Brown University

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 Saad², Jessica Kelemen³, Brian Franco², Leigh Hochberg³, John Simeral³

¹Brown University, ²Massachusetts General Hospital, ³Rehabilitation R&D Service

### 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 Hugueville¹, Ankit Khambhati¹, Danielle Bassett¹, Fabrizio De Vico Fallani¹

¹INRIA-ICM, ²CNRS, ³ICM-UPMC-INSERM-CNRS, ⁴University of Pennsylvania

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
1-C-12 Query exploration for intended task state estimation with BCI
Aziz Kocanaogullari¹, Paula Gonzalez-Navarro¹, Tab Memmott², Betts Peters³, Murat Akcakaya⁴, Deniz Erdoğmus¹
¹Northeastern University, ²Oregon Health & Science University, ³Institute on Development and Disabilities, Oregon Health & Science University, ⁴University of Pittsburgh

1-C-13 A novel detection method of driving emergency situations using EEG and surroundings
Luzheng Bi¹, Huikang Wang¹, Jinling Lian¹
¹Beijing Institute of Technology

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 Zakay¹, Lior Shmuelof¹, Amjad Abu-Rmleh¹
¹Ben-Gurion University of the Negev

1-C-16 Developing a streaming-based P300 BCI paradigm with auditory and tactile stimuli: Effects of training on efficiency, effectiveness and satisfaction
Philipp Ziebell¹, Jana Sumpfig¹, Sonja Kleih¹, Andrea Kübler¹, Marc Erich Latschik¹, Sebastian Halder²
¹University of Würzburg, ²University of Oslo

1-C-17 A novel BCI speller combining dot-based visual stimuli and user voluntary sound-imagery task
Hong-Kyung Kim¹, Min-Ho Lee¹, Seong-Whan Lee¹
¹Korea University

1-C-18 Development of cognitive brain-machine interface based on visual imagery
Koji Koizumi¹, Kazutaka Ueda¹, Masayuki Nakao¹
¹The University of Tokyo

1-C-19 Answering questions in prolonged disorders of consciousness with a brain-computer interface
Damien Coyle¹, Natalie Dayan², Jacqueline Stow³, Jacinta McElligott³, Aine Carroll²
¹Ulster University, ²NeuroConcise, ³National Rehabilitation Hospital (NRH)

1-C-20 Habitation of P300 in the use of P300-based brain-computer interface (BCI)
Xiaoqian Yu¹, Theresa M Vaughan², Emanuel Donchin¹
¹University of South Florida, ²National Center for Adaptive Neurotechnologies, Wadsworth Center

1-C-21 The value-complexity trade-off for reinforcement-learning-based BCI
Hadar Levi Aharoni¹, Michal Moshkowitz¹, Stas Tiomkin¹, Bar Iluz³, Sarel Duanis¹, Naftali Tishby¹
¹The Hebrew University of Jerusalem

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
¹Hanyang University

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
¹Graz University of Technology

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 McCanne⁴, Jonathan R Wolpaw⁴, Dennis J McFarland⁴
¹University of Glasgow, ²Burke Medical Institute, ³New York State Department of Health, ⁴National Center for Adaptive Neurotechnologies, Wadsworth Center

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
¹Hanyang University

1-D-28 EEG-based neglect assessment
Murat Akcakaya¹, Aya Khalaf¹, Safaa Eldeeb¹, Jessica Kersey, Gazihan Alankus², Emily Grattan³, Laura Waterstam¹, Elizabeth Skidmore¹
¹University of Pittsburgh, ²Izmir University of Economics, ³Medical University of South Carolina

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
¹Zhejiang University of Technology

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
¹University of North Texas

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
¹University of Tennessee, Knoxville, ²University of California, Berkeley, ³University of Kentucky, Lexington
**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 Marurí⁵, Olufemi Oluwafemi⁶
¹University of Southern California, ²Intel Corporation, ³Northeastern University, ⁴Volkswagen Group

**1-D-36 Fronto-central theta oscillations reflect cognitive monitoring processes in collision avoidance tasks**
Ruslan Aydarkhanov¹, Marija Uscumlic², Ricardo Chavarriaga¹, José del Millán¹
¹Ecole Polytechnique Fédérale de Lausanne (EPFL), ²Nissan International SA

**1-D-37 Noise-tag BCI for covert selective attention in different modalities**
Sara Ahmadi¹, Marzieh Bohranazad¹, Peter Desain¹
¹Radboud University, Donders Center for Cognition

**1-D-38 Towards multiclass brain-computer interface for joint human-computer image analysis**
Steven Gutstein¹, Brent Lance¹, Anthony Ries¹, Vernon Lawhern¹, David Slayback¹
¹U.S. Army Research Laboratory

**1-D-39 An EEG measure for individual written text difficulty assessment in neuroadaptive learning environments**
Lena Andreessen¹, Peter Gerjets², Detmar Meurers³, Thorsten Zander⁴
¹TU Berlin, ²Leibniz-Institut für Wissensmedien, ³Eberhard-Karls-Universität Tübingen, ⁴Zander Laboratories B.V.

**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 Mattout⁶
¹Potioc Inria, and CRNL Inserm, ²Ullo, ³Lyon Neuroscience Research Center, ⁴Gate CNRS, ⁵Inria, LaBRI (Univ. Bordeaux, CNRS, Bordeaux-INP), France / RIKEN BSI, Wakoshi, Japan

**1-D-41 HAIL: A human-autonomy crowdsourcing approach to image classification**
David Slayback¹, Vernon Lawhern¹, Nicholas Waytowich¹, Addison Bohannon¹, Steven Gutstein¹, Brent Lance¹
¹U.S. Army Research Laboratory

**1-D-42 Neurofeedback improves SSVEP BCI performance on subjects with both ‘high’ and ‘low’ performance**
Qi Tang¹, Wenya Nan¹, Feng Wan², Yong Hu²
¹Shanghai Normal University, ²University of Macau, ³The University of Hong Kong

**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
¹National Chiao Tung University, ²University of Texas at San Antonio, ³University of California, San Diego

**1-D-45 Toward automatized placement of visual stimuli for gaze-independent SSVEP-BCI**
Anibal Cotrina¹
¹Federal University of Espirito Santo

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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

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**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 Giraldo¹, 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**
Qi Qi 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 Salari¹, Zachary Freudenburg¹, Mariska Vansteensel¹, Nick Ramsey¹
¹Brain Center Rudolf Magnus, University Medical Center Utrecht

1-F-53 EEG-guided electrotactile stimulation for haptic feedback
Doug Weber¹, Safaa Eldeeb¹, Aya Khalafi¹, Murat Akcakaya¹, Deniz Erdogmus¹
¹University of Pittsburgh, ²Northeastern University

1-F-54 Post-hoc labeling of arbitrary EEG recordings for data-efficient 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 pre-movement 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

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 Grealy³, Alex Duffy², Pei Ling Choo², Damien Coyle¹
¹Ulster University, ²University of Strathclyde, ³University College London

1-F-60 Prediction of subject-specific affects in music listening using SPoC
Amna Ghani¹
¹Charité

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 McCane³, Dennis J McFarland³, Theresa M Vaughan³, Jonathan R Wolpaw⁴, Debra J Zetlin⁵, Dean Krusienski⁵, Yalda Shahriari¹
¹University 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
Eimar G. M. Pels¹, Mariana Branco¹, Ruben Sars², Erik Aarnoutse¹, Mariska Vansteensel¹, Nick Ramsøy¹, 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 tetraplegic
Sam Colachis¹, Marcie Bockbrader¹, Mingming Zhang², David Friedenberg², Nicholas Annetta², Michael Schwemmer³, Nicholas Skomrock², Jerry Mysiw⁴, Ali Rezai¹, Herbert Bresler², Gaurav Sharma¹
¹The Ohio State University, ²Battelle

Benjamin Ferleger¹, Sebastián Castaño-Candamil², Andrew Haddock³, Brady Houston¹, Michael Tangermann², Howard Chizeck³
¹University of Washington, ²University of Freiburg

2-A-3 Control of multiple hand movements using cortically-controlled, non-invasive muscle stimulation in a tetraplegic person
David Friedenberg², Sam Colachis¹, Nicholas Annetta¹, Mingming Zhang¹, Nicholas Skomrock², Michael Schwemmer¹, W. Jerry Mysiw⁴, 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 Yu⁵, Michael Boninger¹, Robert Gaunt¹, Jennifer Collinger¹, Nicholas Gulachek¹, Bin He¹
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 SSVEP-based brain-computer interface using electroencephalography
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 Weiss⁴, Cody Wabiszewski¹, Timothy Verstynen¹, 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 Angričik¹, Christian Herrf¹, Emily Mugler², Marc Slutzky³, Dean Krusienski³, Tanja Schultz¹
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 multipip-electrodes for closed-loop grasp pattern control
Gernot Müller-Putz¹, Andreas Schwarz², Joana Pereira³, Patrick Oßner¹, Andreas Pinegger¹, Matthias Schneider³, Björn Hessing, Andrew Ramsey³, Roderick Murray-Smith³, Carlos Escalona², Luis Montesano³, Granit Luzhnica¹, Eduardo Veas², Jan Loitz³, Rüdiger Rupp⁴
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 Steiger¹, Christopher Cline¹, Christopher Coogan¹, Bhavani Sai Rohit Murakonda¹, Samantha Sherman¹, Andy Huyhn⁴, Desiree Hammond¹, Kīt 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-Té Wang¹, Tzy-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 Zhang³
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 Semi-automatic physiologically-driven feature selection improves the usability of a brain computer interface system in post-stroke motor rehabilitation
Emma Colamarino¹, Floriana Pichiorri², Donatella Mattia³, Febo Cincotti⁴
¹Sapienza University of Rome, ²Fondazione Santa Lucia-IRCCS

2-C-18 Post-stroke rehabilitation training with a brain-computer interface: clinical and neuropsychological study
Guzel Aziatskaya¹, Roman Lyukmanov¹, Olesya Mokienko¹, Nataliya Varako¹, Alexander Frolov², Lyudmila Chemikova¹, Natalya Suponova¹, Michael Piradov¹
¹Research Center of Neurology, ²Institute of Higher Nervous Activity and Neurophysiology of RAS (IHNA&NH RAS)

2-C-19 Can the MIQ-R 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 McFarland¹, Alex Miner¹, Steven Cramer¹, Eric Wolffbrecht¹, Jonathan R Wolpaw¹, 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, Debra Zeitlin¹, Gaelle Mougin¹
¹Ecole Polytechnique Fédérale de Lausanne (EPFL), ²University Hospital of Tübingen, ³Keio University, ⁴WYSS Center for Bio and Neuroengineering, ⁵MindMaze SA

2-C-22 Evaluation of a congruent auditory feedback for motor imagery BCI
Emmanuel Christophe¹, Jérémy Frey², Richard Kronland-Martinet³, Jean-Arthur Micoulaud-Franchi³, Jelena Mladenovic⁴, Gaelee Mougín⁵, Jean Vion-Dury¹, Solvi Ystad², Mitsuko Aramaki²
¹University of California Irvine, ²National Center for Adaptive Neurotechnologies, Wadsworth Center, ³University of Idaho

2-C-23 BCI-based operation of Microsoft Active Accessibility (MSAA) compatible TOBI Dynavox Communicator 5
Theresa M Vaughan¹, Kamila Gospmanaeva², Charles Carmack³, David Goldberg⁴, Kelly Fitpatrick⁴, 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 Ang², Cuntai Guan⁴
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 of 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 Valeriani¹, Saugat Bhattacharyya¹, Caterina Cinel¹, Luca Citi¹, Riccardo Poli¹
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 Weiller³, Mariacristina Musso²
¹University of Freiburg, ²University Medical Center Freiburg

2-D-29 Brain-computer interfaces for post-stroke motor rehabilitation: A meta-analysis
Maria Cervera¹, Surjo Soekadar², Junichi Ushiba³, José del Millán¹, Meigen Liu², Niels Birbaumer¹, Gangadhar Garipelli²
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)
2-D-33 Zero-calibration c-vep BCI using word prediction: A proof of concept
FedERICA Turtì1, Nathalie Gayraud2, Maureen Clerc3
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, Sungchan Lee3, Kyungho Won1, Jongmin Lee3, Minkyu Ahn3, Sung Chan Jun1
1Gwangju Institute of Science and Technology, 2Wadsworth Center, New York State Department of Health, 3Handsworth 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 Appriou2, 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
1Radboud 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 Yamani3, Hector Garcia4, Srdjan Lesaja4, Krzysztof Rechocicz4, Saikou Diallo5, Dean Krusienski1
1Old Dominion University, 2University of Bremen

2-D-39 Clinician awareness of Brain-Computer Interfaces and eligible populations.
Sasha Letourneau1, Ephrem Zewdie2, Lee Burkholder3, John Andersen1, Adam Kirtun2
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 of California, San Diego, 2University of Chicago, 3Graduate School of Medical Sciences, Kyushu University, 4Osaka University Graduate School of Medicine

2-D-42 Toward a hemicraniectomy-EEG based BMI therapy for the rehabilitation of patients with traumatic brain injury
Muktad Vaidya1, Robert Flint2, Po Wang3, Alex Barry4, Goran Tomic1, Emily Mugler1, Sarah Gallick5, Sangeeta Driver9, Nenad Brkic3, David Ripley8, Charles Liu1, An Do2, Marc Slutzky1
1Northwestern University, 2University of California, Irvine, 3Shirley 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 Schild1, Elizabeth Powell2, Yuvaraj Rajamaniickam1, Matthew Ballard1, Sara Salles1, Lumy Sawaki1, Sridhar Sunderam1
1University of Kentucky

2-D-45 Multi-paradigm EEG classification using deep neural networks
Gabriel Ibarra1, 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, Yadla Shahriri1
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 Hirata2, Kazutaka Takahashi3, Seiji Kameda1, Fumiaki Yoshida1, Takufumi Yanagisawa1, Satoru Oshino3, Toshihiko 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
1University od California, 2University of Technology, 3University of Essex

2-F-52 Reading out reinforcement learning strategies underlying trial-by-trial choice behavior
Dongjiao 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 Michelli², Pieter Marsman², 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 brain-computer 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 Fragá¹
¹Federal University of ABC (UFABC), ²Institut 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 Antonacci¹, Jenia Toppi¹, Antonio Pietrabissa¹, Donatella Mattia², Laura Astolfi¹
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, Snehaj Rajen¹,
Jane Huggins¹, Melanie Fried-Oken²
¹Direct Brain Interface Laboratory, University of Michigan, ²Institute on Development and Disabilities, Oregon Health & Science University
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-of-freedom virtual object by a person with paralysis using an intracortical BCI
Sergey Stavisky¹, Paul Nuyujukian¹, Chethan Pandarinath², Beata Jarosiewicz¹, Leigh Hochberg³, Krishna Shenoy¹, Jaimie Henderson¹
¹Stanford University, ²Emory University, ³Brown University

Eric Trautmann¹, Daniel O’Shea¹, Xulu Sun¹, Stephen Ryu¹, Lucas Cofer¹, James Marashi¹, Will Allen¹, Isaac Kauer¹, Gergö Bohmer⁵, Charu Ramakrishnan¹, Maneesh Sahani², 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 Branco², Zachary Freudenburg², 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

B. 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 low-complexity 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
¹Cumming School of Medicine, University of Calgary, ²Ludwig Maximillian University of Munich, ³University of Calgary

3-C-13 Online decoding of gait-related lower-limb movement intention
Kyuwha Lee¹, Tiffany Corbett¹, Ruslan Aydarkhanov¹, Luca Randazzo¹, Ricardo Chavarriaga¹, José del R. Millán¹
¹Ecole Polytechnique Fédérale de Lausanne (EPFL)

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 Bella³, Krzysztof Malejº, Alexander Heilinger¹, Günter Edlinger¹
¹g.tec medical engineering, Guger Technologies, ²ALS Clinical Research Center, BioNeC, University of Palermo, ³Post-ICU Neurorehabilitation Unit - University Hospital of Nîmes, ⁴Neuro Device Group
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
¹Ecole Polytechnique Fédérale de Lausanne (EPFL)

3-D-20 EEG correlates of decision confidence in feedback processing
Tanja Krümpel¹, 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
¹Graz University of Technology

3-D-22 BciPy: A python framework for brain–computer interface research
Tab Memmott¹, Aziz Kocanaogullari², Deniz Ergodmus², Steven Bedrick¹, Betts Peters¹, Melanie Fried-Oken¹, Barry Oken¹
¹Oregon Health & Science University, ²Northeastern University

3-D-23 Decoding differences in continuously executed and observed tracking movements from EEG signals
Reinmar Kobler¹, Andreea Sburlea¹, Gernot Müller-Putz¹
¹Graz University of Technology

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
¹University of Pittsburgh

3-D-25 Effect of query length and prospect symbol confidence in EEG-based typing systems
Paula Gonzalez-Navarro¹, Moonyoung Kwon¹, Sunghan Lee¹, Jongmin Lee², Minkyu Ahn², Sung Chan Jun¹
¹Gwangju Institute of Science and Technology, ²Handong Global University

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
¹Gwangju Institute of Science and Technology, ²Handong Global University

3-D-31 ERP prevalence and effects of stimulus features and attention on MMN and P300
Matthias Eidel¹, Helena Eribeck¹, Ruben Real², Andrea Kübler¹
¹University of Würzburg, ²Medical University Goettingen

3-D-32 Towards an EEG-based covert attention brain-computer 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
¹EPFL / Inria, ²École Polytechnique Fédérale de Lausanne (EPFL), ³Wyss Center, ⁴Univ. Rennes, Inria, IRISA, CNRS

3-D-33 Gaze versus EEG-based control of a visual P300 BCI in healthy children
Mélodie Fouillen¹, Emmanuel Maby², Lucie Le Carrer³, Jérémy Mattout²
¹Centre de Recherche en Neurosciences de Lyon, ²Lyon Neuroscience Research Center, ³Hospices Civils de Lyon

3-D-34 Automated EEG enhancement and recurrent neural networks for lane change prediction during driving
Marc-Antoine Moinnereau¹, Sam Karimian-Azar¹, Tsuyoshi Sakuma², Hidenori Boutani³, Lucian Gheorghe³, Tiago H. Falk³
¹Institut National de la Recherche Scientifique (INRS - MuSAE Lab), ²Nissan Motor Corp, Nissan Research Center, Mobility Service Lab

3-D-35 Error potentials for identifying auto-correction errors during tablet-based text entry
Felix Putze¹, Tanja Schultz¹, Wolfgang Stuerzlinger²
¹University of Bremen, ²Simon Fraser University

3-D-36 The factors causing the unstable visual stimulus in portable devices
Kuan-Jung Chiou¹, Wen-Hsuan Chan², Masaki Nakanishi², Yu-Te Wang², Tzyy-Ping Jung²
¹SCCN / UCSD, ²University of California San Diego

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 Siddharth¹, Aashish Patel¹, Tzyy-Ping Jung¹, Terrence Sejnowski²
¹University of California San Diego, ²Salk Institute for Biological Studies

3-D-39 STRUM: A Task Battery for Neuroergonomics Research
Tim Mullen¹, Scott Makeig²
¹Intheon, ²University of California San Diego
F. Signal Analysis

3-F-40 Towards reducing calibration in BCI: Artificial EEGs generation by deep learning
Wonjun Ko¹, Jee Seok Yoon¹, Heung-Il 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
¹Fondazione Santa Lucia IRCCS, ²Sapienza University of Rome, ³Sapienza University of Rome, ⁴Fondazione Santa Lucia-IRCCS

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 College, 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 Kirtan², 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, Jinling 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, Garet Johnson², Jerry Shih³, Tanja Schultz², Dean Krsienski¹
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 Liti², 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 Thompson³
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
¹Imria, 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
¹University of California Irvine

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 feedback-related 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. Rupasov2, Mikhail A. Lebedev1,5, 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
1Department 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 Herrera4, Guy M McKhann3, Sameer A Sheh2, Ashesh D Mehta4, Nima Mesgarani1,2
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. Sajda1,2
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 Herff3, Lorenz Diener1, Emily Mugler1, 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 Ajiboye1,2,6, Francis R. Willett1,2,6, Daniel R. Young 1,2,6, William D. Membarg1,2,6, Brian A. Murphy1,2,6, Jonathan P. Miller2,4,6, Benjamin L. Walter2,3,6, Jennifer A. Sweet2,4,6, Harry A. Hsiao1,2,6, Michael W. Keith1,2,6, Paul Hunter Beckham1,2,6, John D. Simen1,2,6, John P. Donoghue1,2,6, Robert F. Kirsch1,2,4,6
1Department of Biomedical Engineering, Case Western Reserve University, 2Louis Stokes Cleveland Department of Veterans Affairs Medical Center, FES Center of Excellence, 3Department of Neurology, University Hospitals Case Medical Center, 4Department of Neurological Surgery, University Hospitals Cleveland Medical Center, 5Department of Orthopaedics, MetroHealth Medical Center, Cleveland, 6School of Medicine, Case Western Reserve University, 7School of Engineering, Brown University, 8Center for Neurorestoration and Neurotechnology, Rehabilitation R&D Service, Department of Veterans Affairs Medical Center, Providence, 9Brown Institute for Brain Science, Brown University, 10Department of Neurology, Massachusetts General Hospital, 11Department of Neurology, Harvard Medical School, 12Department of Neuroscience, Brown University

3-H-64 A BCI-based language training for patients with chronic aphasia
Michael Tangermann1,3, David Hübler2,3, Simone Denzer, Ateh Bamdad4, Sarah Schwarzkopf2,3, Mariacristina Musso2,3
1Brain State Decoding Lab, Dept. Computer Science, Albert-Ludwigs-Universität Freiburg, 2Department of Neurology, University Medical Center Freiburg, 3Cluster of Excellence BrainLinks-BrainTools, Albert-Ludwigs-Universität Freiburg, 4Inovigate

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
1Computer Engineering Department, “Gheorghe Asachi” Technical University of Iasi, 2Computer Engineering Department, “Politehnica” University of Bucharest

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. Tonic1, S. Saeedi1, C. Schneider1, J. del R. Millán1
1École Polytechnique Fédérale de Lausanne (EPFL)

3-H-68 A wireless sensory interface to inform goal-directed 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
1Department of Neurosurgery, University of Pennsylvania, 2Department of Electrical and Systems Engineering University of Pennsylvania

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
1École Polytechnique Fédérale de Lausanne (EPFL)
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BCI Themes
- 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
Poster and Exhibitor Demonstrations Session 2
Tuesday, May 22 • 15:30 – 17:30

Fred Farr Forum

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BCI Themes
- 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

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BCI Themes
- 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
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