IEEE SMC 2020

IEEE

2020 International Conference
on
Systems, Man, and Cybernetics

Workshop on Brain-Machine Interface Systems

October 11 - 14, 2020
Toronto, Canada

Sponsored by

IEEE SMC
Systems, Man, and Cybernetics

The 2020 IEEE International Conference on Systems, Man, and Cybernetics (SMC 2020) is the flagship conference of the IEEE Systems, Man, and Cybernetics Society. This year, for the first time in the history of the Society, it will be held virtually from Toronto, Canada due to the worldwide COVID-19 pandemic. The conference provides an international forum for researchers to report recent innovations and developments, and to exchange ideas and advances in all aspects of systems science and engineering, human-machine systems, and cybernetics. These are areas of increasing importance to the creation of intelligent environments involving technologies interacting with humans to provide an enriching experience and an improved quality of life.

As part of SMC 2020, the **IEEE SMC 2020 10th Workshop on Brain-Machine Interface (BMI) Systems** will be held virtually from October 11–14, 2020. The goal of the Workshop is to provide a forum to present research results and facilitate the interaction and intellectual exchange between researchers, developers, and consumers of BMI technology. Contributions report the latest advances, innovations, and applications in the field of BMI, including affective BMIs, hybrid BMIs, deep learning for BMIs, neurorehabilitation, BMIs and virtual/augmented reality, and other real-world applications. These topics represent both challenges to the field and a tremendous opportunity for collaborative and multidisciplinary research, thus requiring expertise in systems engineering, human-machine systems, cybernetics, neuroscience, medicine, robotics, and other disciplines. This year's theme is ***The Past, Present, and Future of Neurotechnology Development: Towards the "Internet of Minds"***.

The 2020 BMI Workshop will feature a virtual BR41N.IO BCI Hackathon, six invited speakers, one expert panel, contributed paper presentations, and the 2020 International BCI Award. The Workshop is organized by the *IEEE SMC Technical Committee on Brain-Machine Interfaces Systems* and is technically co-sponsored by the *IEEE Brain Initiative*. This year, we have 45 papers accepted after careful peer-review by experts in BMI-related fields and will be presented across 9 oral sessions covering topics related to: new trends in BMI; BMIs for the assessment of consciousness; brain-inspired cognitive systems; BMIs for robotics and movement sciences; advances in motor imagery BMIs; deep learning for BMIs; mobile BMIs; and passive BMIs for operational environments.

We are also pleased to have six outstanding invited speakers:

- **Christoph Kapeller** (g.tec, Austria): Current & future BCI applications (Sunday, October 11, 10:30-11:00 EDT)
- **Martin Walchshofer** (g.tec, Austria): *(1) How to run a real-time BCI and (2) Unicorn BCI demonstration* (Sunday, October 11, 11:00-12:00 EDT)
- **Tim Mullen** (Intheon, USA): *LSL & NeuroPype tools for BCI applications* (Sunday, October 11, 12:00-12:30 EDT)
- **Adam Kirton** (Alberta Children's Hospital, Canada): *Clinical applications of BCIs in pediatric populations* (Sunday, October 11th, 15:00-15:45 EDT)
- **Dean Krusienski** (VCU, USA): *Recent Progress in Intracranial Speech Decoding and Cognitive-state Monitoring in VR* (Monday, October 12, 12:30-13:30 EDT)
- **Ana Maiques** (Neuroelectrics, Spain): *Neurotech: from helping patients in need to changing the way humans interact* (Wednesday, October 14, 12:30-13:30 EDT)

Virtual BR41N.IO Brain-Computer-Interface Hackathon
Hackathons are two-day brainstorming and collaborative marathons that create an environment supporting the rapid production of working prototypes. Registered SMC 2020 attendees interested in BCI/BMI and related technologies may participate in the **free** *Brain Computer Interface Hackathon* organized by the BMI Workshop to be held on Sunday, October 11th and Monday, October 12th, 2020. There are $3,000 in cash prizes to be won. Register at https://www.br41n.io/Toronto-2020 or email guger@gtec.at if you have questions.

Expert Panel
This year we will feature one virtual expert panel on the theme of ***BMIs in the Clinic – Emerging Applications*** (Sunday, October 11th, 16:15-17:00 EDT). Panelists include Dr. Adam Kirton (Alberta Children's Hospital), Dr. Dora Hermes Miller (Mayo Clinic), and Dr. Aysegul Gunduz (University of Florida). Dr. Christoph Guger (g.tec) will moderate the discussion. They will share their research on clinical BCI applications for pediatric patients, deep brain stimulation, and for the development of biomarkers for neurological and neuropsychiatric diseases.

International BCI Award

The International BCI Award, endowed with US$6,000 prize, is one of the top accolades in BCI research. The BCI Award was created to recognize outstanding and innovative research in the field of Brain-Computer Interfaces. Twelve projects are nominated, and the winner will be announced at the BCI Award Ceremony on Tuesday, October 13 from 12:30-14:30 EDT by the BCI Award Chair Dr. Christoph Guger.

10th Anniversary Celebrations

We will celebrate the 10 years of the BMI Workshop with two live virtual events. Join us on Tuesday, October 13th from 19:00-20:30 EDT for a live mixology class over Zoom where you will learn to make a famous Canadian cocktail, followed by a jazz concert from one of Canada's most respected and influential jazz artists.

We will then close the Workshop with a live virtual celebration of the 10 years of the BMI Workshop. Join us on Wednesday, October 14 from 17:30-19:00 EDT to revisit some fun stories from previous editions, see some friends, and celebrate the great people behind the ten years of the Workshop.

Organization Committee and Supporters

We would like to thank the many individuals who worked hard in organizing the Workshop, including the Technical Program Co-Chairs: *Abdelkader Belkacem, Sarah Power* and *Teodiano Bastos*; Special Session Co-Chairs: *Tim Mullen, Sri Krishnan, Francisco Fraga, and Stefanie Blain-Moraes*; Industry Co-Chairs: *Ferdinand Ephrem* and *Javier Minguez*; Publicity Chair: *Yannick Roy*; Student/Young Professional Liaisons: *Soumiya Sivasathiyanath* and *Behnaz Ghoraani*, Media Relations Chair: *Sarah Breinbauer*, and Webmaster: *Liviu Ivanescu*, as well as Brain Hackathon Chair and Co-Chairs: *Christoph Guger, Tiago H. Falk, Adam Kirton, Tim Mullen, Ning Jiang*, and *Diana Ghinda*. Special thanks to also all the Special Session organizers: *Christoph Guger, Ivan Volosyak, Tim Mullen, Tiago H. Falk, Stefanie Blain-Moraes, Amy Kruse, Yingxu Wang, Dongrui Wu, Christian Kothe, Luca Tonin, Luca Ascari, Andrew Law, Tzyy-Ping Jung*.

We also thank the BMI Workshop supporters for their generous funding: IEEE Brain, g.tec, SMC, and Intheon.

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<p style="text-align:center">**Virtual BR41N.IO Brain Hackathon**
Sunday October 11, 9:00 – Monday October 12, 18:00 (EDT)</p>

What is it?
BR41N.IO Brain Hackathon is a brainstorming and collaborative marathon designed to be a learning experience for developers, technologists, engineers, students, artists, and scientists who cram and build brain-computer interface (BCI) applications together in teams.

Who can participate?
Anyone can participate who has interests in BMI, BCI, robotics, AR, VR, machine learning, computing, sensors, human-machine interface systems, control, signal processing, big data, haptics, rehabilitation, and similar areas. Participants do not have to be a BMI expert to participate on a team!

What's in there for me?
Be creative, think outside the box. The best BR41N.IO projects will be awarded with cash prizes:

- BR41N.IO Intheon Prize: $ 1,000
- BR41N.IO IEEE SMC Prize: $ 1,000
- BR41N.IO IEEE Brain Prize: $ 1.000

Schedule
See schedule summary on the next page

HOW TO PARTICIPATE

Step 1: Sign up for a project
There are several predefined projects which you can choose to work on. The projects are described in detail at https://www.br41n.io/Toronto-2020. Participants can use their own hardware and software, if available.

Step 2: Meet your team virtually
Organizers will connect you with the team members of your project. Create your own virtual meeting space using Skype, Google Hangouts, Zoom, etc. to start working on your ideas.

Step 3: Stay connected via Slack
While you work on your groundbreaking new BCI applications, organizer will be available on slack to answer all the questions that might come up and support you wherever they can via Slack.

Step 4: Present your projects virtually and win
You will be invited to present your results virtually via Zoom. Prepare yourself to explain what you did, what the results are and to show a demonstration (live or with a video) to the international audience.

<p style="text-align:center">**Sponsors**</p>

IEEE SMC 2020 Workshop on Brain-Machine Interface Systems - Program Summary

	Sunday, October 11	Monday, October 12	Monday, October 12	Tuesday, October 13	Wednesday, October 14
	Hackathon	Paper Session	Hackathon	Paper session	Paper session
6:00			Start BR41N.IO Hackathon (Christoph Guger)		
9:00-10:00	BR41N.IO Hackathon Press Conference				
10:00-10:30	Welcome				
10:30-11:00	Current and future applications of brain-computer interfaces (Christoph Kapeller)		Hacking		
11:00-11:30	How to run a real-time BCI application (Martin Walchshofer)	BMI Session 1: New Trends in Neural Interfacing (Chairs: Christoph Guger and Ivan Volosyak) 447, 498, 782, 858, 1155		BMI Session 4: New Trends in Neural Interfacing - II (Chair: Ivan Volosyak) 476, 714, 830, 911, 1168	BMI Session 7: Deep Learning for BCIs (Chairs: Abdelkader Belkacem and Tim Mullen) 386, 395, 1177, 1225, 1226
11:30-12:00	Unicorn Brain Interface Demonstration (Martin Walchshofer)				
12:00-12:30	LSL and NeuroPype tools and BCI applications (Tim Mullen)				
12:30-13:00			Recent Progress in Intracranial Speech Decoding and Cognitive-state Monitoring in VR (Dean Krusienski)	BCI Award and Interviews (Christoph Guger)	BMI Industry Keynote: Neurotech: from helping patients in need to changing the way humans interact (Ana Maiques)
13:00-13:30					
13:30-14:00	Start BR41N.IO Hackathon	BMI Session 2: BMIs for the Assessment of Consciousness (Chair: Stefanie Blain-Moraes and Tiago Falk) 428, 659, 685, 703, 903	End BR41N.IO Hackathon	BMI Session 5: BCIs for Robotics and Movement Science (Chairs: Luca Tonin and Luca Ascari) 584, 787, 801, 811, 893	BMI Session 8: Mobile Brain/Body Imaging and BMI (Chairs: Tim Mullen and Christian Kothe) 841, 842, 1044, 1084, 1121
14:00-14:30					
14:30-15:00					
15:00-15:30					
15:30-16:00	Clinical applications of BCIs in pediatric populations (Adam Kirton)	BMI Session 3: Brain-Inspired Cognitive Systems (Chair: Yingxu Wang) 451, 555, 645, 680, 753	Project Presentations (Christoph Guger)	BMI Session 6: Recent Advances in Motor Imagery BCIs (Chair: Sarah Power) 177, 449, 598, 816, 850	BMI Session 9: Passive BCI for Operational Environments (Chairs: Andrew Law and Tiago H. Falk) 770, 914, 1089, 1135, 1174
16:00-16:30	Panel 1: BMIs in the Clinic - Emerging Applications				
16:30-17:00					
17:00-17:30			Meeting of Hackathon Jury		
17:30-18:00			BR41N.IO BCI Hackathon Awards Ceremony (Christoph Guger, Ljiljana Trajkovic)		Panel: Decade of BMI Research
18:00-18:30					
18:30-19:00					
19:00-20:30				BMI Workshop Social Event: 10th Anniversary Celebrations	
24:00:00	BCI Hackathon Night Break				
	Hackathon	BMI Paper Session			BMI Panel
	Hackathon invited speaker	BMI Special Event			BMI keynote