Society for the
Neural Control
of Movement
NCM

35th Annual Meeting

Kobe, Japan
Portopia Hotel

2026

SATELLITE MEETING
April 20, 2026

ANNUAL MEETING
April 21 – 24, 2026

@ncm-soc | #NCMKobe26 | ncm-society.org

Program at a Glance

Portopia Hotel · Schedule is subject to change

Time	Monday 20-Apr	Tuesday 21-Apr	Wednesday 22-Apr	Thursday 23-Apr	Friday 24-Apr
8:00	Registration /Information Desk Open	Registration / Information Desk Open Posters on Display Exhibits on Display *Session 1* *Panel I* Sahni (08:00 - 10:00)	Registration / Information Desk Open Posters on Display Exhibits on Display *Session 5* *Panel II* Haith (08:00 - 10:00)	Registration / Information Desk Open Posters on Display Exhibits on Display *Session 9* *Panel IV* Sun (08:00 - 10:00)	Registration / Information Desk Open Posters on Display *Session 12* *Panel V* Takahashi (08:00 - 10:00)
8:15					
8:30	Satellite Meeting				
8:45					
9:00					
9:15					
9:30					
9:45					
10:00		Break (10:00 - 10:30)	Break (10:00 - 10:30)	Break (10:00 - 10:30)	Break (10:00 - 10:30)
10:15					
10:30		*Early Career Talk* *Pierre Vassiliadis* (10:30 - 11:05)	*Session 6* *Individual II* (10:30 - 12:10)	*Session 10* *Individual III* (10:30 - 12:10)	*Session 13* *Individual IV* (10:30 - 12:10)
10:45					
11:00		*Session 2* *Perspective I* Seki (11:05 - 12:35)			
11:15					
11:30					
11:45					
12:00					
12:15			*Session 7* Posters, Exhibitors & Lunch (12:10 - 15:00)	*Session 11* Posters, Exhibitors & Lunch (12:10 - 15:00)	*Session 14* Posters & Lunch (12:10 - 15:00)
12:30		*Session 3* Posters, Exhibitors & Lunch (12:35 - 15:25)			
12:45					
13:00					
13:15					
13:30					
13:45					
14:00					
14:15					
14:30					
14:45					
15:00			*Session 8* *Panel III* Banerjee (15:00 - 17:00)	Free Time and/or Excursions	*Session 15* *Panel VI* Kadmon Harpaz (15:00 - 17:00)
15:15					
15:30		*Session 4* *Individual I* (15:25 - 17:05)			
15:45					
16:00					
16:15					
16:30					
16:45					
17:00			Members' Meeting (17:00 - 17:30)		*Distinguished Career Award* *Stephen Scott* (17:00 - 18:00)
17:15					
17:30		NCM Board Meeting (17:35 - 20:30) Trainee Social (17:35 - 18:30)	Women in Science Event (17:35 - 18:30)		
17:45					
18:00					Closing Drinks Reception (18:00 - 19:00)
18:15					
18:30			Free Time		
18:45					
19:00	First Timer Social (18:30 - 19:30)				
19:15					
19:30	Opening Reception Portopia Hotel (19:30 - 21:30)			Free Time	
19:45					
20:00					
20:15					
20:30		Free Time			
20:45					
21:00					
21:15					
21:30					
21:45					
22:00					
22:15					
22:30					

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About NCM

The Society for the Neural Control of Movement (NCM) is an international community of scientists, clinician-investigators and students all engaged in research whose common goal is to understand how the brain controls movement.

NCM was conceived in 1990 by Barry Peterson. With an initial leadership team that also included Peter Strick and Marjorie Anderson, NCM was formally established to bring together scientists seeking to understand the neural mechanisms that guide meaningful activities of daily life, primarily through the brain's control of the eyes, head, trunk, and limbs. Early members consisted largely of systems neurophysiologists, behavioral, computational and theoretical neurobiologists, and clinician-investigators interested in disorders of motor function.

From the outset the goal of NCM was to provide a useful gathering of investigators in an informal and casual setting to present and discuss where we are in a diverse and complex field, where we should be going and how we might best proceed as a community with multiple perspectives and approaches. The meeting was to be unique in style, such that sessions were formulated and proposed by small groups of members, each and geared to inform the larger attending community through focused presentations and discussions integrated into themes reflecting the diversity of the membership. Sessions would change in content with each yearly meeting.

The inaugural NCM Conference took place in April 1991 on Marcos Island, Florida, with roughly 140 attendees. The success of the initial years promoted longevity and expansion of NCM and its conference, both in attendance (now over 250) and the breadth of scientific content. Sessions cover all levels of inquiry--from perception to genetic expression, and from whole organism to intracellular function, while also including computational and theoretical approaches. Sessions have expanded to include a variety of formats and durations to accommodate diverse needs and interests, while poster sessions have been augmented to yield highly popular, vibrant and flexible forums of scientific interchange. This highly regarded and robust conference continues to meet in desirable, family-friendly locations typically in late April/early May every year.

Letter from the President

Dear Colleagues,

It is my pleasure to welcome you to Kobe, Japan, for the 35th Annual Meeting of the Society for the Neural Control of Movement.

We are delighted to host this year's meeting in Kobe—a beautiful city, set between mountains and sea, that bridges science, culture, and environment. This year's meeting will take place April 20–24, 2026, at the Portopia Hotel.

We have an exciting program ahead, with a record number of submissions and attendees this year, including over 550 participants. The program includes 20 individual talks selected from 164 submissions, and 7 team panels selected from 27 submissions, as well as 433 posters. It is exciting to see so many members of our community coming together to share ideas and discuss the neural control of movement.

This year's satellite meeting, "Precision neurorehabilitation for movement disorders: Integrating technology, neuroscience, and clinical practice," organized by Lee E. Miller and James Cotton, sets the stage for the week. The satellite will bring together researchers and clinicians to explore how advances in neuroscience and technology can be translated into more precise and effective rehabilitation strategies.

Our main program features two outstanding keynote presentations. On Tuesday, April 21, we will hear from Pierre Vassiliadis (University College London and Imperial College London), winner of the 2026 Early Career Award, who will share his innovative work on how the brain controls movement under uncertainty, with a focus on timing and decision-making. Then, on Friday, April 24, we will close the meeting with a keynote from Steve Scott (Queen's University), our 2026 Distinguished Career Award recipient, whose foundational work has defined how different brain regions contribute to motor control and learning, spanning studies of neural activity in non-human primates, human motor behavior, and clinical populations.

Generous NIH funding—through an R13 conference grant from NINDS, thanks to the support of Daofen—has again allowed us to provide support to trainees and early career researchers. We are also grateful for the continued support of our sponsors, which helps expand access and promote international participation. We also wish to acknowledge Kazuhiko Seki, Nobuhiro Hagura, and their colleagues in Japan, whose leadership—including their efforts to secure local support—has been essential in making this meeting in Kobe possible.

In advance of the meeting, a series of pre-meetings on April 17 will take place across Japan, including the Eye-Movement Symposium in Sendai (organized by Mayu Takahashi), the Neural Control of Hand Symposium in Tokyo (organized by Kazuhiko Seki), and the Human Motor Control and Learning Symposium in Osaka (organized by Nobuhiro Hagura). These meetings provide an opportunity for more focused discussions and help bring the community together ahead of the main conference.

We are also pleased to introduce our first Women in Science discussion and social event. With over 200 participants already signed up, this event reflects the strong interest in fostering open conversations about mentorship, inclusion, and career development across our community.

I would also like to extend deep thanks to the NCM leadership team: Adrian Haith (Vice-President and Program Chair), Alaa Ahmed (Secretary/Treasurer), Kazuhiko Seki (Academic Development Chair), and the entire Board of Directors. We are also happy to welcome our newly elected board members Eiman Azim, Julie Duque, Jonathan Michaels, Tomohiko Takei, and Tianhe Wang (our Trainee Board Member).

And as always, we are especially grateful to Michelle Smith and the team at Podium for their outstanding support in organizing this meeting.

I look forward to seeing many of you in person and to another engaging and forward-looking week for our community.

Sincerely,

Kathy Cullen
President
Society for the Neural Control of Movement

NCM Leadership

Elected members govern the Society for the Neural Control of Movement. These members comprise the Board of Directors who in turn elects Officers that comprise the Executive Committee. The Society's Bylaws govern how the Board manages the Society.

Officers and Board members are elected for three-year terms and may be re-elected to one additional contiguous term. The current Board comprises the following Officers and Directors:

OFFICERS EXECUTIVE COMMITTEE

President & Conference Chair
Kathleen Cullen

Vice President & Scientific Chair
Adrian Haith

Treasurer & Secretary
Alaa Ahmed

Development Officer
Kazuhiko Seki

BOARD MEMBERS

NAME	INSTITUTION	COUNTRY	TERM
Joshua Cashaback[1]	*University of Delaware*	USA	2023 – 2026
Julie Duque[1]	*Université catholique Louvain*	BEL	2023 – 2026
Juan Gallego[2]	*Imperial College London*	GBR	2023 – 2026
Tarkeshwar Singh	*Pennsylvania State University*	USA	2023 – 2026
Nina van Mastrigt*	Justus-Liebig Universität Gießen	GER	2024 – 2026
David Franklin[1]	*Technical University of Munich*	GER	2024 – 2027
Neeraj Gandhi[2]	*University of Pittsburgh*	USA	2024 – 2027

Katja Kornysheva[1]	*University of Birmingham*	GBR	2024 - 2027
Lena Ting[1]	*Emory University & Georgia Tech*	USA	2024 – 2027
Nobuhiro Hagura[1]	*National Institute of Information and Communication*	JPN	2025 – 2028
Samuel McDougle[2]	*Yale University*	USA	2025 – 2028
Elvira Pirondini[1]	University of Pittsburgh	USA	2025 – 2028
Hansjörg Scherberger[2]	*German Primate Center*	GER	2025 – 2028

[1] Serving first 3 year term [2] Serving second 3 year term * Trainee Board Member

INCOMING BOARD MEMBERS

The following members will begin their term at the 2026 Annual Meeting:

NAME	INSTITUTION	COUNTRY	TERM
Eiman Azim	*Salk Institute for Biological Studies*	USA	2026 – 2029
Julie Duque	*Université catholique Louvain*	BEL	2026 – 2029
Jonathan Michaels	*York University*	BEL	2026 – 2029
Tomohiko Takei	*Tamagawa University*	JPN	2026 – 2029
Tianhe Wang*	*University of California, Berkeley*	USA	2026 - 2028

NCM ADMINISTRATION

Association Secretariat & Conference Management *management@ncm-society.org*

Podium Conference Services

- Michelle Smith
- Rachel Waller

BOARD SERVICE

Nominations for NCM Board service open in January. Nominations must come from members in good standing, and only members are invited to stand for election. To learn more about Board service or if you are interested in serving on the NCM Board, please discuss your interest with one of NCM's Board members or Officers, or send an email to *management@NCM-Society.org*.

MEMBERSHIP INFORMATION

NCM membership is open to all scientists, principal investigators and students from around the world, pursuing research whose goal is to understand how the brain controls movement. Memberships are valid September 1 through August 31 each year.

BENEFITS

NCM membership includes the following benefits:

- Opportunity to submit proposals and abstracts for sessions at the Annual Conference
- Opportunity to submit proposals for satellite meetings
- Opportunity to register for Annual NCM Conferences at reduced registration rates
- Access to the member resource database and other members' web services
- Professional development and networking
- Access and ability to respond directly to job opportunity postings
- Ability to post job opportunities
- Access to online NCM resources and Annual Conference proceedings
- Access to scholarships (Grad Students and Post Docs)
- Opportunity to vote in Annual Elections of NCM Board members
- Opportunity to stand for election to, and serve on, the NCM Board of Directors
- Regular email updates and notices

To become an NCM Member please visit us at the registration desk today

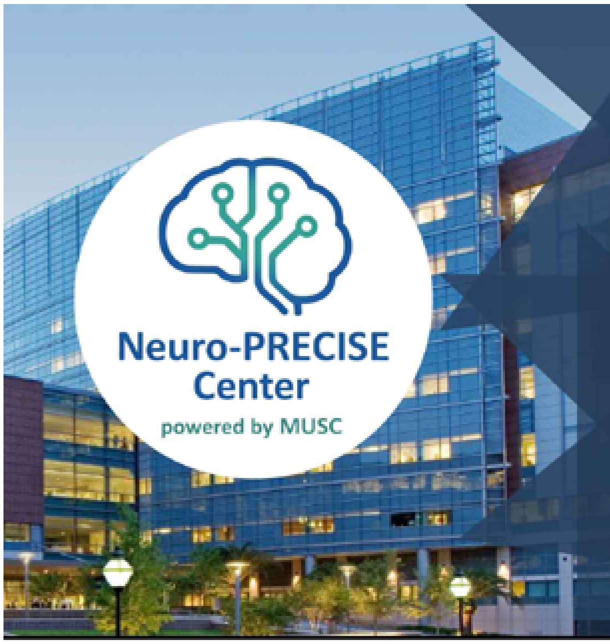
NCM HISTORY

Since 1991 NCM's annual conferences have provided a forum for leading edge research, scholarly debate, the interchange of ideas, and a platform for many exceptional established and emerging researchers in the field of Neural Science. We are proud that this has all been accomplished in some of the nicest destinations in the world. Our history is strong, and our future is bright.

CONFERENCE	DATES	CITY	COUNTRY	HOTEL
34th Annual Meeting*	April 26 – May 2, 2025	Panama City	Panama	Westin Playa Bonita
33rd Annual Meeting*	April 15 – 19, 2024	Dubrovnik	Croatia	Valamar Lacroma, Dubrovnik
32nd Annual Meeting*	April 17 – 21, 2023	Victoria	Canada	Victoria Conference Centre
31st Annual Meeting*	July 25 – 29, 2022	Dublin	Ireland	The Clayton Hotel Burlington Road
30th Annual Meeting	April 20 – 22, 2021	Virtual		
29th Annual Meeting*	April 23 – 27, 2019	Toyama	Japan	Toyama International Conference Center
28th Annual Meeting*	April 30 – May 4, 2018	Santa Fe	USA	Hilton Buffalo Thunder
27th Annual Meeting*	May 1 – 5, 2017	Dublin	Ireland	The Clayton Hotel Burlington Road
26th Annual Meeting	April 24 – 29, 2016	Montego Bay	Jamaica	Hilton Rose Hall Resort
25th Annual Meeting*	April 20 – 24, 2015	Charleston, SC	USA	Francis Marion Hotel
24th Annual Meeting*	April 21 – 25, 2014	Amsterdam	Netherlands	Grand Hotel Krasnapolsky

23rd Annual Meeting*	April 16 – 20, 2013	San Juan, Puerto Rico	USA	El San Juan Hotel & Casino
22nd Annual Meeting*	April 23 – 28, 2012	Venice	Italy	Hilton Molino Stucky
21st Annual Meeting*	April 26 – 30, 2011	San Juan, Puerto Rico	USA	El San Juan Hotel & Casino
20th Annual Meeting*	April 20 – 25, 2010	Naples, Florida	USA	Naples Beach Hotel & Golf Club
19th Annual Meeting*	April 28 – May 3, 2009	Waikoloa, Hawaii	USA	Waikoloa Beach Marriott Resort & Spa
18th Annual Meeting	April 29 – May 4, 2008	Naples, FLA	USA	Naples Beach Hotel & Golf Club
17th Annual Meeting*	March 25 – April 1, 2007	Seville	Spain	Melia Sevilla
16th Annual Meeting*	April 30 – May 7, 2006	Key Biscayne, FLA	USA	Sonesta Beach Resort
15th Annual Meeting	April 12 – 17, 2005	Key Biscayne, FLA	USA	Sonesta Beach Resort
14th Annual Meeting*	March 25 – April 3, 2004	Sitges	Spain	Melia Sitges
13th Annual Meeting	April 22 – 27, 2003	Santa Barbara, CA	USA	Fess Parker's Doubletree Resort
12th Annual Meeting*	April 14 – 21, 2002	Naples, FLA	USA	Naples Beach Hotel & Golf Club
11th Annual Meeting	March 25 – 30, 2001	Seville	Spain	Melia Sevilla
10th Annual Meeting	April 9 – 17, 2000	Key West, FLA	USA	Wyndham Casa Marina Resort
9th Annual Meeting*	April 11 – 19, 1999	Kauai, Hawaii	USA	Princeville Resort
8th Annual Meeting	April 14 – 22, 1998	Key West, FLA	USA	Marriott Casa Marina Resort
7th Annual Meeting*	April 8 – 16, 1997	Cozumel	Mexico	Presidente Intercontinental
6th Annual Meeting	Apri 16 – 21, 1996	Marco Island, FLA	USA	Radisson Suite Beach Resort
5th Annual Meeting	April 18 – 25, 1995	Key West, FLA	USA	Marriott Casa Marina Resort
4th Annual Meeting*	April 13 – 22, 1994	Maui, Hawaii	USA	Maui Marriott Resort (Lahaina)
3rd Annual Meeting	April 13 – 18, 1993	Marco Island, FLA	USA	Radisson Suite Beach Resort
2nd Annual Meeting	April 21 – 26, 1992	Marco Island, FLA	USA	Radisson Suite Beach Resort
1st Annual Meeting	April 6 – 11, 1991	Marco Island, FLA	USA	Radisson Suite Beach Resort

*indicates a Satellite Meeting was held in conjunction with the Annual Conference



Neuro-PRECISE Center

Center for Advancing Neural Circuit-Based Rehabilitation

We are an NIH funded resource center to develop knowledge and diagnostic tools to precisely characterize, modulate, and rehabilitate neural circuitry underlying funciton and recovery.

Our Center Offers...

Precision Neuroarehab Research Consultations	**Pilot Project Grants** Up to $35,000 for a 1-year grant	**Workshops and Training Opportunities**

Don't miss out on news and deadlines, scan the QR code to join our mailing list:

Stop by our booth to say hello and learn more!

MUSC
Medical University of South Carolina

Website
chp.musc.edu/neuro-precise

Email
neuro-precise@musc.edu

Supported by the NIH's *Eunice Kennedy Shriver* National Institute of Child Health & Human Development and the National Center for Complementary & Integrative Health. P50HD118628.

General Conference Information

CONFERENCE VENUE

Portopia Hotel

10-1, 6 Chome, Minatojima Nakamachi, Chuo-ku, Kobe, Japan

All conference sessions will take place in this location, including the Opening Reception.

REGISTRATION

SATELLITE MEETING

Satellite Meeting registration fees include access to the full day meeting with refreshment breaks and a buffet lunch on Monday April 20th.

ANNUAL CONFERENCE

Annual Conference registration fees include access to all sessions including panel, individual, and poster sessions. Registration also includes daily refreshment breaks, buffet lunches, the Opening Reception on Monday evening, and the Closing Drinks Reception.

ADDITIONAL TICKETS

Tickets can be purchased separately for your guests and/or children for the Opening Reception, Closing Drinks Reception and excursions. These additional tickets can be purchased from the staff at NCM's Registration Desk.

NAME BADGES

Your name badge is your admission ticket to the conference sessions, coffee breaks, meals, and receptions. Please always wear it. At the end of the Conference we ask that you recycle your name badge in one of the name badge recycling stations that will be set out or leave it at the Registration Desk.

To help identify and mentor our future investigators, trainee delegates have a banner on their name badge. All other delegates have clear badges. NCM Officers and Board Members, Exhibitors and Staff will be identified by appropriate ribbons. The scholarship winners and the Early Career Award winner will be identified by award winner ribbons.

DRESS CODE

Dress is casual for all NCM meetings and social events.

REGISTRATION AND INFORMATION DESK HOURS

The NCM Registration and Information Desk, located in the foyer of the Grand Ballroom, will be open during the following dates and times:

Monday, April 20	08:00 – 18:00
Tuesday, April 21	07:30 – 15:30
Wednesday, April 22	07:30 – 15:30
Thursday, April 23	07:30 – 15:00
Friday, April 24	07:30 – 17:00

If you need assistance during the conference, please visit the Registration Desk.

POSTER INFORMATION

ANNUAL MEETING

There are two Poster Sessions during the Meeting and posters have been allocated to either one of the sessions based on poster themes. Poster presenters must set-up and remove their posters during the following times.

POSTER SESSION 1

Set-up:
Tuesday, April 21, between 07:30 and 10:00
Remove:
Wednesday, April 22, no later than 17:30

POSTER SESSION 2

Set-up:
Thursday, April 23, between 07:30 and 10:00
Remove:
Friday, April 24, immediately after the poster session completion at 15:00

Any posters that are not taken down by the removal deadline will be held at the registration desk until the end of the Meeting. Any posters that remain unclaimed by the end of the Meeting will be disposed of.

Information on Poster Authors (Lead), Poster Numbers and Poster Titles begins on page 48. For a complete copy of all the poster abstracts, a digital abstract booklet can be downloaded from the Member Only section of the NCM Website.

STAFF

NCM staff from Podium Conference Specialists can be identified by orange ribbons on their name badges. Feel free to ask anyone of our staff for assistance. For immediate assistance please visit us at the Registration Desk.

INTERNET SERVICES

Wireless Internet is available to Annual Meeting delegates for no charge. Kindly note, the WiFi strength is ideal for checking emails and websites but is not strong enough for streaming videos or heavy social media use.

If you are active on social media, make sure to hashtag #NCMKobe26 @ncm_soc when referring to the meeting. We ask all NCM delegates to respect no live tweeting/posting of presentations without prior approval from the speakers/authors. Poster authors may choose to allow photography of their poster. Please check with poster presenters before taking a photo of their poster. We encourage social tweets/posts about the conference and look forward to growing our online community.

If you require assistance, please visit the registration desk and we will endeavour to assist you.

NO SMOKING POLICY

The Portopia Hotel is a completely non-smoking facility indoors.

CODE OF CONDUCT

As a representative of your institution the professional standards and code of conduct of your institution are in effect while at the NCM Annual Meeting, Satellite Meeting and all social events.

The Society for the Neural Control of Movement (NCM) encourages open and honest intellectual debate within a welcoming and inclusive atmosphere at the Annual Meeting and through official NCM social media channels. To help maintain an open and respectful community of scientists, NCM does not tolerate illegal or inappropriate behavior at any annual meeting, including violations of applicable laws of the country in which the meeting is taking place. NCM condemns inappropriate or suggestive acts or comments that demean or harass another person by reason of gender, gender identity or expression, sexual orientation, physical appearance, ethnicity/race, religion (or lack thereof), or that are generally unwelcome or offensive to other members of the community. Sexual language and imagery, unless related to specific scientific discussions, is not appropriate for any conference venue, including talks, workshops, parties, Twitter and other online media. As the NCM Annual Meeting is attended by a wide spectrum of delegates, please be aware of the power dynamic between PIs, post doctoral fellows and students and how that dynamic may affect interactions amongst delegates.

Special Meetings & Events

GENERAL INFO

Monday, April 20 19:30 – 21:30

OPENING RECEPTION

Location: **Kairaku Ballroom**

Wednesday, April 22 17:00 – 17:30

NCM MEMBERS MEETING

Location: **Ohwada A**

17:35 - 18:30

WOMEN IN SCIENCE DISCUSSION AND SOCIAL

Location: **Ohwada A**

Friday, April 24 18:00 – 19:00

CLOSING DRINKS RECEPTION

Location: **Foyer outside Ohwada A**

NCM Excursions

NCM invites you to take advantage of your visit to Kobe by exploring this wonderful and historical city and its surroundings! You can sign up for the excursion by visiting the registration desk.

THURSDAY, APRIL 23, 2026

MAGIC SAKE EXPERIENCE: NADAGOGO SAKEDOKORO

15:30 – 18:00 (approximately)

Cost: $65 per person USD
Includes transportation, licensed guide, multiple sake tasting and small bites of food

Join us at the Sake Wonderland and enjoy sake pairings with food. Participate in the “Magic Sake” pairing experience where the taste of food changes like magic with the sake tasted.

Multiple food and sake pairings will be provided.

TATAMI MAT WORKSHOP

15:30 – 17:30 (approximately)

Cost: $65 per person USD
Includes transportation, guide, and workshop

Tatami mats are used as flooring in traditional Japanese rooms from the grandest castle to an average home. They are covered with woven soft rush (igusa) straw and the core is traditionally made from rice straw.

Participants will listen as a local tatami maker explains the history, culture, and unique characteristics of tatami. You will learn how tatami were popularised in Japanese homes and will also have the opportunity to make your own mini tatami mat using the traditional techniques.

FUGAKU (SUPERCOMPUTER) VISIT

15:15 – 17:30 (approximately)

Cost: $10 per person USD
Includes access to Fugaku/RIKEN and guide. Participants will be required to purchase travel via Portliner rail (two stops from hotel)

Join us for an exclusive tour of Fugaku, the supercomputer, part of RIKEN. Fugaku is a Japanese petascale supercomputer located at the RIKEN Center for Computational Science, only a short distance from the conference hotel. Fugaku was officially ranked as the world’s fastest in June 2020.

Participants will travel via Port Liner Metro from the hotel two stops to the RIKEN location where the RIKEN outreach and communication team will provide information about Fugaku, any overlap with NCM activities, and answer questions about the system. Fugaku will be visible through glass.

Precision neurorehabilitation for movement disorders: Integrating technology, neuroscience, and clinical practice

NCM SATELLITE MEETING, KOBE, JAPAN

MONDAY, APRIL 20, 2026

Sessions held at the Portopia Hotel

Join us for a groundbreaking satellite meeting preceding the 2026 Neural Control of Movement Society meeting in Kobe, Japan, from April 20-24. This meeting will explore the profound revolution in neurorehabilitation that has occurred over the past decade, driven by advances in methods to drive plasticity, machine learning, motion capture, wearable devices, and a growing emphasis on "precision rehabilitation." The day will feature three major themes: Gait & Mobility, Upper Extremity Function, and Speech and Communication, with each group considering the impact on clinical outcomes of animal models, computational modeling, and human behavioral studies, neuroimaging, and neuromodulation. The program will also include a moderated session to synthesize key insights across these critical areas.

We have arranged with IEEE Transactions in Neural Systems and Rehabilitation Engineering to publish an article summarizing our Satellite meeting. The final discussion period is intended to shape the content of that paper, and Sebastian Sporn and Charlotte DeVol have graciously agreed to assist with writing it. In parallel, Editor-in-Chief, Helen Huang, would like to sponsor a special collection of papers related to the Satellite's theme. Both the target article and related articles will be slated for publication approximately 3-5 months after the meeting. All are welcome to consider submission; more details will be forthcoming

The satellite is organized by:

Lee E. Miller, *Northwestern University*

James Cotton, *Shirley Ryan AbilityLab*

MONDAY, APRIL 20, 2026

08:30 – 08:45 **REGISTRATION**

08:45 – 09:00 **WELCOME**

09:00 – 11:10 **SESSION 1:** ***Gait and mobility***

Organized by **Katherine Steele**

Neural mechanisms of perceptual ability contributing to flexible balance control: Implications for (p)rehabilitation

Michael Borich, *Emory University*

Longitudinal gait analysis integrated into inpatient rehabilitation

James Cotton, *Northwestern University*

09:00 – 11:10 *On time mobility: Neuromechanics to support early play and participation*

Katherine Steele, *University of Washington*

Optimal strategies for robot-assisted gait training in patients with hemiparesis

Yohei Otaka, *Fujita Health University*

11:00 – 11:30 COFFEE BREAK

11:30 – 13:30 **SESSION 2:** *Upper extremity function*

Organized by **Nicolas Schweighofer**

Neural control of upper limb muscles: New insights into plasticity

Monica Perez, *Northwestern University*

Impaired reward-based learning but preserved invigoration: From group effects to individual phenotypes

Sebastian Sporn, *University College London*

Epidural spinal cord stimulation for post-stroke upper limb hemiparesis

Marco Capogrosso, *University of Pittsburgh*

Multi-phase CNS adaptation after tendon transfer in humans and non-human primates

Kazuhiko Seki, *National Center of Neurology and Psychiatry*

13:30 – 15:00 LUNCH with trainee round tables

15:00 – 17:00 **SESSION 3:** *Speech and communication*

Organized by **Cara Stepp**

Evidence for sensorimotor impairment in hyperfunctional voice disorders

Cara Stepp, *Boston University*

Computational modeling of speech motor control – applications to clinical speech disorders

Srikantan Nagarajan, *University of California, San Francisco*

Non-invasive closed-loop brain-computer interface for the treatment of laryngeal dystonia

Kristina Simonyan, *Harvard Medical School & Massachusetts Eye and Ear Infirmary*

Finding the beat: Why timing matters in the neurorehabilitation of stuttering

Soo-Eun Chang, *University of Michigan*

17:00 – 17:15 COFFEE BREAK

17:15 – 18:00 **WRAP UP SESSION**

Moderated by **James Cotton**, *Shirley Ryan AbilityLab*

19:30 – 21:30 **OPENING RECEPTION FOR ANNUAL MEETING**

Please Note: *If you registered to attend the Satellite Meeting ONLY and want to attend the dinner, tickets can be purchased at the registration desk.*

Annual Conference Schedule

*All sessions will be held in the Portopia Hotel. Presentations will be in the **Ohwada Room A** with posters in **Ohwada BC Room**.*

DAY 1: MONDAY, APRIL 20, 2026

19:00 – 19:30 **FIRST TIMER SOCIAL**

Keynotes Room

Attending NCM for the first time? Join other first time attendees prior to the opening reception. Key members of the NCM community, and members of the DEI committee, will be in attendance to welcome you to the meeting.

19:30 – 21:30 **OPENING RECEPTION**

Kairaku Ballroom (Main Building)

Join us to meet up with old colleagues and meet new ones at the opening reception. A full meal will be provided in an informal networking event with food stations and passed and plated appetizers.

DAY 2: TUESDAY, APRIL 21, 2026

08:00 - 10:00 **SESSION 1, PANEL I**

The role of descending control systems in recovery after cerebral lesions: Insights from mice, primates, and humans

Vibhu Sahni [1], Nicolo Macellari [2], Eleni Sinopoulou [3], Monica Perez [4]

[1] Weill Cornell Medicine, [2] University of Pittsburgh, [3] University of California, San Diego, [4] Shirley Ryan Ability Lab, Northwestern University

Organizer: **Vibnu Sahni**
Discussant: **Elvira Pirondini**

10:00 – 10:30 BREAK

10:30 – 11:05 **EARLY CAREER AWARD PRESENTATION AND TALK**

How reward sculpts human movement

Pierre Vassiliadis, *University College London & Imperial College London*

11:05 – 12:35 **SESSION 2, PERSPECTIVE**

The next frontier: Dissecting the middleware for movement using multi-neuronal recordings in the spinal cord

Kazuhiko Seki [1], Martyn Goulding [2], Aya Takeoka [3]

[1] National Center of Neurology and Psychiatry, [2] Salk Institute for Biological Studies, [3] RIKEN Center for Brain Science

Organizer: **Kazuhiko Seki**
Discussant: **Simon Giszter**

12:35 – 15:25 SESSION 3, POSTER 1, EXHIBITORS, & LUNCH

15:25 – 17:05 SESSION 4, INDIVIDUAL I

O1.1 *An output-null neural manifold for planning-on-the-fly during free manual control*

Nicolas Meirhaeghe [1], Julio Rodino [2], Shrabasti Jana [3], Lucio Condro [3], Frédéric Barthélemy [3], Junji Ito [2], David Dahmen [2], Alexa Riehle [1], Sonja Grün [4], Thomas Brochier [1]

[1] *CNRS,* [2] *Institute for Advanced Simulation (IAS-6), Jülich Research Centre,* [3] *Aix-Marseille University,* [4] *Institute for Advanced Simulation (IAS-6) Jülich Research Centre*

Presenting Author: **Nicolas Meirhaeghe**

O1.2 *Neural population geometry underlying sequential reach in the macaque motor cortex*

Di Zhu [1], Tianwei Wang [2], Yu-Qi You [1], Yao Chen [1], He Cui [3], Ru-Yuan Zhang [1]

[1] *Shanghai Jiao Tong University,* [2] *Lin Gang Laboratory,* [3] *Chinese Institute for Brain Research, Beijing(CIBR)*

Presenting Author: **Di Zhu**

O1.3 *Disrupting PnC Activity impairs skilled hand reaching and grasping in non-human primates*

Yiping Sun [1], Reona Yamaguchi [1], Tadashi Isa [1]

[1] *Kyoto University*

Presenting Author: **Yiping Sun**

O1.4 *Deep Brain Stimulation of the Motor Thalamus Alleviates Post-Stroke Upper-Limb Motor Deficits*

Arianna Damiani [1], Nicolo Macellari [1], Mel Xu [1], Miles Uribe [1], Lucy Liang [1], Catherine Jezerc [1], Jordyn Ting [1], Sirisha Nouduri [1], Erinn Grigsby [1], Lilly Tang [1], Marco Capogrosso [1], Jorge Gonzalez-Martinez [1], Elvira Pirondini [1]

[1] *University of Pittsburgh*

Presenting Author: **Arianna Damiani**

O1.5 *Behavioral and neural determinants of speech motor memory*

Nishant Rao [1], Rosalie Gendron [2], Timothy Manning [2], David Ostry [2]

[1] *Yale University,* [2] *McGill University*

Presenting Author: **Nishant Rao**

17:35 – 18:30 **TRAINEE SOCIAL**

Keynotes
South Wing, 3F

Sponsored by:

All trainees welcome to join us for a casual, networking social following the conclusion of the day. Network in a relaxed environment, get to know new people, and enjoy this trainee focused event.

DAY 3: WEDNESDAY, APRIL 22, 2026

08:00 – 10:00 **SESSION 5, PANEL II**

Reinforcement learning of motor skills

Adrian Haith [1], Nidhi Seethapathi [2], Eric Yttri [3], Alexander Mathis [4]

[1] Unaffiliated, [2] Massachusetts Institute of Technology, [3] Carnegie Mellon University, [4] EPFL

Organizer: **Adrian Haith**
Discussant: **Jörn Diedrichsen**

10:00 – 10:30 BREAK

10:30 - 12:10 **SESSION 6, INDIVIDUAL II**

O2.1 *Network features underlying motor learning and skill generalization in marmosets*

Samantha Johnson [1], Jeffrey Walker [2], Nicholas Hatsopoulos [1]

[1] University of Chicago, [2] Yale University

Presenting Author: **Samantha Johnson**

O2.2 *Distinct premotor and motor cortical population dynamics support adaptive control in brain-machine interfaces in nonhuman primates*

Alessia Sepe [1], Ophelie Saussus [1], Sofie De Schrijver [1], Irene Caprara [2], Renaud Detry [1], Pinhao Song [1], Thomas Decramer [3], Peter Janssen [1]

[1] Katholieke Universiteit Leuven, [2]Massachusetts General Hospital, [3] Universitair Ziekenhuis Leuven

Presenting Author: **Alessia Sepe**

O2.3 *Linking neural control and muscle mechanics: feedforward and feedback contributions in healthy and neuropathic balance control*

Hansol Ryu [1], Surabhi Simha [2], Gregory Sawicki [1], Lena Ting [2]

[1] Georgia Institute of Technology, [2] Georgia Institute of Technology & Emory University

Presenting Author: **Hansol Ryu**

O2.4 ***Cerebellar signals to the motor cortex link preparation to execution of voluntary movements***

Nirvik Sinha [1], Ora Ben Harosh [1], Henn Kramer [1], Ran Harel [2], Julius Dewald [3], Jonathan Kadmon [1], Yifat Prut [1]

[1] Hebrew University of Jerusalem, [2] Tel Aviv University, [3] Northwestern University

Presenting Author: **Nirvik Sinha**

O2.5 ***Cereballar circuits anticipate dopamine rewards***

Benjamin Filio [1], Mark Wagner [2]

[1] National Institute of Neurological Disorders and Stroke, [2] National Institutes of Health

Presenting Author: **Benjamin Filio**

12:10 – 15:00 **SESSION 7, POSTER, EXHIBITORS, & LUNCH**

15:00 - 17:00 **SESSION 8, PANEL III**

Hierarchical control of pattern generation: A comparative perspective

Arkarup Banerjee [1], Britton Sauerbrei [2], Daniela Vallentin [3], Gregg Castellucci [4]

[1] Cold Spring Harbor Laboratory, [2] Case Western Reserve University School of Medicine, [3] Max Planck Institute for Biological Intelligence, Germany, [4] University of Rochester

Organizer: **Arkarup Banerjee**
Discussant: **Andrew Pruszynski**

17:00 – 17:30 **NCM MEMBERS MEETING**

All members of the Society for the Neural Control of Movement are invited to attend

17:35 – 18:30 **WOMEN IN SCIENCE DISCUSSION AND SOCIAL**

Join us to hear from key members of the NCM community as they discuss their professional journey in industry and academia. Following the presentation, stay for networking and focused group discussions, facilitated by leaders in the community and society. This event is welcome to all attendees who want to hear, learn, and support others in the community.

DAY 4: THURSDAY, APRIL 23, 2026

8:00 – 10:00 **SESSION 9, PANEL IV**

Motor abstraction in mind and brain: How abstract motor representations are learned, modified, and reused

Zekun Sun [1], Katja Kornysheva [2], Lucas Tian [3], Yuto Makino [4]

[1] Yale University, [2] University of Birmingham, [3] Rockefeller University, [4] National Institute of Information and Communications Technology

Organizer: **Zekun Sun**
Discussant: **Samuel McDougle**

10:00 – 10:30 BREAK

10:30 - 12:10 **SESSION 10, INDIVIDUAL III**

O3.1 *Understanding strategic sensorimotor adaptation as a process of hypothesis testing*

Anjuli Niyogi [1], Elizabeth Cisneros [2], Wei Ding [3], Richard Ivry [4], Jonathan Tsay [1]

[1] Carnegie Mellon University, [2] University of California, Berkeley, [3] Tsinghua University, [4] University of California

Presenting Author: **Anjuli Niyogi**

O3.2 *Cortex-dependent motor control can be learned from subcortical demonstration*

Jason Keller [1], Joshua Dudman [2]

[1] HHMI Janelia Research Campus, [2] Howard Hughes Medical Institute

Presenting Author: **Jason Keller**

O3.3 *Coordinated spinal locomotor network dynamics emerge from cell-type-specific connectivity patterns*

Frank Wandler [1], Benjamin Lemberger [1], James Murray [1], David Mclean [2]

[1] University of Oregon, [2] University of Edinburgh

Presenting Author: **Frank Wandler**

O3.4 *Cortico-subcortical dynamics underlying adaptive locomotion*

Martin Esparza [1], Ioana Lazar [1], Catia Fortunato [1], Mostafa Safaie [1], Juan Gallego[2]

[1] Imperial College London, [2] Champalimaud Foundation

Presenting Author: **Martin Esparza**

O3.5 *Dynamic whole-body fetal sensorimotor behavior captured by 4D Cine-MRI and musculoskeletal model*

Hoshinori Kanazawa [1], Seiichi Morokuma [2], Yukiyo Shimada [2], Koji Sagiyama [2], Tatsuhiro Wada [3], Chiaki Tokunaga [3], Kei Nisikawa [3], Yuya Saito [3], Yasuo Kuniyoshi [1]

[1] The University of Tokyo, [2] Kyushu University, [3] Kyushu University Hospital

Presenting Author: **Hoshinori Kanazawa**

12:10 – 15:00 **SESSION 11, POSTER, EXHIBITORS, & LUNCH**

15:00 – onwards **FREE TIME AND TICKETED EXCURSIONS**

8:00 – 10:00 **SESSION 12, PANEL V**

Divergent pathways, convergent function: New physiological, anatomical, and theoretical perspectives on sensory driven and top down control of rapid eye movements

Mayu Takahashi [1], Ziad Hafed [2], Jeffrey Schall [3], Martin Bohlen [4]

[1] *Tohoku University,* [2] *Centre for Integrative Neuroscience,* [3] *York University,* [4] *Duke University*

Organizer: **Mayu Takahashi**
Discussant: **Neeraj Gandhi**

10:00 – 10:30 BREAK

10:30 - 12:10 **SESSION 13, INDIVIDUAL IV**

O4.1 *Dual descending pathways drive the initiation of skilled movements*

Yutaka Yoshida [1], Akimasa Ishida [1], Esther Lai [1], Teruko Danjo [2], Fumiyasu Imai [2], Jay Bikoff [3], Samuel Sober [4], Amanda Jacob [4], Matthew Williams [4], Kyle Thomas [4]

[1] *Okinawa Institute of Science and Technology,* [2] *Weill Cornell,* [3] *St. Jude,* [4] *Emory*

Presenting Author: **Yutaka Yoshida**

O4.2 *The influence of using finger-extending exoskeletons on proprioceptive and tactile localization*

Dominika Radziun [1], Siebe Geurts [1], Valeria Peviani [1], Luke Miller [1]

[1] *Donders Institute for Brain, Cognition and Behaviour, Radboud University*

Presenting Author: **Dominika Radziun**

O4.3 *Spatially independent and temporally robust somatosensory hand representations in expert pianists*

Masato Hirano [1], Sachiko Shiotani [2], Shinichi Furuya [1]

[1] *Sony Computer Science Laboratories, Inc.,* [2] *NeuroPiano Institute*

Presenting Author: **Masato Hirano**

O4.4 *Setting the gains: Neural and behavioral evidence for pre-movement feedback controller configuration*

Dominique Delisle-Godin [1], Pierre-Michel Bernier [1]

[1] *Université de Sherbrooke*

Presenting Author: **Dominique Delisle-Godin**

10:30 - 12:10 **O4.5** ***Hierarchical and context-dependent population codes for intended and observed actions in human parietal and motor cortex***

Celia Bougou [1], Jorge Gamez [2], Emily Rosario [3], Charles Liu [4], Kelsie Pejsa [1], Ausaf Bari [5], Richard Andersen[2]

[1] *California Institute of Technology,* [2] *Division of Biology and Biological Engineering, California Institute of Technology,* [3] *Casa Colina Hospital and Centers for Healthcare,* [4] *Keck School of Medicine of USC,* [5] *University of California, Los Angeles*

Presenting Author: **Celia Bougou**

12:10 – 15:00 **SESSION 14, POSTER & LUNCH**

15:00 - 17:00 **SESSION 15, PANEL VI**

How do distributed motor circuits reorganize to support the execution of learned actions?

Naama Kadmon Harpaz [1], Alice Mosberger [2], Vivek Athalye [3], Karunesh Ganguly [4], Michael Long [5]

[1] *Harvard University,* [2] *NYU Langone Health,* [3] *Allen Institute,* [4] *University of California, San Francisco,* [5] *New York University Langone Medical Center*

Organizer: **Naama Kadmon Harpaz**
Discussant: **Alice Mosberger**

17:00 – 18:00 **SESSION 16, DISTINGUISHED CAREER AWARD PRESENTATION AND TALK**

How multiple feedback pathways can generate goal-directed movements

Stephen Scott, *Queen's University*

18:00 – 19:00 **CLOSING DRINKS RECEPTION**

Foyer

TUESDAY, APRIL 21, 2026

08:00 – 10:00 SESSION 1, PANEL I

The role of descending control systems in recovery after cerebral lesions: Insights from mice, primates, and humans

Vibhu Sahni [1], Nicolo Macellari [2], Eleni Sinopoulou [3], Monica Perez [4]

[1] *Weill Cornell Medicine,* [2] *University of Pittsburgh,* [3] *University of California, San Diego,* [4] *Shirley Ryan Ability Lab, Northwestern University*

Discussant: **Elvira Pirondini**

Descending cortical projections to the brainstem and spinal cord form the essential substrate through which the cortex shapes skilled movement. A central unanswered question is how reorganization within these circuits contributes to recovery after injury, and whether insights into their developmental and evolutionary origins can guide strategies to promote repair. However, emerging work across species now reveals how the organization of this circuitry diverges across mammals, raising new questions about how these differences shape motor control and recovery potential. Integrating these cross-species insights might allow us to infer the roles these pathways play in both the intact and injured CNS promoting the development of novel intervention and technologies. This symposium brings together new molecular, anatomical, and functional insights from mice, primates, and humans to refine our understanding of these descending projections in motor control and their role in recovery after cerebral damage.

Dr. Vibhu Sahni will present findings from the mouse that dissect how descending corticobrainstem and corticospinal pathways emerge during development, integrating molecular delineation, axonal anatomy, and circuit-level function. These developmental principles provide a framework for understanding both the consequences of early disruptions on movement control as well as the opportunities they provide for recovery after adult injury. Dr. Eleni Sinopoulou will then present findings comparing rodent and primate descending systems, highlighting conserved features as well as key species-specific divergences in connectivity that potentially shape motor capabilities and recovery potential. Finally, Dr. Nicolo Macellari and Dr. Monica Perez will turn the focus to evidence from primates and humans demonstrating how plasticity within corticofugal circuits supports functional recovery after cortical and spinal lesions, and how plasticity mechanisms within these networks can be leveraged to design more precise and effective therapeutic interventions to restore motor function.

Together, the talks will illustrate how a cross-species, developmental-to-clinical perspective on descending control systems can uncover fundamental principles of motor circuit organization and resilience, offering a framework to understand normal function and inform strategies for restoring function after injury.

10:30 - 11:05 EARLY CAREER AWARD PRESENTATION AND TALK

How reward sculpts human movement

Pierre Vassiliadis, *University College London & Imperial College London*

Movement, like perception and cognition, is fundamentally shaped by the pursuit of reward. Across species, reward is known to be a powerful modulator of action, guiding action selection, movement invigoration and reinforcing successful behavior. Most work on reward has leveraged decision-making paradigms, in which agents have to learn to select among a discrete number of actions through reinforcement. Yet growing evidence indicates that reward is also instrumental in tasks with richer motor demands, such as motor learning, where individuals refine movement kinematics through practice. Despite the clear potential of incorporating reward into motor rehabilitation, the precise behavioral and neural mechanisms by which reinforcement shapes motor learning remain underexplored.

In this talk, I will first present evidence that specific properties of reinforcement feedback such as its extrinsic value, timing, and the quality of concurrent sensory feedback profoundly influence how humans control, learn, and retain motor skills. I will also discuss the feasibility, efficiency, and constraints of delivering personalized reinforcement in real time during continuous motor control in healthy adults and patients with chronic stroke.

In the second part, I will present work investigating the causal role of the striatum in motor and reinforcement learning, using transcranial Temporal Interference Stimulation (tTIS)—a non-invasive method for deep-brain neuromodulation in humans—in combination with fMRI. In particular, I will discuss data supporting the causal involvement of specific striatal rhythms in reinforcement and sensory-based motor learning, and highlight their possible implications for neuropsychiatric disorders that impact the motor and reward systems. Overall, these results illustrate the breadth of mechanisms by which reward shapes movement and delineate the promise—as well as the potential limitations—of reward-based approaches to motor rehabilitation.

11:05 – 12:35 SESSION 2, PERSPECTIVE I

The next frontier: Dissecting the middleware for movement using multi-neuronal recordings in the spinal cord

Kazuhiko Seki [1], Martyn Goulding [2], Aya Takeoka [3]

[1] *National Center of Neurology and Psychiatry,* [2] *Salk Institute for Biological Studies,* [3] *RIKEN Center for Brain Science*

Discussant: **Simon Giszter**

For more than a century, the field of sensorimotor control has aimed to clarify the organization of central nervous system circuits. The field is now entering a pivotal phase, as multiple research streams converge on the same conclusion: to move forward, we need large-scale recordings from spinal circuits during natural behavior.

This shift is driven by advances in molecular-genetic circuit dissection. Since Sherrington, spinal physiology has identified fundamental circuit modules using electrophysiological approaches. Modern genetic tools have now refined these modules with remarkable precision, enabling causal tests by selectively removing specific components. Transcriptomic profiling further reveals extensive cellular heterogeneity. Yet real-world behavior is clearly not governed by isolated modules but by their coordinated interaction. To understand what each module contributes—and how they work together—we need direct recordings during natural movement.

A similar momentum comes from population-level research in the cerebral cortex. Since Evarts, systems neuroscience has shown that individual cortical neurons regulate force, direction, and motor patterns. Recent advances in large-scale recording and computational analysis now link population dynamics to behavior. Yet cortical commands are rarely executed directly; most are routed through spinal circuits. Without understanding this spinal "middleware," long treated as a black box, we cannot fully explain motor control. Large-scale spinal recordings in behaving animals will therefore be essential.

In this session, we will discuss—together with the audience—how such recordings are beginning to revise long-standing textbook views of the neural control of movement, drawing on the speakers' recent experimental findings and their implications.

The session will open with Kazuhiko Seki outlining the motivation and historical context of this Perspective session, followed by his latest experimental results showing how spinal interneuron dynamics are differentially recruited during rat and monkey reaching, depending on various movement parameters. Martyn Goulding will then discuss how sensory information that is used to control movement is represented in the spinal cord and brainstem, followed by Aya Takeoka's talk demonstrating how the multiunit activity recorded from the spinal cord opens new avenues for the circuit mechanisms underlying movement adaptation and learning. The session will conclude with a discussion led by Simon Giszter, exploring—with audience participation—how the spinal cord serves as a "middleware" for the sensorimotor control and motor learning, and what new insights are emerging from this line of research.

15:25 – 17:05 SESSION 4, INDIVIDUAL I

O1.1 - An output-null neural manifold for planning-on-the-fly during free manual control

Nicolas Meirhaeghe [1], Julio Rodino [2], Shrabasti Jana [3], Lucio Condro [3], Frédéric Barthélemy [3], Junji Ito [2], David Dahmen [2], Alexa Riehle [1], Sonja Grün [4], Thomas Brochier [1]

[1] CNRS, [2] Institute for Advanced Simulation (IAS-6), Jülich Research Centre, [3] Aix-Marseille University, [4] Institute for Advanced Simulation (IAS-6) Jülich Research Centre

Presenting Author: **Nicolas Meirhaeghe**

Studies of the neural basis of motor planning have largely focused on scenarios in which a single movement is specified in advance and prepared "offline" prior to execution. However, much of natural behavior cannot be reduced to a sequence of discrete, preplanned steps. Instead, everyday actions unfold as a continuous stream of movement that is controlled "online," updated in real time as errors are detected and goals evolve. This raises two key unresolved questions for the field of motor control: How are unconstrained, naturalistic actions planned at the neural level, and do offline and online planning rely on shared neural principles?To address these questions, we analyzed motor cortical population activity from two macaque monkeys trained to perform both offline- and online-prepared reaches to visual targets. In both tasks, animals initiated behavior with a center-out reach to a randomly chosen peripheral target. They were then either (1) free to reach the remaining simultaneously presented targets in any order (unconstrained task), or (2) required to follow a sequence imposed by targets that appeared one at a time (constrained task).In the constrained task, we first replicate and extend classical findings: preparatory activity associated with offline planning of center-out reaches is (1) low-dimensional, (2) expressed in output-null dimensions forming a preparatory subspace, and (3) organized as direction-specific preparatory states lying on a circular manifold. We then show that this manifold is preserved across different initial hand positions and generalizes to any reach direction planned offline within sequences of the constrained task. This invariance suggests that

the manifold provides a substrate for context-independent encoding of reach direction—analogous to the ring-like structure observed in the mammalian head-direction system.Crucially, we demonstrate that this same manifold is re-engaged during the unconstrained task, when movements are planned online and continuously updated. The strongest evidence for such reuse comes from our ability to predict upcoming reach direction hundreds of milliseconds in advance during free movement, using only activity projected onto the manifold defined from the center-out preparatory epoch. We further confirm that this predictive signal reflects genuine planning rather than motor execution: although hand trajectory can also be decoded from the execution subspace, these signals exhibit systematically shorter temporal lags than predictions derived from the orthogonal preparatory subspace.Together, these results provide a unified view of how motor cortex supports both discrete and continuous action planning. They reveal shared neural mechanisms underpinning offline and online planning and offer new opportunities for leveraging invariant preparatory structure to design more robust and efficient brain–machine interface decoders suited for naturalistic movement.

O1.2 - Neural population geometry underlying sequential reach in the macaque motor cortex

Di Zhu [1], Tianwei Wang [2], Yu-Qi You [1], Yao Chen [1], He Cui [3], Ru-Yuan Zhang [1]

[1] *Shanghai Jiao Tong University,* [2] *Lin Gang Laboratory,* [3] *Chinese Institute for Brain Research, Beijing(CIBR)*

Presenting Author: **Di Zhu**

Natural motor behavior relies on the smooth concatenation of discrete actions. When generating multiple actions in sequence, the motor cortex must encode not only the physical features of each action (e.g., reach direction) but also integrate them into a coherent behavioral sequence. Previous studies have proposed three distinct hypotheses regarding how sequencing influences neural representations of individual actions. The competition hypothesis suggests that representations of adjacent actions interfere with one another due to increased cognitive load or limited neural resources. In contrast, evidence for coarticulation in some motor tasks indicates that blending actions into a sequence actually enhances the representation of each component. A third account, the independence hypothesis, posits that individual actions are generated separately and thus sequencing should not alter individual's neural encoding. However, these competing hypotheses have not been systematically tested at the neural population level.Here we analyzed population activity from the primary motor cortex of two rhesus macaques (monkey C: 118 units; monkey G: 44 units, Utah array) performing a sequential reaching task. The task was a variant of the center-out delayed-reach paradigm and included both single-reach (SR) and double-reach (DR) trials. In SR trials, one target was presented, followed by a random delay, after which the monkey executed one reach. In DR trials, two targets were presented and remembered, and the monkeys executed two reaches sequentially without an inter-movement pause. Comparing neural activity between SR and DR trials allowed us to examine how planning and executing a subsequent action influences the neural representation of the first action.We report three main findings. First, decoding accuracy for the first reach direction in the DR condition was significantly higher than that in the SR condition throughout most of the preparatory and execution periods. This enhancement indicates that planning an additional action strengthens the representation of the first action, consistent with the coarticulation hypothesis. Second, neural population geometry revealed that improved representations arose from increased separation between manifolds corresponding to different reach directions, driven by systematic tuning changes at the single-neuron level. Third, population subspace analyses showed that this manifold separation originated primarily within the preparatory subspace rather than the execution subspace. In addition, analyses of single-neuron responses uncovered several nonlinear tuning modulations that further contributed to the strengthened population representation.These results provide direct neural evidence supporting the coarticulation hypothesis in the coding of sequential actions. Our findings also highlight the importance of examining neural population geometry to understand how action sequencing can enhance the encoding of individual movements in the motor cortex by optimizing neural resources.

O1.3 - Disrupting PnC activity impairs skilled hand reaching and grasping in non-human primates

Yiping Sun [1], Reona Yamaguchi [1], Tadashi Isa [1]

[1] *Kyoto University*

Presenting Author: **Yiping Sun**

Dexterous finger control is important for daily hand functions in nonhuman primates and humans. Maintaining balanced muscle strength and tone is necessary for precise finger coordination, but its control mechanisms are less clear compared to the mechanisms of individual finger movement, primarily attributed to the corticospinal tract. Recent evidence suggests that reticulospinal neurons (RSNs) play a critical role in this process.In this study, we recorded single-unit activity in two healthy Macaca fuscata to localize startle-reaction neurons, presumably RSNs, in the caudal pontine reticular formation (PnC). The identified location was consistent with previous studies. Based on this anatomical information, we manipulated the RSNs by microinjections of muscimol, a GABAA receptor agonist, into the PnC to investigate their contribution to hand dexterity. To quantify the behavioral effects of PnC inactivation, we developed a markerless 3D kinematic reconstruction pipeline based on DeepLabCut™, enabling frame-by-frame extraction of multi-joint kinematics of the index finger and thumb—including joint angles, fingertip trajectories, and apertures—during natural reach-and-grasp tasks.Transient inactivation of the PnC produced clear impairments in hand dexterity without overt changes in overall posture. Across grasp types, monkeys showed significantly prolonged grasping time, distinct aperture modulation patterns across individuals, and compromised thumb–index coordination. Although the two monkeys adopted different natural grasping strategies, both exhibited task-dependent abnormalities in aperture control during the pre-shaping phase. To determine whether these differences reflected a shared deficit, we applied dynamic time warping (DTW) to all time-varying joint angles and apertures. Increased DTW distances reflected lower similarity between movement time-series. Following muscimol injection, both monkeys exhibited significantly greater DTW distances, indicating that PnC inactivation disrupted finger coordination during grasping.These findings suggest that PnC neurons contribute to fine finger control by regulating the coordinated activation of finger muscles. Future physiological studies will further elucidate the role of RSNs in sensorimotor integration and brainstem contributions to dexterous motor control.

O1.4 - Deep brain stimulation of the motor thalamus alleviates post-stroke upper-limb motor deficits

Arianna Damiani [1], Nicolo Macellari [1], Mel Xu [1], Miles Uribe [1], Lucy Liang [1], Catherine Jezerc [1], Jordyn Ting [1], Sirisha Nouduri [1], Erinn Grigsby [1], Lilly Tang [1], Marco Capogrosso [1], Jorge Gonzalez-Martinez [1], Elvira Pirondini [1]

[1] *University of Pittsburgh*

Presenting Author: **Arianna Damiani**

Stroke is among the leading causes of permanent disability in the United States, affecting approximately 795,000 people each year. Infarcts mostly damage subcortical areas, thus interrupting long-range connections between cortical and spinal centers that regulate movements, i.e., the corticospinal tract

(CST). Consequently, humans with stroke invading the CST suffer from the most severe and permanent upper-limb motor deficits, including loss of strength and dexterity. Despite the large population size of affected individuals, intense physical therapy remains the only significant intervention with limited impact on moderate to severe paresis. Therefore, novel and effective therapeutic approaches are necessary.
We previously demonstrated that Deep Brain Stimulation targeting the motor thalamus (mThDBS), a subcortical region with direct excitatory projections to the motor cortex, facilitates residual CST axons and consequently increases motor output in anesthetized monkeys. Yet, whether motor thalamus stimulation leads to functional improvements for post-stroke hemiparesis remains unclear. Here, we hypothesized that mThDBS increases the excitability of the CST also when voluntarily activated to perform a movement and thus alleviates post-stroke upper-limb motor deficits. To test this hypothesis, we trained n=2 monkeys to perform a battery of tasks to measure hand and arm dexterity and strength. We then performed a controlled thermocoagulation of the CST inducing chronic stroke with moderate upper-limb paresis. We also implanted a DBS electrode in the motor thalamus and assessed behavioral performances and kinematics with and without DBS, both in subacute and chronic stages. Following the CST thermocoagulation, the monkeys developed hallmark post-stroke motor symptoms, including mild loss of arm dexterity, and moderate loss of finger and hand control. mThDBS immediately facilitated 3D arm and finger control, as evidenced by higher task success rate and improvement in several kinematic variables, such as velocity, joints range of motion and endpoint precision. Finally, we replicated these results in n=1 human patient with post-stroke hemiparesis, who received a temporary DBS implant in the motor thalamus and was stimulated for 4 weeks, 2h per day during motor tasks. Our intervention led to immediate improvements in strength across multiple joints, increased dexterity and range of motion. Notably, electrophysiological testing confirmed enhanced corticospinal excitability after only 4 weeks of DBS, as evidenced by the emergence of transcranial magnetic stimulation-induced motor evoked potentials in the forearm muscles. Importantly, we also observed clinically relevant improvement in clinical scales (+8 points in Fugl-Meyer). These findings demonstrate for the first time the potential of motor thalamus DBS to alleviate motor symptoms developed after stroke and pave the way towards novel therapies for upper-limb hemiparesis.

O1.5 - Behavioral and neural determinants of speech motor memory

Nishant Rao [1], Rosalie Gendron [2], Timothy Manning [2], David Ostry [2]
[1] Yale University, [2] McGill University
Presenting Author: **Nishant Rao**

In speech motor behavior, the involvement of auditory and somatosensory streams offers a unique opportunity to probe the relationship between sensory inputs and motor output. In this study, we sought to determine the behavioral and neural underpinnings of speech motor memory using speech formant frequency perturbation as a model task to induce motor learning. Akin to a visuomotor reach adaptation task, the speech formant perturbation task records formant frequencies (constituents of vowels in any language) via a microphone, alters the first formant frequency, and plays back the modified speech in real time to the participants via headphones. When subjected to several such trials, participants learn to compensate for the perturbed formant frequency by shifting the first formant in their speech output in an opposite direction. In a first experiment (n=14), we show that this speech motor learning paradigm enables participants to produce new speech movements leading to speaking a new vowel, which is sufficiently different from the well-learned vowels. In a second experiment (n=58), participants first performed the speech motor learning task and returned either 8- or 24-hours later for retention assessment. We find that the newly acquired motor memory is substantially retained for at least 24 hours post learning. The retention is similar to that when probed 8 hours following learning, and with abrupt or gradual formant shifts. Importantly, the memory was retrieved only when speech feedback was available, but not in presence of noise feedback, highlighting the context dependence of the speech motor memory upon presence of speech feedback. In a third experiment (n=60), the neural underpinnings of speech motor memory were investigated by separately disrupting either the primary motor, somatosensory, or auditory cortex using continuous theta burst transcranial magnetic brain stimulation (cTBS). Participants first underwent the speech motor learning task, immediately after which they received cTBS, and returned 24 hours later for retention assessment. We found that disruption of either auditory or somatosensory cortex impaired the retention of speech motor memory. In contrast, retention following disruption of motor cortex was not different than a no-TMS control, indicating the causal involvement of sensory cortex in retaining speech motor memory. Taken together, the study documents the behavioral and neural underpinnings of speech motor memory and underscores the relationship between sensory inputs and motor output when both auditory and somatic sensory streams are involved in guiding motor behavior.

WEDNESDAY, APRIL 22, 2026

08:00 – 10:00 SESSION 5, PANEL II

Reinforcement learning of motor skills

Adrian Haith [1], Nidhi Seethapathi [2], Eric Yttri [3], Alexander Mathis [4]

[1] *Unaffiliated,* [2] *Massachusetts Institute of Technology,* [3] *Carnegie Mellon University,* [4] *EPFL*

Discussant: **Jörn Diedrichsen**

Humans can learn to perform a seemingly limitless array of complex motor skills. But how are we able to learn these skills? This panel will explore reinforcement learning as a potential theoretical framework for understanding learning of new motor skills. Existing computational theories of learning are largely founded on principles of supervised learning, appealing to notions of internal models and error-driven learning. Such theories account very well for short-term adaptation of existing behaviors, but don't seem to account for how we learn new motor skills over timescales of days, weeks or months. A lot of work has examined reinforcement-based learning in operant-learning paradigms and in simple, adaptation-like tasks, and it has often been proposed that reinforcement learning may play an important role in more challenging forms of motor learning, but few concrete theories have been proposed. Meanwhile, the robotics community has leveraged reinforcement-learning-based approaches to power remarkable advances in recent years. This panel will present emerging work examining how these same approaches can be applied to understand biological learning. The panel will describe key ideas and approaches used in modern RL, and show how they can be applied to model biological learning. Adrian Haith will introduce policy-gradient reinforcement learning, a simple and widely-used model-free method, and show how this can account for dynamics of learning through practice over thousands of trials across a range of motor learning tasks. Nidhi Seethapathi will extend these ideas to consider reinforcement learning in continuous control settings, focusing on the interplay between exploration and stability during locomotor learning. Eric Yttri will provide causal evidence from animal studies demonstrating how cell types within the basal ganglia exert continuous control through policy-based RL across a range of motor tasks. Alexander Mathis will argue that, despite advances in RL, insights from psychology are currently necessary to learn skills with high-dimensional musculoskeletal models, and will furthermore illustrate what can be concluded about biological motor control from these models. We will conclude with a panel discussion in which we will consider the feasibility and scope of reinforcement learning as a theoretical framework for understanding motor skill learning in humans and animals, potential underlying learning mechanisms, and challenges associated with learning complex repertoires of skills through reinforcement learning.

10:30 – 12:10 SESSION 6, INDIVIDUAL II

O2.1 - Network features underlying motor learning and skill generalization in marmosets

Samantha Johnson [1], Jeffrey Walker [2], Nicholas Hatsopoulos [1]

[1] *University of Chicago,* [2] *Yale University*

Presenting Author: **Samantha Johnson**

Motor skill learning occurs across multiple timescales, yet most studies focus on short-term adaptations within single-session learning paradigms. Consequently, the network-level mechanisms underlying long-term skill acquisition remain poorly characterized. Emerging rodent work suggests that connectivity dynamics may pass through distinct phases during extended learning periods but has not been extensively examined with primates. Moreover, it is unclear how these network dynamics support generalization, the process by which previously acquired skills are adapted to new but related task contexts. The neural basis of generalization, especially across multiple interconnected sensorimotor areas, remains largely unknown.In this study, we trained marmosets on two sequential motor tasks requiring similar behavioral profiles. In the first task, animals performed a reach–grasp–carry movement toward a static food reward, reaching asymptotic performance over two weeks of daily exposure. We then introduced a more complex version of the task in which the target moved dynamically, requiring animals to generalize previously acquired movement strategies to a new context. Faster learning in the dynamic as compared to the static version of the task provided behavioral evidence of generalization. Throughout both tasks, we wirelessly recorded neural activity from chronically implanted Utah arrays spanning dorsal premotor, primary motor, and somatosensory cortices in unrestrained animals. Using spike timing of simultaneously recorded single units, we constructed functional networks to capture changes in sensorimotor connectivity over learning and generalization.We found that functional networks exhibited structured, biphasic changes across weeks of learning. Trial-to-trial network variability started high, consistent with exploration, decreased during the early stages of initial skill acquisition, and then increased as the skill consolidated. When animals transitioned to the dynamic task, we saw a return to variability, mirroring the early learning phase of the first task. These findings suggest that motor cortex and broader sensorimotor networks become heavily structured during the early phase of long-term learning, but may reduce their engagement after a skill becomes stable. Importantly, generalization appears to rely not on modifying an existing stable connectivity pattern but on reinstating a variability-rich network state. This indicates that generalization recruits similar neural mechanisms as initial skill acquisition rather than simple adaptation of an established motor program.Together, this work provides rare long-timescale, multi-area recordings in a primate model and reveals network-level signatures of exploration, consolidation, and generalization. These results highlight how sensorimotor connectivity reorganizes across sequentially acquired skills and motivate further comparison of functional network structure during expert phases of related behaviors.

O2.2 - Distinct premotor and motor cortical population dynamics support adaptive control in brain-machine interfaces in nonhuman primates

Alessia Sepe [1], Ophelie Saussus [1], Sofie De Schrijver [1], Irene Caprara [2], Renaud Detry [1], Pinhao Song [1], Thomas Decramer [3], Peter Janssen [1]

[1] *Katholieke Universiteit Leuven,* [2] *Massachusetts General Hospital,* [3] *Universitair Ziekenhuis Leuven*

Presenting Author: **Alessia Sepe**

Motor brain-machine interfaces (BMIs) translate cortical activity into device control, offering a platform not only for restoring movement but also for investigating the neural principles underlying motor behavior. Although natural action requires rapid adjustments to changing environmental conditions, most BMI paradigms rely on simple, unperturbed movements, leaving the neural basis of adaptive control unsolved and limiting the development of more flexible motor BMIs. Here we recorded neural activity from primary motor cortex (M1), ventral premotor cortex (PMv), and dorsal premotor cortex (PMd) using three 96-channel Utah arrays in three macaques performing BMI-control in a 3D virtual environment in Unity. Monkeys guided a sphere toward one of five distant targets using the neural activity of all three areas, with trials occasionally including two environmental perturbations, obstacle appearance and target displacement. In obstacle appearance trials, an obstacle appeared unpredictably in half of the trials, midway between the starting point and the target location, and the monkeys had to move the sphere around this obstacle to reach the target. In target displacement trials, the target changed location in half of the trials when the sphere was at one third of the distance to the target. We quantified firing rates and across-unit variance within the subpopulation of units directly used by the BMI decoder (based on Preferential Subspace Identification) to determine how each area contributes to online corrective control. M1 activity was largely unaffected by the presence or type of perturbation. By contrast, both PMv and PMd exhibited marked reductions in across-unit variance early after the perturbation, indicating increased population-level coherence during adaptive control. Notably, PMv responses decreased for both perturbation types, whereas PMd showed enhanced responses selectively in target displacement trials.These findings demonstrate that adaptive visuomotor control in BMIs relies predominantly on premotor circuits, with PMd playing a specialized role in updating movement plans when goal locations shift. M1 contributes minimally to early perturbation processing, consistent with a division of labor in which premotor areas compute corrective commands that M1 implements downstream. This framework provides a foundation for designing BMIs tailored to flexible, real-world motor behavior.

O2.3 - Linking neural control and muscle mechanics: Feedforward and feedback contributions in healthy and neuropathic balance control

Hansol Ryu [1], Surabhi Simha [2], Gregory Sawicki [1], Lena Ting [2]

[1] *Georgia Institute of Technology,* [2] *Georgia Institute of Technology & Emory University*

Presenting Author: **Hansol Ryu**

Effective control of perturbed movement relies on the interplay between feedforward and feedback control. Computational models are needed to dissociate their respective contributions to perturbed movement control because they are difficult to separate experimentally. Standard Hill-type muscle models, though useful for steady-state force estimation, may lead to inaccurate simulated neural control strategies as they miss critical transient behaviors such as short-range stiffness (SRS). As shown previously [1], Hill-type models without SRS predict unrealistically large initial movements before corrective activity engages, limiting interpretations of neural control in health and impairments.To develop a mechanistic simulation

of perturbed movement, we incorporated a 3-state cross-bridge model [2] into a closed-loop inverted pendulum system. Our muscle model under baseline activation reproduces rapid, history-dependent force rise observed in single fibers during stretch [3], but its implications for perturbed movement control have not been explored. We coupled agonist-antagonist muscle pair to an inverted pendulum and simulated responses to sudden translational perturbations. Both muscles were controlled with feedforward tonic activation, modulated by fiber length, velocity, and acceleration feedback with delays.Cross-bridge mechanics markedly reduces initial displacement compared to Hill-type models due to SRS. Simulations reproduce the rapid, SRS-driven rise in joint torque at perturbation onset, followed by a distinct initial burst and plateau in muscle activation from sensorimotor feedback, as observed in cats and humans [4,5]. The model also captures sensory neuropathy signatures: removing velocity and acceleration feedback causes loss of balance, as in acute neuropathy, while restoring partial feedback yields large excursions, diminished initial bursts and increased co-contraction, consistent with chronic neuropathy in cats [5].Our novel biophysical muscle model in a closed-loop simulation dissociates feedforward and feedback contributions to perturbed balance control, incorporating SRS tuned by feedforward co-contraction. Because SRS naturally emerges from cross-bridge dynamics under baseline activation rather than being phenomenologically imposed, the model can be applied to different tasks such as reaching and walking. This framework allows for better understanding of muscle–neural interactions in perturbed movement control and may help generate hypotheses about how movement is controlled in health and altered in conditions like neuropathy, aging, fatigue, or disease. [1] De Groote F, Allen JL, Ting LH. (2017) J. Biomech. [2] Campbell KS. (2014) J. Gen. Physiol. [3] Horslen, BC., et al. (2023) J. Exp. Biol. [4] Jakubowski, KL, et al. (2025) J. Neurophysiol. [5] Lockhart, DB., Ting, L. H. (2007) Nat. Neurosci.

O2.4 - Cerebellar signals to the motor cortex link preparation to execution of voluntary movements

Nirvik Sinha [1], Ora Ben Harosh [1], Henn Kramer [1], Ran Harel [2], Julius Dewald [3], Jonathan Kadmon [1], Yifat Prut [1]

[1] Hebrew University of Jerusalem, [2] Tel Aviv University, [3] Northwestern University

Presenting Author: **Nirvik Sinha**

Performing rapid, coordinated, and accurate voluntary movements relies on predictions that guide movements before sensory feedback can be used. The cerebellum is essential for calculating these predictive signals based on efferent copies of motor commands and a forward internal model. Although this view emphasizes the role of the cerebellum in the initial phase of movements, recent studies have shown cerebello-thalamo-cortical interactions as early as the movement preparation period. This suggests that cerebellar predictions may already shape emerging motor commands during planning. To test this hypothesis, we trained two monkeys to perform center-out delayed reaching movements on a vertical touchscreen. During task performance, we reversibly disrupted cerebellar output using high-frequency (130 Hz) stimulation of the superior cerebellar peduncle while recording muscle and neural activity. Neurons were sampled using high-density linear probes inserted into the task-related regions of the primary motor (M1) and premotor (PM) cortices. Blocking the cerebellar outflow altered motor behavior, leading to delayed onset ($p<0.001$), diminished peak speed ($p=0.013$) and increased variability in hand position ($p<0.001$). At the neural level, cerebellar block produced changes in the structure of preparatory activity, including a rotation of the preparatory subspace away from the control condition (45% alignment, $p< 0.001$) and an increase in its dimensionality ($p<0.001$). These results indicate an impaired pattern of inter-neuron coordination, with effects emerging earlier in PM than in M1. Next, we examined changes in the predictive power of the preparatory state under these conditions. To this end, we used reduced rank regression on the single-trial data to identify the low dimensional linear mapping linking the neural activity during preparation to that of execution. Cerebellar block increased the dimensionality of this mapping (quantified as the minimum rank needed to reach the R^2 asymptote of the full rank regression, p=0.021) even though its capacity to predict the execution-related activity was reduced (i.e., lower R2, p = 0.004), indicating a less efficient transformation of the preparatory state into movement-related activity. Consistent with this impaired mapping at the neural level, cerebellar block markedly reduced the ability of preparatory activity to predict movement kinematics (peak speed and hand position; $p < 0.001$), whereas the prediction of these parameters from execution-related activity was unchanged (p = 0.286; p = 0.979). This indicates that cerebellar signals primarily support the transformation of preparatory neural states into accurate movement plans rather than their execution. Taken together, our findings show that cerebellar predictive signals relayed through motor thalamus play a dual role in controlling voluntary movements. First, these signals are necessary for organizing the structure of preparatory dynamics in the motor cortex. Second, these signals play a critical role in sustaining the mapping that links preparation to execution and carries kinematic information essential for accurate and timely multi-joint reaching.

O2.5 - Cerebellar circuits anticipate dopamine rewards

Benjamin Filio [1], Mark Wagner [2]

[1] *National Institute of Neurological Disorders and Stroke,* [2] *National Institutes of Health*

Presenting Author: **Benjamin Filio**

Theories of motor control, especially skill acquisition and reward-driven motor learning, place heavy emphasis on the role of cortical and striatal circuits, while the cerebellum is most famous for motor adaptation and refining movements. Extensive evidence demonstrates that the cerebellum is functionally interconnected with cortical and striatal circuits, highlighting a need to update brain-wide computational frameworks. The cerebellum is also causally involved in functions traditionally ascribed to forebrain and midbrain, one of these functions being reward-based motor learning. Cerebellar circuits can predict rewards such as food and water, but it is unclear whether the cerebellum also encodes reward outside of conditions where (1) the reward satisfies homeostatic craving and (2) when a physical action is required to consume the reward. Hee, we developed a reward-driven operant task where mice pushed a lever to receive dopamine (DA) self-stimulation, which was either optogenetic activation of DA neurons in the ventral tegmental area or electrical activation of the medial forebrain bundle. This satisfies the requirements to answer our questions: first, the mice did not need to physically consume a reward, disentangling neural representations of reward from consummatory movements. Second, the reward was temporally delayed, allowing us to separate reward predictive signals from neural representations of action. Third, the stimulation paradigm was surgically, genetically, and optically compatible with two-photon cerebellar imaging. Mice performed robustly for both types of DA reward. In expert mice, 22% of GrC continually ramped up activity for a 1-s delay between push and expected DA reward. Further, 65% of CFs spiked with short latency when DA stimulation occurred. When we subsequently trained mice on a 2-s delay, we observed 31% of individual GrCs “stretched” their activity profiles to match the expected time of DA release. When we trained mice sequentially with water reward either preceding or following DA reward, both rewards elicited similar population GrC and CF representations. Individually, 32% of GrCs had significantly correlated activity between water and DA, while 33% of CFs activated similarly for water and DA. Causally, mice learned operant reinforcement to push for CF optogenetic activation, with GrCs anticipating the predicted self-stimulation. Finally, inhibiting GrC activity in the delay period between push and DA reduced operant task performance, push quality, and motivation compared to control mice. We detail that previously characterized GrC-CF computations for homeostatic reward also extends to direct mesolimbic dopamine stimulation, displaying the cerebellum uses a general computation to link motor programs to expected rewards. This broadens the involvement of cerebellum in brain-wide computational networks involved in sensorimotor behavior and motor control.

15:00 – 17:00 SESSION 8, PANEL III

Hierarchical control of pattern generation: A comparative perspective

Arkarup Banerjee [1], Britton Sauerbrei [2], Daniela Vallentin [3], Gregg Castellucci [4]

[1] Cold Spring Harbor Laboratory, [2] Case Western Reserve University School of Medicine, [3] Max Planck Institute for Biological Intelligence, Germany, [4] University of Rochester

Discussant: **Andrew Pruszynski**

The control of voluntary movements (e.g., reaching) is modeled as a top-down process in which cortical commands are filtered through spinal networks to determine motor output. Behaviors like speech, singing, and locomotion, however, require bidirectional coordination between higher brain areas and subcortical circuits which can generate motor patterns independently. In this session, we explore such coordination in a range of vertebrate species and behaviors.

Arkarup Banerjee, using the singing mouse, will discuss how motor cortex hierarchically interacts with brainstem pattern-generator circuits to control vocal production. Using circuit perturbations, electrophysiological data, and computational modeling, he will show that motor cortex activity adjusts song duration, while downstream circuits determine note-level features. These findings outline a systems-level framework illustrating how higher-level cortical controllers shape lower-level pattern generators to flexibly adapt behavior—a challenge shared by natural and artificial agents.

Daniela Vallentin, using the nightingale, will reveal a hierarchical mechanism by which temporal and spectral features are integrated during vocal matching. Wild nightingales show real-time pitch matching, and manipulating syllable duration shifts their own whistle durations toward the presented structure. When exposed to unnatural pitch–duration pairings, they flexibly trade off spectral and temporal imitation. A computational model formalizes this hierarchy, showing that syllable duration provides the temporal scaffold for pitch adjustments and shapes real-time matching behavior.

Gregg Castellucci will introduce a conceptual model of multi-effector action that places behaviors along a continuum from multitasking (simultaneous, competing actions) to unitary whole-body movements aimed at a single goal. He will discuss how sequential multi-effector behaviors across species—including speech and gesture in humans and wingspread displays in cowbirds—fit within this framework, and how different levels of the motor hierarchy and biomechanical factors contribute to their coordination. Finally, he will show how the kinematics of multi-effector actions can be used to infer their underlying planning and control strategies and illuminate their neural basis.

Britton Sauerbrei will discuss coordination between neural dynamics in motor cortex and the spinal central pattern generator (CPG) in mice performing an obstacle traversal task. Cortical dynamics consist of a large preparatory transient as the animal nears the barrier, oscillations driven by an efference copy from the CPG, and small, muscle-like signals resembling corticospinal commands. A simple model is then proposed which transforms inputs conveying obstacle proximity and locomotor phase into motor commands. These results reveal a regime in which higher brain areas must sculpt an ongoing, spinally-generated program to flexibly control behavior.

THURSDAY, APRIL 23, 2026

08:00 – 10:00 SESSION 9, PANEL IV

Motor abstraction in mind and brain: How abstract motor representations are learned, modified, and reused

Zekun Sun [1], Katja Kornysheva [2], Lucas Tian [3], Yuto Makino [4]

[1] Yale University, [2] University of Birmingham, [3] Rockefeller University, [4] National Institute of Information and Communications Technology

Discussant: **Samuel McDougle**

A violinist can move between instruments with only minor adjustment, a tennis player can switch rackets with little effort, and a child can draw the same shape using crayons, markers, or finger paint. Our ability to generalize motor skills so efficiently suggests that the mind can encode actions in an abstract format — one that preserves their essential structure while freeing them from the constraints of specific muscle commands and contexts. This panel will present recent theoretical advances and empirical findings that significantly modify and extend beyond traditional accounts of motor abstraction.

First, Zekun Sun will present behavioral evidence showing that motor abstractions support novel skill learning at the very earliest stages of acquisition. Using a novel handwriting paradigm, Sun will show that the motor system recruits genuinely motoric, high-level representations that generalize across substantial kinematic variation.

Building on this theme of generalization, Yuto Makino will then introduce a new theoretical framework for how the motor system retrieves and applies learned skills across contexts. Makino shows that motor learning is best explained by representations organized around the relative phase of a movement, rather than absolute state or timing parameters.

Transitioning from behavioral to neural mechanisms, Katja Kornysheva will examine how skilled actions are constructed in real time. Kornysheva argues that behavioral fusion in memory-guided sequences cannot be taken as a proxy for neural fusion of sequential elements, but that skilled actions are dynamically assembled from coordinated interactions between motor, premotor, parietal, and hippocampal systems. This perspective highlights a flexible, distributed control architecture that can rapidly reorganize skilled actions as task demands evolve.

Finally, Lucas Tian will address how the brain represents and manipulates the symbolic building blocks of action. Using a compositional drawing task paired with large-scale neural recordings in macaques, Tian identifies neural populations that encode discrete, recombinable action symbols in premotor cortex, and neurons in preSMA that represent variables in grammatical rules. The structured population geometry of these signals explains macaques' capacity to generalize learned grammars.

Together, these four perspectives converge on a new understanding of motor abstraction as a transferable, flexible, dynamic, and generative phenomenon. Rather than relying on rigid templates or invariant schemata, the motor system appears to build actions from flexible symbolic units, modular neural components, and phase-based representations that support rapid learning, adaptive recombination, and robust generalization. This panel highlights how behavioral experiments, neural analyses, and computational modeling are reshaping foundational theories of how the brain constructs and generalizes skilled actions.

10:30 – 12:10 SESSION 10, INDIVIDUAL III

O3.1 - Understanding strategic sensorimotor adaptation as a process of hypothesis testing

Anjuli Niyogi [1], Elizabeth Cisneros [2], Wei Ding [3], Richard Ivry [4], Jonathan Tsay [1]

[1] *Carnegie Mellon University,* [2] *University of California, Berkeley,* [3] *Tsinghua University,* [4] *University of California*

Presenting author: **Anjuli Niyogi**

Picture a surgeon, mid-procedure, suddenly forced to switch from a trusted instrument to an unfamiliar one. In that moment, success—or catastrophe—hinges on the ability to rapidly adapt to the new tool's weight and dynamics. This capacity for motor adaptation is fundamental to human competence, allowing us to adjust to changes in our bodies (e.g., injury) and environments (e.g., novel tools). Indeed, motor adaptation emerges from multiple learning processes—some implicit and automatic, others explicit and strategic—that jointly enable flexible, goal-directed behavior.

For decades, motor learning research has largely revolved around the mechanisms supporting implicit adaptation. The dominant computational account, the error reduction model, casts adaptation as a gradual, trial-by-trial minimization of motor error. This framework has captured many core phenomena of implicit motor adaptation and has guided extensive work identifying the cerebellum as its core neural substrate.

However, the processes underlying strategic motor adaptation remain largely unknown. To close this gap, we developed a psychophysical paradigm that isolates strategic adaptation and measures the full two-dimensional structure of participants' movements (via an unconstrained x–y workspace). This approach uncovers a striking pattern: although group-averaged behavior looks gradual, individuals produce large, diverse, and highly structured errors before a sudden insight that brings performance into a stable solution space. These idiosyncratic learning functions contradict the smooth, incremental learning predicted by Error Reduction, pointing to a qualitatively different process.

We propose a new computational account in which strategic adaptation arises from learners generating, evaluating, and revising causal explanations for their motor errors (e.g., rotation, translation, reflection), and devising strategies to counteract the inferred perturbation. Our model accounts for a broad range of strategic phenomena across diverse perturbation types (rotations, reflections, gain changes). The model outperforms leading alternatives in the motor-learning literature (error reduction, reinforcement-learning models, win–stay/lose–shift heuristics, "moment-of-insight") in capturing individual learning functions.

Moreover, the model reveals how uncertainty in feedback—symbolic feedback offering abstract, numeric guidance vs. sensory feedback offering precise, location-based information—attenuates strategy discovery. Additionally, it can also explain how environmental structure (e.g., target arrangement) biases learners toward specific hypotheses, producing dramatically different motor-error distributions. It also provides a mechanistic account of why strategic adaptation deteriorates in both healthy and pathological aging. Finally, we discuss how, in more complex sensorimotor tasks (e.g., riding a bicycle), the relevant hypotheses may extend beyond geometric primitives to other conceptual primitives. Altogether, these findings define a new, unifying theory of how humans discover successful sensorimotor strategies, bridging action closer to cognition.

O3.2 - Cortex-dependent motor control can be learned from subcortical demonstration

Jason Keller[1], Joshua Dudman[2]

[1] HHMI Janelia Research Campus, [2] Howard Hughes Medical Institute

Presenting Author: **Jason Keller**

Motor control in mammals is traditionally viewed as hierarchical, with the frontal cortex at the top. This framework suggests that cortex learns to control subcortical circuits through trial-and-error, a process that is both inefficient and inconsistent with the rapid contextual learning observed with innate behaviors. To address this, we studied cortical and subcortical interactions as head-fixed mice learned contextual control of a hindlimb extension motor primitive. Naïve mice performed reactive extensions to a cold air stimulus within seconds and, using predictive cues, learned to avoid the stimulus altogether in tens of trials. Using 3D kinematic tracking, we show that while extension movements were remarkably consistent across avoidance learning, predictive avoid extensions were subtly slower than reactive ones, reminiscent of cortically-controlled motor preparation. We thus examined the cortical dependence of hindlimb extension using intermittent local optoinhibition of the frontal cortex and found that it prevented avoid but not react extensions. However, mice with such inhibition on every trial easily adapted to this perturbation, suggesting distributed cortical control of the contextual, predictive extensions. To test this, we also inhibited the majority of the dorsal cortex using a novel “acute optogenetic decortication” and found that this perturbation could indeed inhibit all avoid extensions when applied on every trial, but still left reactive extensions intact with only minor posture changes. Surprisingly, though, when we released mice from this decortication on every trial, we observed an immediate appearance of avoid trials, indicating that mice can “covertly” learn to use predictive cues to elicit avoid extensions, even in the absence of any prior cortically-mediated avoidance experience. Simultaneous Neuropixels recordings in several brain areas confirmed the extent of optogenetic inhibition and were consistent with distributed control of hindlimb extension movements and widespread motor corollary activity. Furthermore, they revealed that avoid extensions were marked by persistent cue activity in the frontal cortex that was linearly separable from movement-related activity. These findings support a distributed cortical-subcortical, heterarchical control logic in which the frontal cortex can learn contextual, predictive motor control from subcortical demonstration of innate motor primitives.

O3.3 - Coordinated spinal locomotor network dynamics emerge from cell-type-specific connectivity patterns

Frank Wandler[1], Benjamin Lemberger[1], James Murray[1], David Mclean[2]

[1] University of Oregon, [2] University of Edinburgh

Presenting Author: **Frank Wandler**

Vertebrate locomotion is accomplished by rhythmic muscle activity that is generated and precisely coordinated by a dedicated neural circuit in the spinal cord, called the locomotor central pattern generator (CPG). Despite decades of research, how this rhythmic activity emerges from the locomotor CPG remains incompletely understood. Existing models tend to rely on local (often single-cell) oscillators to generate rhythmic activity, which is then patterned by network-level mechanisms. However, such models have not fully accounted for recent experimental results in zebrafish and other organisms that point to the importance of cell-type-specific intersegmental connectivity patterns and recruitment of speed-selective subpopulations of interneurons. To address these limitations, we develop a hierarchy of increasingly detailed models of the locomotor CPG in larval zebrafish that iteratively incorporate these observations. Surprisingly, in these models, rhythmogenesis occurs at the network level, without the need for local oscillators. In particular, we find that coordinated locomotion emerges in an inhibition-dominated network in which connectivity is determined by intersegmental phase relationships among interneurons and variable-speed control is implemented by recruitment of speed-selective subpopulations. Further, while structured excitatory connections are not necessary for rhythmogenesis, they are useful for increasing peak locomotion frequency, albeit at the cost of smooth interpolation between frequencies, suggesting a basic computational trade-off between speed and control. We verify these network-level mechanisms for rhythmogenesis by reproducing our results in a spiking model. Finally, by training the weights in the model using gradient descent, we find that hierarchical and modular connectivity motifs emerge as a solution to reproduce experimentally observed dynamics from intracellular recordings from various cell types. Our results establish a novel mechanistic understanding of rhythm generation and control in CPGs based on biologically-motivated connectivity motifs.

O3.4 - Cortico-subcortical dynamics underlying adaptive locomotion

Martin Esparza[1], Ioana Lazar[1], Catia Fortunato[1], Mostafa Safaie[1], Juan Gallego[2]

[1] *Imperial College London,* [2] *Champalimaud Foundation*

Presenting Author: **Martin Esparza**

Locomotion is a fundamental behaviour common to all animal species. As such, its neural underpinnings have been extensively characterized, with particular emphasis on spinal and brainstem circuits during stereotyped locomotion. Yet, the neural processes mediating adaptive locomotion, which likely involve higher-order cortical and subcortical areas, remain elusive.

To address this gap, we designed a task based on delivering rapid, unpredictable mechanical perturbations to head-fixed mice running on a spherical treadmill using 12 evenly distributed actuators. This allowed us to elicit a broad range of behavioural corrections, determined by the actuator's location and the animals' ongoing gait cycle. We recorded from sensorimotor cortices, downstream basal ganglia projections, and relay centres in the motor thalamus, while also collecting whole-body 3D kinematics.

To investigate the role of each region during adaptive locomotion, we projected their firing rates onto the dominant patterns of covariation to obtain region-specific latent dynamics. Linear decoders trained on these latent dynamics were able to classify the perturbation direction from all regions as well as from the kinematics. Yet, the peak decoding time was variable across brain regions, with the primary motor and somatosensory cortices leading downstream regions. Additionally, perturbations selectively increased inter-region interaction strength when compared to unperturbed running, with interaction peaks happening at different time shifts, suggesting "information flow" from primary motor to somatosensory cortex and then basal ganglia and thalamus.

To disentangle how sensory responses and motor corrections contributed to these results, we trained linear regressors to predict latent dynamics from kinematics (sensory encoding) and vice-versa (motor decoding). Primary motor cortex presented both the best encoding and decoding of limb kinematics in absolute terms. Although both types of predictions improved across all regions following a perturbation, the magnitude of this increase was region-specific. Particularly, motor cortex showed the largest improvement in predictive accuracy when encoding kinematics, while the downstream dorsolateral striatum and thalamus showed the largest increase in decoding kinematics.

Finally, as animals engaged in perturbed trials, decoding accuracy of kinematics from latent dynamics increased compared to a ~10 min pre-perturbation period. This marked improvement was accompanied by a region-specific change in the leading covariation patterns across neurons, which spanned directions nearly orthogonal in between these two periods. These observations suggest a shift in "control mode", where adaptive locomotion recruits higher-order regions when facing unpredictable perturbations. Ongoing pharmacological manipulations will causally define these regions' contributions, shedding light on how sensorimotor cortical and subcortical interactions enable adaptive locomotion.

O3.5 - Dynamic whole-body fetal sensorimotor behavior captured by 4D Cine-MRI and musculoskeletal model

Hoshinori Kanazawa [1], Seiichi Morokuma [2], Yukiyo Shimada [2], Koji Sagiyama [2], Tatsuhiro Wada [3], Chiaki Tokunaga [3], Kei Nisikawa [3], Yuya Saito [3], Yasuo Kuniyoshi [1]

[1] The University of Tokyo, [2] Kyushu University, [3] Kyushu University Hospital

Presenting Author: **Hoshinori Kanazawa**

Spontaneous movements during the fetal period generate sensory feedback that is thought to contribute to the earliest organization of the human sensorimotor system. Animal studies demonstrate that twitch-like limb and body movements reliably trigger structured neuronal events in spinal and cortical circuits, shaping somatotopic organization and early coordination. However, in humans, the absence of methods for capturing whole-body dynamics has limited our understanding of how fetal movements give rise to structured sensorimotor interactions. Here, we developed an imaging–modeling framework that reconstructs dynamic whole-body fetal behavior from 4D Cine-MRI and quantifies the resulting patterns of joint motion, posture transitions, and multimodal sensory feedback.

We acquired multi-slice 4D Cine-MRI from third-trimester fetuses and spatially and temporally concatenated the volumes to generate continuous motion sequences. Manual annotation of approximately 1% of frames provided fetal body and uterine boundaries, and automated segmentation propagated these labels across the full dataset. A subject-specific musculoskeletal fetal model was fitted to the segmented surfaces using robust Chamfer-distance–based registration, enabling estimation of 3D joint angles, posture trajectories, dynamic skin contacts, and changes in muscle–tendon lengths used to infer proprioceptive input.

This approach successfully reconstructed coordinated, spontaneous whole-body movements—including rolling, limb extension, flexion–extension cycles, and gradual postural adjustments—together with their associated sensory consequences. Contact mapping revealed rich, spatially distributed tactile input generated by interactions between moving fetal limbs and the uterine environment. Proprioceptive estimates fluctuated with major phases of movement, indicating tight temporal coupling between motor output and sensory feedback. These findings demonstrate that human fetal behavior exhibits structured sensorimotor patterns, consistent with early forms of organization observed in neonatal animal models and in early infancy. In parallel with postnatal “sensorimotor wandering” described in infants, fetal movements already display coherent spatiotemporal organization that may serve as a foundation for later coordination.

Together, these results provide the first non-invasive, quantitative description of whole-body human fetal sensorimotor interactions. By capturing multi-joint kinematics, tactile interactions, and proprioceptive dynamics within the fetal environment, this framework offers new empirical access to the developmental origins of sensorimotor organization well before birth. The method establishes a basis for linking early fetal sensorimotor experience to postnatal motor development, and it may contribute to understanding how early disruptions in movement or sensory feedback influence atypical developmental trajectories.

FRIDAY, APRIL 24, 2026

08:00 – 10:00 SESSION 12, PANEL V

Divergent pathways, convergent function: New physiological, anatomical, and theoretical perspectives on sensory-driven and top-down control of rapid eye movements

Mayu Takahashi [1], Ziad Hafed [2], Jeffrey Schall [3], Martin Bohlen [4]

[1] Tohoku University, [2] Centre for Integrative Neuroscience, [3] York University, [4] Duke University

Discussant: **Neeraj Gandhi**

Rapid eye movements (saccades) are among the most elementary and time-critical motor actions performed by the nervous system. Such eye movements are under a perpetual influence of endogenous cognitive demands as well as exogenous sensory drives, and this is reflected in decades of research largely investigating these two classes of oculomotor system influences in isolation. However, even simple retrospection reveals that exogenous sensory inputs, arriving asynchronously with respect to internal brain state, must compete with endogenous processes to drive behavior. This symposium will highlight novel perspectives on the enduring tension between peripheral sensory drives and top-down control of eye movements. Using recent advances in anatomical, physiological, and theoretical approaches, we address a fundamental question in systems neuroscience: how distinct pathways—direct retinal projections to midbrain and brainstem circuits, and cortical sensory and decision networks—interact, and potentially even compete, to govern rapid sensorimotor decisions. Starting from the final gate for allowing saccade generation to proceed, the brainstem omnipause neurons, we will show how feature-tuned sensory modulations of these neurons' activity jumpstart a highly reflexive and precise coordination between exogenous sensory events and endogenous motor plans; remarkably, these sensory-driven ocular reflexes depend entirely on the geniculostriate pathway (Hafed). This dominance of the geniculostriate pathway starkly contrasts with novel and compelling tracing and high-density electrophysiology evidence revealing diverse direct projections from the retina to the superior colliculus in primates (Bohlen), raising essential questions about when sensory pathways that bypass the geniculostriate system are functionally engaged. Upstream of the omnipause neurons, we will address the question of how the decision to initiate, suppress, or interrupt an eye movement requires top-down impacts from parietal and frontal cortical areas on the brainstem, and ultimately the omnipause neurons (Schall). Theoretically, similar coordination principles to those involved in sensory-driven modulations of omnipause neurons emerge, but with clearly distinct functions and time scales. These distinctions are further elucidated by integrated physiological and anatomical evidence defining the connectivity among the frontal eye field, superior colliculus, and omnipause neurons (Takahashi), revealing a shared brainstem switching mechanism through which fixation and saccade initiation are implemented. By aligning bottom-up, intermediate, and top-down perspectives on rapid eye-movement control, this session will redefine and sharpen classic questions in oculomotor neuroscience and highlight where the next major conceptual breakthroughs are likely to arise.

10:30 – 12:10 SESSION 13, INDIVIDUAL IV

O4.1 - Dual descending pathways drive the initiation of skilled movements

Yutaka Yoshida[1], Akimasa Ishida[1], Esther Lai[1], Teruko Danjo[2], Fumiyasu Imai[2], Jay Bikoff[3], Samuel Sober[4], Amanda Jacob[4], Matthew Williams[4], Kyle Thomas[4]

[1 2] Okinawa Institute of Science and Technology, [2] Weill Cornell, [3] St. Jude, [4] Emory

Presenting Author: **Yutaka Yoshida**

The initiation of skilled movements is regulated by descending neurons in the sensorimotor cortex and brainstem projecting to the spinal cord. However, the mechanisms by which these pathways convey initiation signals remain unclear. This uncertainty arises from two key previous observations. First, inhibition of each descending pathway does not abolish the initiation of skilled movements such as reach–grasp behaviors. Second, brief stimulation of descending neurons fails to evoke the sequence of these movements. In this study, we demonstrate that combined inhibition of corticospinal neurons (CSNs) in the rostral forelimb area (rCSNs) and reticulospinal neurons (ReSNs) in the reticular formation effectively blocks the initiation of skilled reaching behaviors. Conversely, simultaneous brief activation of both rCSNs and ReSNs is sufficient to not only initiate reaching, but also to evoke sequential, naturalistic reach–grasp movements. These findings suggest that rCSNs and ReSNs converge on a “reach–grasp generator” located in the cervical spinal cord. Supporting this, we find that both rCSNs and ReSNs are activated prior to movement initiation, and that these two descending circuits synergistically operate, with no apparent crosstalk in the central nervous system. Together, these findings reveal a cooperative mechanism by which two parallel descending pathways drive the initiation and execution of skilled motor sequences in mammals.

O4.2 - The influence of using finger-extending exoskeletons on proprioceptive and tactile localization

Dominika Radziun[1], Siebe Geurts[1], Valeria Peviani[1], Luke Miller[1]

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

Presenting Author: **Dominika Radziun**

Humans show a remarkable ability to incorporate tools and artificial extensions into their sensorimotor control loops. Yet the perceptual and computational consequences of such integration remain poorly understood. We investigated how finger-extending exoskeletons reshape proprioceptive and tactile localization, providing a controlled test case for probing the flexibility of somatosensory body maps during technological augmentation. In the first experiment, twenty participants completed a high-density proprioceptive mapping task across four phases: before wearing the exoskeleton, after donning it, after active use, and after device removal. We identified three dynamic phases of plasticity. Wearing the device initially contracted the perceived length of the biological finger. After active use, both biological and exoskeletal fingers exhibited significant representational stretching, an effect absent in a non-augmenting control condition. Finally, a post-removal aftereffect persisted on the biological finger. In the second experiment, seventeen adults performed tactile localization on their index and middle fingers before and after 45 minutes of training with 10-cm finger-extending exoskeletons. Using a probabilistic model of tactile localization, we isolated changes in sensory processing, decision variables, and body representation. Exoskeleton use selectively altered the spatial remapping between mechanoreceptor and physical space, producing a ~24% stretch in tactile maps accompanied by a proportional increase in localization uncertainty. All other sensory and decisional parameters remained stable. These results show that wearable augmentations drive structured updates to somatosensory representations rather than simple spatial shifts, revealing principled computational rules governing representational expansion. Together, these findings demonstrate that tactile and proprioceptive maps rapidly adapt to artificial extensions, with changes governed by structured probabilistic computations and shaped by both the structural and functional properties of the device. This work highlights the flexibility of the sensorimotor system in accommodating technological augmentations and provides a computational framework for understanding how artificial extensions become integrated into the body representation.

O4.3 - Spatially independent and temporally robust somatosensory hand representations in expert pianists

Masato Hirano [1], Sachiko Shiotani [2], Shinichi Furuya [1]

[1] *Sony Computer Science Laboratories, Inc.*, [2] *NeuroPiano Institute*

Presenting Author: **Masato Hirano**

In the sensorimotor system, population neural activity is constrained by the physical structure of the musculoskeletal system and its kinematics. A seminal study has shown that the geometry of hand representation, the covariation structure across fingers, mirrors the covariation patterns of finger use in daily life (Ejaz et al. 2015), suggesting that long-term usage or training can reorganize hand representations. Classical studies in musicians suggested that long-term instrumental practice increases the spatial independence of cortical motor and somatosensory hand representations (Elbert et al., 1995). However, recent fMRI work has challenged this view, claiming no clear expansion and even reduced representational distances between fingers in musicians (Ogawa et al., 2019), and preserved somatosensory maps after amputation (Schone et al., 2025). The controversy raises the question of whether long-term training of dexterous finger movements reorganizes somatosensory hand representations.An additional open question is whether structured somatosensory mappings are preserved or distorted when multiple fingers are moved in rapid succession, as in musical performance. In such situations, somatosensory signals from different fingers arrive close in time, requiring the nervous system to separate temporally overlapping inputs while maintaining a segregated mapping of which finger moved and how. This challenge is particularly pronounced in expert pianists who, through years of practice, execute rapid sequences of multi-finger movements. Pianists therefore provide a unique model to elucidate how extensive training overcomes such a challenge through adaptation of somatosensory hand representations.Here we tested these ideas by comparing expert pianists with matched nonmusicians. EEG was recorded while a custom-made hand exoskeleton robot delivered precisely controlled passive flexion/extension movements to individual fingers and to multiple fingers in rapid succession. By systematically varying movement tempo, we characterized both the spatial organization and temporal robustness of somatosensory hand representations by using multivariate pattern analyses of evoked responses. When the robot delivered isolated passive movements to individual fingers, nonmusicians exhibited a characteristic representational geometry, with shared activity patterns between the middle, ring, and little fingers. In contrast, expert pianists showed a more differentiated spatial geometry with increased separation across these digits. When multiple fingers were moved in rapid succession, nonmusicians showed a distortion of this structure, with finger- and motion-specific representational patterns largely collapsing. However, pianists maintained clear finger- and motion-specific geometry during rapid multi-finger movements. These findings suggest that long-term piano training induces somatosensory hand representations that are both spatially more independent and temporally robust, supporting accurate processing of proprioceptive inputs during high-speed sequential actions.

O4.4 - Setting the gains: Neural and behavioral evidence for pre-movement feedback controller configuration

Dominique Delisle-Godin [1], Pierre-Michel Bernier [1]

[1] *Université de Sherbrooke*

Presenting Author: **Dominique Delisle-Godin**

Humans routinely perform skilled actions that involve automatic, context-appropriate adjustments to movement, such as reaching for a cup of coffee while reading this abstract and seamlessly correcting the hand's trajectory if bumped by a co-worker. These rapid feedback corrections are thought to rely on the engagement of controllers whose feedback gains are tuned to the specific demands of the task. For instance, previous work using mechanical perturbations has shown that feedback gains scale with accuracy requirements, yielding stronger long-latency (LL) muscle responses when targets are narrower. Despite the contention that these controllers are set up before movement, the neural evidence for such preparatory configuration remains limited because prior studies have predominantly focussed on movement execution. Here, we tested whether neural activity preceding movement reflects the preparation of a feedback controller with increased feedback gains. A secondary objective was to test whether the availability of online visual feedback influences preparatory neural activity. Twenty-eight healthy adults performed a delayed, goal-directed reaching task toward either a narrow (2.5 cm) or wide (80 cm) target. On a subset of trials, mechanical perturbations (±12 N) were applied to probe feedback responses. To assess the role of vision, blocks of trials were performed both with and without online visual feedback of the cursor. Surface electromyography (EMG) and electroencephalography (EEG) were recorded simultaneously to characterize muscle and neural activity. We hypothesized that preparing a controller with increased feedback gains (narrow target) would be accompanied by stronger beta-band (13–30 Hz) event-related desynchronization (ERD) during the delay period, reflecting greater investment of neural resources in motor preparation. As previously reported, LL responses were significantly larger for the narrow compared to the wide target for both +12 N and -12 N perturbations ($p < 0.001$), confirming the modulation of feedback gains by accuracy demands. Critically, and consistent with our predictions, EEG analyses revealed a frontoparietal cluster showing significantly stronger beta ERD in the later portion of the delay period for the narrow target condition ($p < 0.01$). Interestingly, the same qualitative pattern of EMG and EEG results held true irrespective of the vision condition, indicating that similar controllers were engaged with or without visual feedback. By linking pre-movement neural activity to feedback responses during movement, this work provides evidence that feedback controllers are configured prior to movement and identifies beta ERD as a marker of preparing a high-gain controller.

O4.5 - Hierarchical and Context-Dependent Population Codes for Intended and Observed Actions in Human Parietal and Motor Cortex

Celia Bougou [1], Jorge Gamez [2], Emily Rosario [3], Charles Liu [4], Kelsie Pejsa [1], Ausaf Bari [5], Richard Andersen [2]

[1] *California Institute of Technology,* [2] *Division of Biology and Biological Engineering, California Institute of Technology,* [3] *Casa Colina Hospital and Centers for Healthcare,* [4] *Keck School of Medicine of USC,* [5] *University of California, Los Angeles*

Presenting Author: **Celia Bougou**

How the human brain represents actions across intention and observation remains unknown, largely because direct intracortical comparisons across cortical levels have been exceptionally rare. We addressed this gap by recording neural activity from Utah arrays implanted in motor cortex (MC) and posterior parietal

cortex (PPC) of two individuals with tetraplegia participating in an ongoing brain–machine interface study. Across five implants, we obtained more than 4,500 single units, providing an unprecedented opportunity to examine how action features are encoded across cognitive formats and cortical hierarchies. Participants either internally generated or passively viewed the same set of actions in a fully crossed design manipulating hand, action type, and movement direction. We identified a clear functional dissociation between areas. MC robustly encoded internally generated actions yet exhibited only sparse and unreliable tuning during observation, offering the first direct human evidence that single-unit mirroring in MC is minimal. However, population analyses revealed a latent overlap between intention and observation: observed actions occupied a weak but geometrically aligned subspace of the intention manifold, reconciling the sparse responses at the single-unit level with longstanding imaging reports of MC activity during action observation. PPC showed a contrasting profile. Single-unit selectivity and population activity both demonstrated that action identity was represented invariantly across intention and observation. Representational similarity analysis, cross-format decoding, and low-dimensional trajectory alignment all converged on a shared, generalizable code for action features in PPC, suggesting that it supports an abstract representation of actions. To examine how these representations behave when observed and intended actions occur simultaneously, one participant performed a dissociation paradigm in which the viewed action and the instructed action were presented simultaneously and could be either congruent or incongruent. When the participant simply intended an action while observing another, PPC predominantly encoded the internal motor plan, with the observed action largely suppressed. However, when the task required the participant to intend an action, observe a potentially conflicting action, and subsequently report the observed one, PPC represented both the intended and the observed action. MC, in contrast, encoded only the instructed action in all conditions. These findings provide the first single-unit evidence in humans that the posterior parietal cortex flexibly regulates visual–motor coupling based on behavioral relevance and together support a hierarchical framework in which motor and parietal cortices occupy distinct and complementary roles in action encoding.

15:00 – 17:00 SESSION 15, PANEL VI

How do distributed motor circuits reorganize to support the execution of learned actions?

Naama Kadmon Harpaz [1], Alice Mosberger [2], Vivek Athalye [3], Karunesh Ganguly [4], Michael Long [5]

[1] Harvard University, [2] NYU Langone Health, [3] Allen Institute, [4] University of California, San Francisco, [5] New York University Langone Medical Center

Discussant: **Alice Mosberger**

Animals can expand their behavioral repertoire by flexibly combining and sequencing existing motor elements into novel actions. Such behavioral versatility is essential for adapting to a changing environment and new conditions. However, only with practice, an initially slow, discontinuous, and variable sequence of movements is transformed into a fast, smooth, and stereotyped skilled behavior. These behavioral changes are thought to arise from plasticity within motor circuits and the reorganization of neural dynamics and cross-area interactions. This raises a central question: How and when do neural circuits reorganize during learning to support a new action composed of a sequence of motor elements, and how does this learning alter the representation of those elements themselves?

This panel will bring together work addressing these questions across diverse model organisms, including non-human primates, mice, rats, and parrots. We will examine how interactions among premotor and primary motor cortical regions and subcortical structures such as the striatum support the acquisition and execution of learned actions. The panel will also highlight recent methodological advances that allow manipulation and tracking of the activity of single neurons during learning. Together, we will explore circuit-level mechanisms that may be shared across species and that enable animals to expand their behavioral repertoire.

First, Athalye will discuss how movements are encoded in the striatum, a key region for learning and controlling skilled actions. He will show that the minimal movements required for an isometric push–pull task in mice - opposing muscle contractions - are represented in striatal neurons even prior to learning, providing a substrate upon which learning can build to support more complex actions.

Ganguly will then focus on mechanisms of circuit reorganization that stabilize a newly learned action composed of multiple motor elements. He will demonstrate how cross-area reactivation during NREM sleep drives cortico-striatal plasticity in mice and non-human primates practicing a reach-to-grasp task and discuss a specific NREM rhythm spanning cortex and striatum that causally contributes to the emergence of skilled performance.

Next, Kadmon Harpaz will discuss how animals learn and execute multiple actions composed of partially overlapping motor sequences. She will present work tracking behavioral changes in rats learning several lever-press sequences and the accompanying reorganization of the cortico-striatal circuit.

Finally, Long will explore how motor regions interact to generate multiple learned vocalization sequences in the budgerigar, a parrot species with a versatile vocal repertoire. He will describe how neurons in a premotor region generate temporally structured activity that is relayed to a motor output region, forming a hierarchical model that supports the acquisition and execution of versatile vocal behaviors.

17:00 – 18:00 DISTINGUISHED CAREER AWARD PRESENTATION AND TALK

How multiple feedback pathways can generate goal-directed movements

Stephen Scott, *Queens's University*

How does the human motor system produce goal-directed movements given multiple feedback pathways: spinal, subcortical, and cortical? This question occupied much of my career. Early on, as a graduate student studying cat locomotion, I viewed motor control through the traditional Jackson/Sherrington hierarchical framework, where supraspinal regions influence the spinal cord, which generates muscle activity. This model is straightforward to simulate using engineering principles. However, during my postdoctoral work on voluntary control in non-human primates, this strict hierarchy seemed less convincing. Primates have corticospinal projections targeting both spinal interneurons and motoneurons, indicating more complex interactions. Later, approaching the problem with optimal feedback control theory, our research emphasized the importance of transcortical feedback for goal-directed actions, with spinal feedback playing a limited role. Still, I found it challenging to explain such shifts in feedback processing across species and behaviors. Modeling multiple parallel pathways often felt speculative, with strong but conflicting views about the dominance of each level. Our recent work offers fresh insight by making one feedback pathway trainable, allowing it to learn the contributions of the other non-trainable pathway—effectively one part of the motor system modeling another. As predicted, increased spinal feedback during mechanical disturbances corresponded with reduced motor cortex activity. This suggests that goal-directed movements arise from the combined contributions of multiple feedback pathways, with transcortical feedback providing motor commands that are the difference between *what is generated* by subcortical pathways and *what is required* for goal-directed behaviour.

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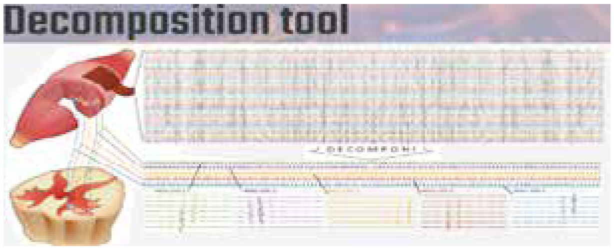

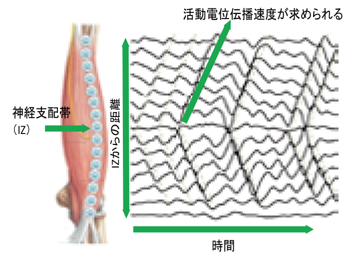

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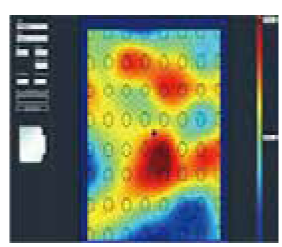

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Poster Sessions

The Society for the Neural Control of Movement is pleased to present a wide range of current research through the poster sessions. The posters have been divided over two sessions, each on display for two days.

SESSION 1

Tuesday, April 21, 2026 — 8:00 – 17:00
Wednesday, April 22, 2026 — 8:00 – 17:00

SESSION 2

Thursday, April 23, 2026 — 8:00 – 15:00
Friday, April 24, 2026 — 8:00 – 15:00

The poster numbers are divided first by session, then by theme, and finally with a unique number.

Session – Theme – Board Number (ex. 1-A-1)

THEMES

A – Control of Eye & Head Movement
B – Fundamentals of Motor Control
C – Posture and Gait
D – Integrative Control of Movement
E – Disorders of Motor Control
F – Adaptation & Plasticity in Motor Control
G – Theoretical & Computational Motor Control
H - Neurorehabilitation

POSTER SESSION 1

TUESDAY, APRIL 21, 2026

A – CONTROL OF EYE & HEAD MOVEMENT

P1-A-1 ***Effort sensitivity shapes saccade dynamics in a gaze holding choice task***

Caelan Thom [1], Alaa Ahmed [1]

[1] *University of Colorado, Boulder*

P1-A-2 ***Coordinated head, body and eye-movements support active sensing to reduce spatial uncertainty during navigation***

Fabian Kessler [1], Isabella Chiani [1], Julia Frankenstein [1], Constantin Rothkopf [2]

[1] *Centre of Cognitive Science TU Darmstadt,* [2] *Technical University of Darmstadt*

P1-A-3 ***A direction-dependent role for complex spikes firing during the peri-saccade onset period in modulating saccade kinematics***

Junya Inoue [1], Akshay Markanday [2], Peter Thier [2]

[1] *University Tübingen,* [2] *Hertie Institute for Clinical Brain Research*

P1-A-4 ***Event-locked patterns of macroscopic traveling wave in visually-guided saccade task***

Kuan-Ting Ho [1], Chih-Yang Chen [1], Hirotaka Onoe [1], Tadashi Isa [1]

[1] *Kyoto University*

P1-A-5 ***Electrophysiological correlates of differential anatomical inputs to brainstem omnipause neurons during saccadic eye movements***

Maria Ermolova [1], Antimo Buonocore [2], Ziad Hafed [3]

[1] *Centre for Integrative Neuroscience, University of Tübingen,*
[2] *Werner Reichardt Centre for Integrative Neuroscience,*
[3] *Centre for Integrative Neuroscience*

P1-A-6 ***Ketamine disrupts the saccadic signature of agency in the common marmoset***

Masatoshi Yoshida [1], Daisuke Koketsu [2], Acer Chan-Yu Chang [3], Wen Wen [4]

[1] *Hokkaido University,* [2] *Center for Research Collaboration, NIPS,*
[3] *University of Helsinki,* [4] *Rikkyo University*

P1-A-7 ***Action possibilities contextualize motor memories***

Ryo Ishibashi [1], Nobuhiro Hagura [1]

[1] *National Institute of Information and Communications Technology*

P1-A-8 ***Skill differences in head–eye coordination during real-world tracking of an approaching ball***

Saya Ogino [1], Tomohiro Kizuka [2], Seiji Ono [2]

[1] *University of Tsukuba,* [2] *Institute of Health and Sport Sciences, University of Tsukuba*

P1-A-9 ***Different roles of the cerebellum in long-term memory of vestibulo-ocular reflex enhancement and suppression***

Toshimi Yamanaka [1], Takumi Ikeda [1], Yutaka Hirata [1]

[1] *Chubu University*

P1-A-10 ***Frontal eye field inhibition disrupts saccade reaction time, accuracy, and express saccade generation in Marmosets***

Wajd Amly [1], Chih Yang Chen [2], Tadashi Isa [3]

[1] *ASHBi, Kyoto University,* [2] *Tohoku University,* [3] *Kyoto University*

P1-A-11 ***Relating trial-to-trial variance in eye movements to variance in superior colliculus and primary visual cortex***

Yue Yu [1], Amarender Bogadhi [2], Matthias Baumann [3], Ziad Hafed [4]

[1] *University of Tübingen,* [2] *Boehringer Ingelheim,* [3] *Hertie Institute for Clinical Brain Research,* [4] *Centre for Integrative Neuroscience*

B – FUNDAMENTALS OF MOTOR CONTROL

P1-B-12 ***The predictive gaze: Linking eye movements to the sense of control***

Ala Ali A Alsaleh [1], Markus Lappe [2]

[1] *University of Münster,* [2] *University of Muenster*

P1-B-13 ***Vibrotactile stimulus detection during Fitts aiming: Implications for the use of biofeedback devices during skilled, manual tasks***

Alice Atkin [1], Bernard Marius 'T Hart [1], Sebastian Tomescu [2], Bradley Strauss [2], Cari Whyne [2], Qingguo Li [3], Denise Henriques [1]

[1] *York University,* [2] *Sunnybrook Health Sciences Centre,* [3] *Queen's University*

P1-B-14 ***Refinement of movement patterns in sequential skill learning***

Amin Nazerzadeh [1], Medha Porwal [2], J. Andrew Pruszynski [2], Jörn Diedrichsen [2]

[1] *University of Western Ontario,* [2] *Western University*

P1-B-15 ***Exploring the effects of auditory stimuli on motor skill learning***

Anthonia Aina [1], Joyce Chen [1]

[1] *University of Toronto*

P1-B-16 ***Motor cortical dynamics underlying coarticulated reaching sequences***

Armin Panjehpour [1], Mehrdad Kashefi [2], Joern Diedrichsen [2], J. Andrew Pruszynski [2]

[1] *University of Western Ontario,* [2] *Western University*

P1-B-17 ***Parallel and distributed processing of value-based information during multi-attribute action decisions***

Ayuno Nakahashi [1], Paul Cisek [2]

[1] *German Primate Center,* [2] *Université de Montréal*

P1-B-18 ***Time course of corticospinal excitability during observation of anatomically and spatially variable body stimuli***

Baptiste Waltzing [1], Charlène Truong [1], Marcos Moreno-Verdú [1], Elise Van Caenegem [1], Robert Hardwick [1]

[1] *Université Catholique de Louvain*

P1-B-19 ***Contribution of GABAA(δ)R in nucleus ambiguus motor control of cardiac contraction rate***

Kaylie Dow [1], Yoko Wang [1], Jeffery Boychuk [1], Carie Boychuk [1]

[1] *University of Missouri*

P1-B-20 ***Can finger movements be decoded from early visual cortex?***

Caroline Heimhofer [1], Ingrid Odermatt [2], Paige Howell [1], Robin Weber [1], Kathy Ruddy [3], Nicole Wenderoth [1], Sanne Kikkert [1]

[1] *ETH Zürich,* [2] *School of Psychology, Queen's University Belfast,* [3] *Queen's University, Belfast*

P1-B-21 ***A brain-computer interface paradigm reveals different constraints on cortical and striatal activity***

Cecilia Gallego-Carracedo [1], Mostafa Safaie [1], Nicole Wang [1], Juan Álvaro Gallego [2]

[1] *Imperial College London,* [2] *Champalimaud Foundation*

P1-B-22 ***The effect of Reward and Punishment on the Acquisition and Consolidation of a Basketball Free-Throw Skill***

Charalampos Papaxanthis [1], Lionel Crognier [2], Elias Pibarot [2], Célia Ruffino [3], Pierre Vassiliadis [4]

[1] *Université de Bourgogne Europe, INSERM,* [2] *Université Bourgogne Europe, Inserm, CAPS UMR [1093],* [3] *Université marie et louis pasteur,* [4] *University College London*

P1-B-24 ***Cortical mechanisms underlying human eye-hand coordination: beyond summation of saccade and reach networks***

Cristina Rubino [1], Kiana Masoudi [1], J Douglas Crawford [1]

[1] *York University*

P1-B-25 ***Asymmetric grip forces in a bimanual peg-in-hole task***

Niklas Heimburger [1], Clara Günter [1], Raz Leib [1], David Franklin [1]

[1] *Technical University of Munich*

P1-B-27 *Influence of hand dominance and stimulus eccentricity on the StartReact effect*

Edward Wiggins [1], Ned Jenkinson [1]

[1] *University of Birmingham*

P1-B-28 *Impact of movement repetition on physical and imagined movements*

Elise Van Caenegem [1], Robert Hardwick [1], Baptiste Waltzing [1], Charlène Truong [1], Marcos Moreno-Verdú [1]

[1] *Université Catholique de Louvain*

P1-B-29 *The role of kinematic and muscular synergies in dexterous, contact-rich manipulation*

Federico Tessari [1], Johanna Happold [2], Aaron Michael West Jr. [3], Patricia Capsi Morales [2], Johannes Lachner [1], Neville Hogan [1], Cristina Piazza [2]

[1] *Massachusetts Institute of Technology,* [2] *Technical University of Munich,* [3] *Johns Hopkins University*

P1-B-31 *Toward an integrated view of the role of multi-region networks in locomotor control*

Genji Kawakita [1], Jimmie Gmaz [1], Martin Esparza [2], Ioana Lazar [1], Cecilia Gallego-Carracedo [1], Mostafa Safaie [1], Juan Gallego [3]

[1] *Imperial College London,* [2] *Imperial College London, InBrain,* [3] *Champalimaud Foundation*

P1-B-32 *'Automatic and selective inhibition in the brain: A MEG and selective stop task study'*

Heather Statham [1]

[1] *Cardiff University*

P1-B-33 *Salient and latent neural motor representations for whole body movements*

Hunter Schone [1], Brian Dekleva [1], Charles Greenspon [2], John Downey [2], Aaron Batista [1], Jennifer Collinger [1]

[1] *University of Pittsburgh,* [2] *University of Chicago*

P1-B-34 *Reconciling cell and network effects of 5-HT1ARs on motor cortex excitability*

Kyle Kammerer [1], Sidney Moss [1], Christopher Romero [1], Kathryn Parris [1], Jeffery Boychuk [1]

[1] *University of Missouri*

P1-B-35 *Subcortical control of object interception in the real-world*

Lucas Orssatto [1], Adam Boddy [2], Rhys Penny [2], Guy Wallis [2], Gerald Loeb [3], Brian Corneil [4], Timothy Carroll [2]

[1] *University of Queensland,* [2] *The University of Queensland,* [3] *University of Southern California,* [4] *Western University*

P1-B-36 *Virtual brush illusion paradigm reveals importance of disembodiment in multisensory integration*

Lyndah Lovell [1], Ethan Brown [1], Sarah Derrick [1], Mohit Singhala [2], Jeremy Brown [1]

[1] *Johns Hopkins University,* [2] *University of Pittsburgh*

P1-B-37 *The roles of the posterior parietal and motor cortices in grasp and object processing in three humans with tetraplegia*

Mackenzie Thurston [1], David Bjånes [2], Sarah Wandelt [3], Kelsie Pejsa [4], Brian Lee [5], Charles Liu [6], Richard Andersen [2]

[1] *Caltech,* [2] *Caltech, T&C Chen Brain-machine Interface Center,* [3] *Feinstein Institutes for Medical Research,* [4] *California Institute of Technology,* [5] *Caltech, Keck School of Medicine of USC,* [6] *Caltech, Rancho Los Amigos National Rehabilitation Center*

P1-B-38 *The impact of task instructions on finger motor sequence learning*

Marco Testoni [1], Giacomo Costa [2], Mirta Fiorio [1], Matteo Bertucco [1]

[1] *University of Verona,* [2] *Biomedicine and Movement Sciences, University of Verona*

P1-B-39 *Sex-specific associations between motor unit remodeling and pinch force in older adultsc associations between motor unit remodeling and pinch force in older adults*

Masahiro Kuniki [1], Kaito Igawa [1], Yuichi Noto [2], Ryosuke Takeda [1], Kohei Watanabe [1]

[1] *Chukyo University,* [2] *Kyoto Prefectural University of Medicine*

P1-B-40 *Motor cortical dynamics during long sequences of reaching movements*

Mehrdad Kashefi [1], Jonathan Michaels [2], Jörn Diedrichsen [1], J. Andrew Pruszynski [1]

[1] *Western University,* [2] *York University*

P1-B-41 *Error correction strategies in a redundant hand-foot reaching task*

Nagisa Inubashiri [1], Shota Hagio [2]

[1] *Ritsumeikan University,* [2] *Kyoto University*

P1-B-42 *The contributions of natural and artificial touch to motor cortex and their implications in BCI control*

Natalya Shelchkova [1], Brian Dekleva [2], Jennifer Collinger [2], John Downey [1], Charles Greenspon [1]

[1] *University of Chicago,* [2] *University of Pittsburgh*

P1-B-43 *A markerless tracking setup for examining a large variety of grasping movements in macaque monkeys and humans*

Nicolas Zdun [1], Hans Scherberger [1], Benjamin Dann [1]

[1] *German Primate Center*

P1-B-44 *Distinct neural control of alpha motor neurons in individual finger contraction and pinch task*

Nijia Hu [1], Elmira Pourreza [2], Hélio Cabral [3], Mikaël Desmons [4], J Greig Inglis [2], Francesco Negro [2]

[1] University of Brescia, [2] Università degli Studi di Brescia, [3] Federal University of Rio de Janeiro, [4] Université Limoges

P1-B-45 *Demedicalizing individual longitudinal follow-up and frailty detection*

Florian Legrand [1], Ioannis Bargiotas [2], Jean-Marc Eychene [3], Evelyne Alastor [4], Lise Haddouk [3], Christophe Labourdette [3], Jean-Marc Franco [5], Frédéric Sandron [1], Pierre-Paul Vidal [3]

[1] IRD Ceped—UMR 196, Université Paris Cité, Paris, France, [2] Université Paris-Saclay, Inria, CIAMS, [3] Centre Borelli, UMR 9010, CNRS, ENS Paris-Saclay, Université Paris-Saclay, Paris, France, [4] IRD, Sainte Clotilde Cedex, France, [5] UFR Santé, University of La Réunion, 97410 SaintPierre, France

P1-B-46 *Modality-selective onset timing of sensory gating in primate motor cortex during preparation for voluntary movement*

Ruto Kadowaki [1], Junichiro Yoshida [2], Woranan Hasegawa [2], Satomi Kikuta [2], Shinji Kubota [3], Tetsuro Funto [1], Kazuhiko Seki [2]

[1] The University of Electro-Communications, [2] National Center of Neurology and Psychiatry, [3] National Institute of Neuroscience

P1-B-47 *Timing of target motion affects target choice*

Clara Günter [1], Yiming Liu [1], Sae Franklin [1], Raz Leib [1], Rieko Osu [2], David Franklin [1]

[1] Technical University of Munich, [2] Waseda University

P1-B-48 *Neural population dynamics during bimanual finger control*

Seitaro Iwama [1]

[1] Keio University

P1-B-49 *Intrinsic motor representation in congenitally and acquired blindness*

Sergio Gurgone [1], Ryosuke Murai [1], Tsuyoshi Ikegami [1]

[1] National Institute of Information and Communications Technology

P1-B-50 *Medullary and intersegmental cervical networks underlying mammalian forelimb movement control*

Shahab Vahdat [1], Vishwas Jindal [2], Matteo Grudny [2]

[1] University of California, Riverside, [2] University of Florida

P1-B-51 *Causal involvement of the M1-parietal area 5 pathway in movement-related sensory suppression and fine hand motor control*

Shinji Kubota [1], Junichiro Yoshida [2], Ken-Ichi Inoue [3], Masahiko Takada [3], Kazuhiko Seki [2]

[1] National Institute of Neuroscience, [2] National Center of Neurology and Psychiatry, [3] Kyoto University

P1-B-52 *Functional ultrasound imaging of goal-directed reaching in awake infants*

Sofia Sakellaridi [1], Erik Hakopian [2], Shan Zhong [3], Argishti Stepanian [4], Ipsita Sahin [4], Michele Alaniz [1], Yovana Harris [1], Charles Liu [5], Elena Kokkoni [4], Vasileios Christopoulos [3]

[1] Casa Colina Hospital and Centers for Healthcare, [2] University of California, Irvine, [3] University of Southern California, [4] University of California, Riverside, [5] Rancho Los Amigos National Rehabilitation Center

P1-B-53 *The subthalamic nucleus in the regulation of motor variability*

Steffen Wolff [1]

[1] University of Maryland School of Medicine

P1-B-54 *Neuron population correlations cycle over fast timescales*

Stephen Clarke [1], Liz Jun [1], Paul Nuyujukian [1]

[1] Stanford University

P1-B-55 *The effect of gravitational force on path selection in 3D obstacle-avoidance reaching*

Suguru Goto [1], Yoshihiro Itaguchi [1]

[1] Keio University

P1-B-56 *Motor-evoked modules elicited by transcranial magnetic stimulation*

Takuya Morishita [1], Martina Coscia [2], Mirea Bacigalupo [2], Michael Lassi [3], Camille Proulx [1], Lisa Fleury [1], Friedhelm Hummel [1]

[1] École Polytechnique Fédérale de Lausanne, [2] HEPIA, HESSO University of Applied Science and Art Western Switzerland, [3] Sant'Anna School of Advanced Studies

P1-B-57 *Development of an experimental system for analyzing redundancy in multi-person cooperative movements*

Toshiki Kobayashi [1], Shunichi Kasahara [2]

[1] Sony Computer Science Laboratories, [2] Sony Computer Science Laboratories, Inc.

P1-B-58 *Current direction determines neural recruitment patterns in magnetic spinal stimulation*

Hironori Tsuji [1], Toshiki Tazoe [1], Yukio Nishimura [1]

[1] Tokyo Metropolitan Institute of Medical Science

P1-B-59 *A paired-pulse TMS method to measure cortico-reticulo-spinal responsiveness in humans*

Tyler Henderson [1], Filipe Estacio Costa [2], Eugene Poh [3], Lucas Orssatto [4], Jonathan Shemmell [3], Timothy Carroll [4]

[1] Charles Darwin University, [2] Universidade Federal de Santa Catarina, [3] University of Wollongong, [4] The University of Queensland

P1-B-60 *Striatal ensembles specify and control granular forelimb actions*

Vivek Athalye [1], Ines Rodrigues-Vaz [1], Darcy Peterka [2], Rui Costa [1]

[1] Allen Institute for Neural Dynamics, [2] Columbia University

P1-B-61 *The brain's internal rhythm generator: Understanding the behavioral traits and neural functional correlates of spontaneous motor tempo*

Wenyu Zhang [1], Ryoichi Nagatomi [1], Sai Sun [1]

[1] Tohoku University

P1-B-63 *Spatiotemporal modulation of lower limb spinal reflexes by combined transcranial magnetic and transcutaneous spinal cord stimulation*

Yousuke Tanaka [1], Atsushi Sasaki [1], Dimitry Sayenko [2], Nadaka Hakariya [1], Hiroki Arakawa [1], Yume Mashiki [1], Ryo Aoki [1], Yohei Masugi [3], Kimitaka Nakazawa [1]

[1] The University of Tokyo, [2] Houston Methodist Research Institute, [3] Tokyo International University

C – POSTURE AND GAIT

Poster Cluster (P1-C-64 & P1-C-65)

P1-C-64 *The effects of globus pallidus internus deep brain stimulation on locomotor adaptation in Parkinson's Disease*

Anjela Gurrala [1], Joshua Wong [1], Julia Choi [1]

[1] University of Florida

P1-C-65 *Pallidal beta oscillations underlying locomotor adaptation in Parkinson's Disease*

Julia Choi [1], Anjela Gurrala [1], Coralie De Hemptinne [1], Joshua Wong [1]

[1] University of Florida

P1-C-66 *Modulation of broadband EEG during walking in younger and older adults*

Charlotte Devol [1], Chang Liu [2], Jacob Salminen [1], Erika Pliner [3], Arkaprava Roy [1], Chris Hass [1], David Clark [4], Todd Manini [1], Rachael Seidler [1], Daniel Ferris [1]

[1] University of Florida, [2] University of Illinois at Chicago, [3] University of Utah, [4] Malcom Randall VA Medical Center; University of Florida

P1-C-67 *Improving propulsion in stroke survivors with haptic stance time instruction*

Christopher Engsberg [1], Nathaniel Hunt [1], Philippe Malcolm [1], Mukul Mukherjee [1]

[1] University of Nebraska, Omaha

P1-C-68 *Discovering feedback pathways for human walking with a structured neural controller*

Gunwoo Park [1], Seungbum Koo [1]

[1] Korea Advanced Institute of Science and Technology

P1-C-69 *Resting-state and task-related cortical signatures of static balance inform the predictive efficacy of tDCS*

Hadis Imani [1]

[1] Oldenburg University

P1-C-70 *Digital twin of human upright stance: identifying neural control disruptions in Parkinson's disease via Bayesian parameter inference*

Kazuki Matsui [1], Yasuyuki Suzuki [2], Charles Smith [3], Toru Nakamura [4], Takuyuki Endo [5], Saburo Sakoda [5], Taishin Nomura [1]

[1] Kyoto University, [2] Aichi Prefectural University, [3] North Carolina State University, [4] Osaka University, [5] Osaka Toneyama Medical Center

P1-C-71 *The difference of motor modules during the anticipatory phase between static-dynamic and dynamic-dynamic motion transition*

Kiyohiro Konno [1], Tokiya Noshiro [1], Atsushi Itaya [2], Tomohiro Kizuka [3], Seiji Ono [3]

[1] University of Tsukuba, [2] Hokkaido University of Education, [3] Institute of Health and Sport Sciences, University of Tsukuba

P1-C-72 *Time-locked spinal neurons transform descending drive into locomotor rhythms*

Kotaro Muramatsu [1], Kazutaka Maeda [2], Yuta Soga [3], Shiro Egawa [2], Enrique Contreras [2], Trevor Smith [2], Taku Hasegawa [2], Akito Kosugi [2], Shusei Fukuyama [4], Mirai Takahashi [4], Kaoru Tkakusaki [4], Kazuhiko Seki [2]

[1] University of Copenhagen, [2] National Center of Neurology and Psychiatry, [3] The University of Electro-Communications, [4] Asahikawa Medical University

P1-C-73 *Adding platform and visual perturbations significantly increased postural responses*

Manami Fujii [1], Sophia Chirumbole [1], Andrew Wagner [2], Jaclyn Caccese [1], Ajit Chaudhari [1], Dan Merfeld [1]

[1] The Ohio State University, [2] Creighton University,

P1-C-74 ***Sequential movement patterns during the transition from standing to independent walking: A longitudinal analysis***

Mei-Hua Lee [1], Jennifer Burns [1], Promise Robinson [1], Gao Kang [1], Tianxiang Zhang [1], Subir Biswas [1]

[1] *Michigan State University*

P1-C-75 ***Gait-combined transcranial alternating current stimulation around gait cycle frequency over cerebral motor areas modulates spatiotemporal gait variabilities***

Ryosuke Kitatani [1], Runa Sorimachi [1], Akane Amano [1], Rima Watanabe [1], Naofumi Osturu [1], Hideaki Onishi [1]

[1] *Niigata University of Health and Welfare*

P1-C-76 ***Light fingertip touch stabilizes gait and alters vestibulomotor coupling during stochastic vestibular stimulation***

Sadiya Abdulrabba [1], Jessica Selinger [1], Gerome Manson [1]

[1] *Queen's University*

P1-C-77 ***Age-related differences in startle-like responses and reactive postural stiffening during unexpected external perturbations***

Satoshi Kasahara [1], Yo Iwama [2], Ruka Kawabe [1], Tomoya Ishida [1], Yuta Koshino [1], Hiroshi Saito [3], Mina Samukawa [1], Harukazu Tohyama [1]

[1] *Hokkaido University,* [2] *Nishi Sapporo Hospital,* [3] *Tokyo Kasei University*

P1-C-78 ***Post-stroke reorganisation of gait-related functional muscle networks***

Sora Ohnishi [1], Yusaku Takamura [1], David O'reilly [2], Shu Morioka [1]

[1] *Kio University,* [2] *University of Leeds*

P1-C-79 ***Distortion of internal heading representation reflected in vestibular reflexes and gaze direction***

Takashi Hirata [1], Toshimi Yamanaka [2], Shin Tadokoro [3], Takeshi Miyamoto [1], Yutaka Hirata [2]

[1] *Nagoya University,* [2] *Chubu University,* [3] *National Defense Medical College*

P1-C-80 ***Relationship between avoidance patterns and the direction of center of mass motion during walking following unexpected obstacle recognition***

Tatsuya Hayashi [1], Issei Ogasawara [1], Shoji Konda [1], Tomoyuki Matsuo [1], Susumu Iwasaki [2], Ken Nakata [1]

[1] *The University of Osaka,* [2] *Fort Lewis College*

P1-C-81 ***Human sensory-musculoskeletal modeling and control of whole-body movements***

Yanan Sui [1]

[1] *Tsinghua University*

D – INTEGRATIVE CONTROL OF MOVEMENT

P1-D-82 ***Dynamic and selective interactions in the motor system during naturalistic reach-to-grasp***

Adam Smoulder [1], Nicole Carr [1], Chandramouli Chandrasekaran [1]

[1] *Boston University*

P1-D-83 ***Selective gain modulation of different spinal reflex pathways for movement execution as revealed by optogenetic manipulation of primary afferent activity***

Akito Kosugi [1], Moeko Kudo [1], Shiro Egawa [1], Ken-Ichi Inoue [2], Masahiko Takada [2], Kazuhiko Seki [1]

[1] *National Center of Neurology and Psychiatry,* [2] *Kyoto University*

P1-D-84 ***Combined representation of grasping and body posture in premotor neurons of freely moving monkeys***

Alessandro Becchini [1], Riccardo Spanu [1], Federica Cimmelli [2], Rebecca Moretti [1], Monica Maranesi [1], Matteo Di Volo [3], Luca Bonini [1]

[1] *University of Parma,* [2] *University of Parma; University of Rome Tor Vergata,* [3] *University of Lyon*

P1-D-85 ***Alpha and beta cortico-motor phase dynamics index hasty and cautious control in human visuomotor loops***

Alice Tomassini [1], Francesco Torricelli [2], Luciano Fadiga [1], Alessandro D'ausilio [1]

[1] *University of Ferrara,* [2] *Italian Institute of Technology*

P1-D-86 ***Dissociable neurocognitive dynamics characterize Kinesthetic and Visual Motor Imagery of a complex motor sequence***

Camilla Scaramuzza [1], Stefano Tortora [2], Federico Gennaro [1], Marika Berchicci [1], Maurizio Bertollo [1], Filippo Zappasodi [1]

[1] *'Gabriele d'Annunzio' University,* [2] *University of Padova*

P1-D-87 ***Reaching under (visually) inferred wind forces***

Dawei Bai [1], Samuel Mcdougle [1]

[1] *Yale University*

P1-D-88 ***Effect of task difficulty and auditory warning stimulus on plantar flexion position task and its subjective psychological states***

Hinano Takagi [1], Kohei Watanabe [1]

[1] *Chukyo University*

P1-D-89 *Motor cortex encodes subjective value*

Hiroo Miyata [1], Raeed Chowdhury [2], Adam Smoulder [3], Mrunal Zambre [2], Zingkai Wen [4], Aaron Batista [2], Steven Chase [1]

[1] Carnegie Mellon University, [2] University of Pittsburgh, [3] Boston University, [4] Massachusetts Institute of Technology

P1-D-90 *Visuospatial context and task performance are encoded in Ventrolateral Prefrontal Cortex LFP activity during a head-unrestrained, memory-guided reach task*

Jennifer Lin [1], Veronica Nacher Carda [1], Hongying Wang [2], Saihong Sun [1], Xiaogang Yan [1], Julio Martinez-Trujillo [3], J Douglas Crawford [1]

[1] York University, [2] Centre for Integrative & Applied Neuroscience, Centre for Vision Research and Connected Minds, [3] Western University

P1-D-91 *Pupil size reflects physical effort but not motor fatigability during a sustained motor task*

Jenny Imhof [1], Caroline Heimhofer [1], Marc Bächinger [2], Sarah Meissner [1], Richard Ramsey [1], Nicole Wenderoth [1]

[1] ETH Zürich, [2] Neural Control of Movement Lab

P1-D-92 *Neural mechanisms underlying action-based predictions and visual false percepts*

Juan Carlo Cabato [1], Lilli Charlotte Jung [1], Bianca Van Kemenade [1]

[1] Justus Liebig University Giessen

P1-D-93 *Mechanistic principles underlying flexible control in dynamic pursuit*

Jungsuk Lee [1], Daehoon Kim [2], Benjamin Hayden [3], Sengbum Yoo [2]

[1] Case Western Reserve University, [2] Sungkyunkwan University, [3] Baylor College of Medicine

P1-D-94 *Layer Va neurons, as major presynaptic partners of corticospinal neurons, play critical roles in skilled movements*

Ken Matsuura [1], Yutaka Yoshida [2], Fumiyasu Imai [3]

[1] Okinawa Institute of Science and Technology Graduate University, [2] Okinawa Institute of Science and Technology, [3] Weill Cornell

P1-D-95 *State-dependent gain control and spinal–cortical coupling during motor imagery revealed by simultaneous EEG–fMRI*

Kengo Tsujimoto [1], Yuta Miyazaki [2], Shahab Vahdat [3], Kazuhiko Seki [2], Kazuaki Sajima [2], Ryo Tokimura [2], Shin-Ya Tanaka [2], Mayumi Inoue [2], Mitsunari Abe [2]

[1] National Institute of Neuroscience, [2] National Center of Neurology and Psychiatry, [3] University of California, Riverside

P1-D-96 *The effect of attentional focus on countermovement jumps*

Leonel Dujardin [1], Juliana Otoni Parma [1], David I Anderson [1], Leia Bernardi Bagesteiro [1]

[1] San Francisco State University

P1-D-97 *Geometry of action grammar structure in primate frontal cortex*

Lucas Tian [1], Daniel Hanuska [1], Kedar Garzón Gupta [1], Yue Liu [2], Xiao-Jing Wang [3], Josh Tenenbaum [4], Winrich Freiwald [1]

[1] The Rockefeller University, [2] New York University, Florida Atlantic University, [3] New York University, [4] Massachusetts Institute of Technology

P1-D-98 *Modulation of corticospinal excitability with movement imagery*

Marcos Moreno-Verdú [1], Alfredo Lerín-Calvo [2], Baptiste Waltzing [1], Elise Van Caenegem [1], Charlène Truong [1], Robert Hardwick [1]

[1] Université Catholique de Louvain, [2] Autonomous University of Madrid

P1-D-99 *Combined action observation and motor imagery: evidence for simultaneous sensorimotor representations*

Matthew Scott [1], David J. Wright [2], Nicola Hodges [3], Justine Magnuson [3], Sarah Kraeutner [3]

[1] Texas A&M University, [2] Manchester Metropolitan University, [3] University of British Columbia

P1-D-100 *The arm-mazing task: Investigating movement bias in a hierarchical cognitive motor task*

Maud Ottenheijm [1], Mark Schram Christensen [1]

[1] University of Copenhagen

P1-D-101 *How are continuous sequential actions learned and represented?*

Max Xia [1], Tim Verstynen [1], Jonathan Tsay [1]

[1] Carnegie Mellon University

P1-D-102 *Motor memory embedded in relational structure of the environment*

Ryoji Onagawa [1], Nobuhiro Hagura [2]

[1] Queen's University, [2] National Institute of Information and Communications Technology

P1-D-103 *Closed-loop perturbations reveal how shared-control modulates iBCI innovation dynamics*

Ophelie Saussus [1], Pinhao Song [2], Sofie De Schrijver [1], Irene Caprara [3], Thomas Decramer [4], Renaud Detry [2], Peter Janssen [1]

[1] Katholieke Universiteit Leuven, [2] KU Leuven, [3] Massachusetts General Hospital, [4] Universitair Ziekenhuis Leuven

P1-D-104 *Applying drift diffusion modeling to unravel contextual information integration in split-second handball penalty decisions*

Henrietta Weinberg [1], Florian Müller [1], Rouwen Cañal Bruland [1]

[1] *Friedrich Schiller University Jena*

P1-D-105 *Kinematic adaptation to expected sensory feedback during uni- and bimanual motor sequences*

Roy Mukamel [1]

[1] *Tel Aviv University*

P1-D-106 *Theta dynamics as a marker of stress resilience in threat-related movement*

Alaa Abu Ahmad [1], Stefan Hall [1], Matthew Lawton [1], Yasmin Benishti [2], Moussa Hamati [1], Ofer Prager [2], Abed N. Azab [2], Alon Friedman [1]

[1] *Dalhousie University,* [2] *Ben-Gurion University of the Negev*

P1-D-107 *Fronto-parietal LFP signatures of inter-individual motor coordination in primates*

Stefano Grasso [1], Lucia Maria Sacheli [2], Eros Quarta [1], Laura Zapparoli [2], Eraldo Paulesu [2], Alexandra Battaglia-Mayer [1]

[1] *Sapienza University of Rome,* [2] *University of Milano-Bicocca*

P1-D-108 *Action controllability shapes the sense of agency during continuous BCI-controlled avatar gait*

Taiga Seri [1], Seitaro Iwama [1], Junichi Ushiba [1]

[1] *Keio University*

P1-D-109 *Express sensorimotor responses to visual and auditory stimuli*

Ken Mcanally [1], Samuele Contemori [1], Cao Yang [1], Guy Wallis [1], Brian Corneil [2], Gerald Loeb [3], Timothy Carroll [1]

[1] *The University of Queensland,* [2] *Western University,* [3] *University of Southern California*

P1-D-110 *Neural signatures of perceptual decision-making and action selection under uncertainty*

Tomoya Okaguchi [1], Kazumasa Uehara [1]

[1] *Toyohashi University of Technology*

P1-D-111 *Premotor and supplementary motor areas retain main-task selectivity during interruptions within a dual task*

Toshi Nakajima [1], Atsushi Miyazaki [2], Hajime Mushiake [3]

[1] *Kindai University Faculty of Medicine,* [2] *Shokei Gakuin University,* [3] *Tohoku University School of Medicine*

P1-D-112 *Neurons in the rat cervical spinal cord demonstrate common neural dynamics during different types of forelimb reach*

Trevor Smith [1], Akito Kosugi [1], Shiro Egawa [1], Kazutaka Maeda [1], Chiaki Sugai [1], Amit Yaron [1], Kazuhiko Seki [1]

[1] *National Center of Neurology and Psychiatry*

P1-D-113 *Dissociation of perceived cognitive demand and physiological strain in varied modes of work-matched eccentric/concentric interval cycling: Implications for sensorimotor integration*

Yi-Hung Liao [1], Chun-Chung Chou [2]

[1] *National Taipei University of Nuring and Health Sciences,* [2] *National Taipei University of Technology*

P1-D-114 *Exploring cerebellar prediction errors in statistical learning*

Yiran Ou [1], Juliana Trach [1], Samuel Mcdougle [1]

[1] *Yale University*

E – DISORDERS OF MOTOR CONTROL

Poster Cluster (P1-E-115 to P1-E-118)

P1-E-115 *Effects of costs and rewards on the flexibility of reaching control in Parkinson's disease*

Astrid Doyen [1], Antoine De Comite [2], Thibault Warlop [3], Philippe Lefevre [1], Frederic Crevecoeur [1]

[1] *Université Catholique Louvain,* [2] *Massachusetts Institute of Technology,* [3] *Service de Neurologie, Centre Hospitalier de Wallonie Picarde*

P1-E-116 *Graph-theoretic assessment of brain connectivity in essential tremor*

Chaewoo Kim [1], Flo Blondiaux Pirson [2], Laurence Dricot [2], Frederic Crevecoeur [1]

[1] *Université Catholique de Louvain,* [2] *Institute of Neuroscience (IoNS), Université catholique de Louvain*

P1-E-117 *Task-dependent modulation of gait control in Parkinson's disease*

Clémence Vandamme [1], Thibault Warlop [2], Renaud Ronsse [1], Frederic Crevecoeur [1]

[1] *Université Catholique de Louvain,* [2] *Service de Neurologie, Centre Hospitalier de Wallonie Picarde*

P1-E-118 *Sensory attenuation in patients with Essential Tremor*

François Lessage [1], Flo Blondiaux Pirson [2], Thibault Fumery [1], Konstantina Kilteni [3], Frederic Crevecoeur [1]

[1] *Université Catholique de Louvain,* [2] *Institute of Neuroscience (IoNS), Université catholique de Louvain,* [3] *Donders Institute for Brain, Cognition and Behavior, Radboud University*

P1-E-119 *Neural mechanisms of spinal hyperexcitability in children with cerebral palsy*

Antea Ceko[1], Martin Piazza[1], Genis Prat Ortega[1]

[1] *University of Pittsburgh*

P1-E-120 *Neuronal avalanche dynamics as network biomarkers of motor disorders and features for brain–computer interface classification and prediction*

Camilla Mannino[1], Pierpaolo Sorrentino[2], Mario Chavez[3], Marie-Constance Corsi[1]

[1] *Institut National de Recherche en Informatique et en Automatique,* [2] *INSERM,* [3] *Centre National de la Recherche Scientifique*

P1-E-121 *In vivo mapping of descending motor and ascending somatosensory pathways in the human brain*

Divya Rai[1], Peter Kasarda[2], Sweya Surapaneni[3], Timothy Verstynen[2], Jing Xu[3]

[1] *The University of Georgia,* [2] *Carnegie Mellon University,* [3] *University of Georgia*

P1-E-122 *Decoding face and hand gestures from intracortical activity for emotional expression*

Elizaveta Okorokova[1], Nicholas Card[1], Tyler Singer-Clark[1], Zachery Fogg[1], Carrina Iacobacci[1], Hamza Peracha[1], Leigh Hochberg[2], David Brandman[1], Sergey Stavisky[1]

[1] *University of California, Davis,* [2] *Brown University*

P1-E-123 *Portable VR-based assessment of upper-limb motor control after stroke*

Kahori Kita[1], Aravind Nehrujee[1], Ronan Mooney[1]

[1] *Shirley Ryan AbilityLab*

P1-E-124 *Systematic quantification and comparison of upper limb tremor during adaptation to novel movement dynamics*

Kate Foray[1], Pierre Gianferrara[2], Weiwei Zhou[1], Justin Fitzgerald[1], Wilsaan Joiner[1]

[1] *University of California, Davis,* [2] *Carnegie Mellon University*

P1-E-125 *Freezing and transition behaviours in people living with Parkinson's disease*

Leah J. Steinke[1], Jennifer Stevenson[1], Gabriella Sutherland[1], Precious Adeyemo[1], Leia Bernardi Bagesteiro[2], Liana Brown[1]

[1] *Trent University,* [2] *San Francisco State University*

P1-E-126 *Uncovering sleep-related barriers to motor recovery after stroke: Behavioural, neurophysiological, and structural insights*

Matthew Weightman[1], Barbara Robinson[1], Anna Guttesen[1], Teresa Simoes Steyn[1], Katrijn Schruers[1], Melanie Fleming[1], Heidi Johansen-Berg[1]

[1] *University of Oxford*

P1-E-127 *Multiscale sleep-wake cycle neural perturbation accompanies motor impairment after a cortical ischemic lesion*

Michela Chiappalone[1], Simone Del Corso[1], Federico Barban[1], Marta Care'[2], Vinicius Rosa Cota[3]

[1] *University of Genova,* [2] *IRCCS Azienda Ospedaliera Metropolitana, Genova,* [3] *National University of Ireland*

P1-E-128 *Flexor synergy after stroke: Magnitude, expression, and association with reaching performance*

Sarah Cavanagh[1], Prabhat Pathak[1], James Arnold[1], Lynn Blaney[1], Patrick Puma[1], Daniel Barch[2], Conor Walsh[1], David Lin[2]

[1] *Harvard University,* [2] *Massachusetts General Hospital*

P1-E-129 *Spatiotemporal desynchronization of motor units during Parkinsonian tremor by deep brain stimulation*

Ning Lan[1], Xiaoxiao Zhang[1], Xinkai Wang[1], Bomin Sun[1]

[1] *Shanghai Jiao Tong University*

F – ADAPTATION & PLASTICITY IN MOTOR CONTROL

Poster Cluster (P1-B-130 to P1-F-133)

P1-B-130 *The impact of coaching in the visual perception of damping*

Taliyah Huang [1], Jeremy Brown [1], Michael West [1]

[1] *Johns Hopkins University*

P1-F-131 *Skill memory consolidation, not reactive inhibition, explains offline contributions to early learning of naturalistic skills*

Ethan Buch [1], Leonardo Cohen [1], Fumiaki Iwane [2]

[1] *National Institute of Neurological Disorders & Stroke,* [2] *NINDS*

P1-F-132 *A state-space model of real-time performance dynamics for different sequential keypress skills*

Ethan Buch [1], Leonardo Cohen [1], Fumiaki Iwane [2]

[1] *National Institute of Neurological Disorders & Stroke,* [2] *NINDS*

P1-F-133 *Multi digit synergies reorganize over rest breaks during early naturalistic skill learning*

Ethan Buch [1], Leonardo Cohen [1], Sven Bestmann [2], William Kistler [2]

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Poster Cluster (P1-F-134 & P1-F-135)

P1-F-134 *Composition and decomposition of high-dimensional complex hand motor components in De novo motor learning*

Takanori Ito [1], Takuji Hayashi [1]

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P1-F-135 *Acquisition and interference of a novel visuomotor map formed through De novo motor learning*

Daiki Mori [1], Takanori Ito [1], Takuji Hayashi [1]

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P1-F-136 *Consolidation fails to protect motor memories from interference during implicit learning*

Aarohi Pathak [1], Timothy Welsh [1]

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P1-F-137 *Prior experience regulates error sensitivity in implicit motor learning*

Ajay Kumar Sahu [1], Pratik Mutha [1]

[1] *Indian Institute of Technology Gandhinagar*

P1-F-138 *Modulation of maximal motor performance by visual feedback: Effects of manipulation magnitude and explicit knowledge*

Ayane Kusafuka [1], Daw-An Wu [2], Kazutoshi Kudo [3], Kazuhisa Shibata [4], Katsumi Watanabe [1], Shinsuke Shimojo [2]

[1] *Waseda University,* [2] *California Institute of Technology,* [3] *The University of Tokyo,* [4] *RIKEN Center for Brain Science*

P1-F-139 *Cross-cultural analysis of visuomotor adaptation in Japanese and Norwegian young adults: Effects of input devices and gaze-hand coordination*

Chiharu Yamada [1], Yoshihiro Itaguchi [2], Claudia Rodríguez-Aranda [3]

[1] *Waseda University,* [2] *Keio University,* [3] *University of Tromsø, UiT The Arctic University of Norway*

P1-F-140 *Distinct effects of acute and chronic achilles tendon pain on motor unit control and force-tracking learning*

Eduardo Martinez-Valdes [1], David Jiménez-Grande [1], Michail Arvanitidis [1], Deborah Falla [1], Dario Farina [2], Ned Jenkinson [1], Francesco Negro [3]

[1] *University of Birmingham,* [2] *Imperial College London,* [3] *Università degli Studi di Brescia*

P1-F-141 *Mechanisms underlying enhanced implicit recalibration and attenuated strategy use with age*

Elizabeth Cisneros [1], Sheer Karny [2], Richard Ivry [3], Jonathan Tsay [4]

[1] *University of California, Berkeley,* [2] *University of California, Irvine,* [3] *University of California,* [4] *Carnegie Mellon University*

P1-F-142 *Redefining explicit adaptation into three phenotypes*

Elysa Eliopulos [1], Denise Henriques [1], Bernard Marius 'T Hart [1]

[1] *York University*

P1-F-143 *Longitudinal neurofeedback training enhances voluntary control of Peripheral Beta-Band Oscillations for non-invasive motor augmentation*

Emanuele Abbagnano [1], Alejandro Pascual Valdunciel [2], Dario Farina [3]

[1] *Imperial College London,* [2] *University of Zaragoza,* [3] *University Medical Center Goettingen*

P1-F-144 *Visual perspective taking in remote visuomotor control*

Emily Crowe [1], Simon Castle-Green [1], Nick Martin [2]

[1] *University of Nottingham,* [2] *University of Bristol*

P1-F-145 *Express sensorimotor responses to visual and somatosensory stimuli*

Eugene Poh [1], Kate O'loughlin [1], Guy Wallis [1], Gerald Loeb [2], Brian Corneil [3], Timothy Carroll [1]

[1] *The University of Queensland,* [2] *University of Southern California,* [3] *Western University*

P1-F-146 *Cortical beta synchronization during virtual stick balancing as a dynamical biomarker of motor learning*

Haruki Shimokado [1], Taishin Nomura [1]

[1] *Kyoto University*

P1-F-147 *Bilateral premotor cortical plasticity during skill acquisition of intracortical BCI typing*

Hiroaki Hashimoto [1], Justin Jude [2], Hadar Levi Aharoni [2], Ziv Williams [3], John Simeral [4], Leigh Hochberg [4], Daniel Rubin [2]

[1] *The University of Osaka,* [2] *Massachusetts General Hospital,* [3] *Massachusetts General Hospital; Harvard Medical School,* [4] *Brown University*

P1-F-148 *Somatosensory inputs paired with auditory perceptual training modulate speech motor adaptation*

Inès Vallois [1], David Ostry [2], Takayuki Ito [3]

[1] *Université Grenoble Alpes,* [2] *McGill University,* [3] *GIPSA Lab - CNRS*

P1-F-149 ***Temporal neural dynamics associated with cognitive flexibility in neurotypical young adults***

Iran Gutierrez[1], Janna Protzak[2], Michael Borich[1], Lena Ting[2]

[1] Emory University, [2] Emory University & Georgia Institute of Technology

P1-F-150 ***Learning to throw against the current: Internal models of object–environment dynamics***

Jacob Boulrice[1], Denise Henriques[1], Andrew King[1], Bernard Marius 'T Hart[1]

[1] York University

P1-F-151 ***A longitudinal examination of hand representation reorganization after right sensorimotor stroke***

Zhihan Guo[1], Luisa Raigosa Posada[2], Elisabetta Ambron[3], Jared Medina[1]

[1] Emory University, [2] University of Delaware, [3] University of Pennsylvania

P1-F-152 ***Impact of explicitness and interference on motor memory consolidation following opposing visuomotor adaptations***

Jinsung Wang[1]

[1] University of Wisconsin, Milwaukee

P1-F-153 ***Heightened arousal induced by task-relevant psychological pressure reduces learning rate in force-field adaptation***

Kagari Yamada[1], Kazutoshi Kudo[1], Atsushi Yokoi[2]

[1] The University of Tokyo, [2] National Institute of Information and Communications Technology

P1-F-154 ***Emergence and stabilization of coordinated movement in large group joint action***

Kazuma Takada[1], Sotaro Taniguchi[2], Katsumi Watanabe[2], Shunichi Kasahara[3]

[1] Okinawa Institute of Science and Technology, [2] Waseda University, [3] Sony Computer Science Laboratories, Inc.

P1-F-155 ***Adaptation-dependent modulation of coordinated muscle activities in human gait adaptation as revealed by tensor decomposition***

Ken Takiyama[1], Hikaru Yokoyama[1], Yuki Ishida[1], Naotsugu Kaneko[2], Tatsuya Kato[3], Kei-Ichi Ishikawa[2], Kimitaka Nakazawa[2]

[1] Tokyo University of Agriculture and Technology, [2] The University of Tokyo, [3] The University of Tokyo; Sony Computer Science Laboratories Inc

P1-F-156 ***Intrinsic motor variability determines the magnitude of implicit sensorimotor recalibration***

Kunlin Wei[1], Xiaoyue Zhang[2]

[1] Peking University, [2] School of Psychological and Cognitive Sciences

P1-F-157 ***Peripersonal space reshaping in response to cooperative human-robot interaction***

Léo Guérin[1], Carine Michel-Colent[1], Peter Ford Dominey[1], Adrien Guzzo[1], Anne-Lise Jouen[1], Ahmad Kaddour[1]

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P1-F-158 ***Dopaminergic modulation of motor sequence learning depends on music training***

Jane Tan[1], Yan Zhou[2], Kimberley Innes[3], Jarrad Lum[4], Li-Ann Leow[5], Welber Marinovic[2]

[1] Murdoch University, [2] Curtin University, [3] Edith Cowan University, Curtin University, [4] Deakin University, [5] Edith Cowan University

P1-F-159 ***Motor recovery and corticospinal plasticity promoted by repetitive transcranial magnetic stimulation after spinal cord injury in macaques***

Longxiang Zhang[1], Masahiro Mitsuhashi[1], Reona Yamaguchi[1], Satoko Ueno[1], Kaoru Isa[1], Kohei Matsuda[1], Tadashi Isa[1]

[1] Kyoto University

P1-F-160 ***Sensory and motor building blocks of an extra robotic digit representation***

Lucy Dowdall[1], Elena Amoruso[2], Giulia Dominijanni[3], Maria Molina-Sanchez[1], Jörn Diedrichsen[4], Dani Clode[1], Tamar Makin[1]

[1] University of Cambridge, [2] University College London, [3] École Polytechnique Fédérale de Lausanne, [4] Western University

P1-F-161 ***Subthalamic nucleus oscillatory dynamics during speech motor sequencing and auditory-motor learning***

Hantao Wang[1], Jeffrey Herron[2], Gabriel Cler[2], Andrew Ko[2], Ludo Max[2]

[1] University of California, San Francisco, [2] University of Washington

P1-F-162 ***Articulatory effort modulates speech adaptation to auditory perturbations***

Elodie Ronayette[1], Fabien Cignetti[2], Pascal Perrier[3], Maeva Garnier[4]

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P1-F-163 ***Adaptive changes in anticipatory postural control during implicit learning of goal-directed lower-limb movements***

Mai Moriyama[1], Motoki Kouzaki[1], Shota Hagio[1]

[1] Kyoto University

P1-F-164 ***Perceptual and behavioural consequences of using an upper-limb assistive augmentation device***

María Molina-Sanchez[1], Francesco Missiroli[2], Viktorija Pavalkyte[1], Mabel Ziman[3], Noham Wolpe[4], Rani Moran[5], Lorenzo Masia[2], Tamar Makin[1]

[1] University of Cambridge, [2] Technical University of Munich, [3] Imperial College London, [4] Tel Aviv University, [5] University College London

P1-F-165 ***Predictive outcome feedback counters temporal discounting in complex motor learning***

Mathias Hegele[1], Britta Hinneberg[2], Lisa Maurer[3], Sven Hoffmann[4], Jan Tünnermann[5], Heiko Maurer[1], Hermann Müller[1]

[1] Justus Liebig Universität Giessen, [2] University of Giessen, [3] University of Kassel, [4] University of Hagen, [5] University of Marburg

P1-F-166 ***Reversed gravity promotes acquisition of predictive eye movements in goldfish***

Mizuki Ishikawa[1], Yutaka Hirata[1]

[1] Chubu University

P1-F-167 ***Adaptive control by the primary motor cortex maintains motor output under muscular fatigue***

Norihiro Iwamoto[1], Michiaki Suzuki[2], Osamu Yokoyama[2], Kei Obara[2], Hironori Tsuji[2], Shin-Ichiro Osawa[1], Kuniyasu Niizuma[1], Hidenori Endo[1], Toshiki Tazoe[2], Yukio Nishimura[2]

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P1-F-168 ***Implicit recalibration contributes to skill-like improvements during visuomotor adaptation***

Opher Donchin[1], Ying Jin[1]

[1] Ben-Gurion University of the Negev

P1-F-169 ***Learning to retrain the body for robotic motor augmentation***

Peiqi Kang[1], Ema Jugovic[1], Julien Russ[1], Zehra Merchant[1], Gauthier Everard[2], Rupsha Panda[3], Viktorija Pavalkyte[1], Hristo Dimitrov[1], Celia Foster[1], Dani Clode[1], Tamar Makin[1]

[1] University of Cambridge, [2] Université Catholique Louvain, [3] University of Michigan

P1-F-170 ***Motor variability in task-irrelevant dimensions when learning a rapid bimanual throwing task***

Nikolas Pearson[1], Narae Shin[1], Rajiv Ranganathan[1]

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P1-F-171 ***Muscle-specific cortical dynamics following tendon cross-transfer in the Macaque monkey***

Roland Philipp[1], Yuki Hara[2], Masaki Iwasaki[2], Naohito Ohta[3], Tetsuro Funto[3], Kazuhiko Seki[2]

[1] National Institute of Neuroscience, National Center of Neurology and Psychiatry, [2] National Center of Neurology and Psychiatry, [3] The University of Electro-Communications

P1-F-172 ***Multi-hierarchical plasticity of corticofugal projections through motor recovery from spinal cord injury in macaques***

Satoko Ueno[1], Reona Yamaguchi[1], Kaoru Isa[1], Toshinari Kawasaki[1], Masahiro Mitsuhashi[1], Tadashi Isa[1]

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P1-F-173 ***Exploring the neural mechanisms of motor learning and action selection during visuomotor rotation in the presence of uncertainty***

Shota Uchikoshi[1], Taishin Nomura[1]

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P1-F-174 ***Hand dexterity recovered in spinal cord injury Macaques by a synthetic synapse organizer***

Stefan Peyda[1], Reona Yamaguchi[1], Yiping Sun[1], Satoko Ueno[1], Kaoru Isa[1], Kunimichi Suzuki[2], Kenta Kobayashi[3], Hiroyuki Sasakura[4], Keiko Matsuda[2], Kosei Takeuchi[4], A. Radu Aricescu[5], Hirotaka Onoe[1], Michisuke Yuzaki[6], Tadashi Isa[1]

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P1-F-175 ***Supplementary motor area facilitation enhances precision in high-speed throwing***

Taishi Okegawa[1], Ayane Kusafuka[2], Daiki Yamasaki[1], Naotsugu Kaneko[1], Kimitaka Nakazawa[1]

[1] The University of Tokyo, [2] Waseda University

P1-F-176 ***Speech sensorimotor adaptation using altered auditory feedback in cochlear implant users***

Monica Ashokumar[1], Jean-Luc Schwartz[1], Takayuki Ito[2]

[1] GIPSA-Lab, [2] GIPSA Lab CNRS

P1-F-177 ***Expertise-related differences in whole-body muscle synergy organization during overarm throwing***

Takuya Murakami[1], Hiroki Arakawa[1], Yuto Sakakibara[1], Nadaka Hakariya[1], Ryo Aoki[1], Daiki Yamasaki[1], Atsushi Sasaki[1], Kimitaka Nakazawa[1]

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G – THEORETICAL & COMPUTATIONAL MOTOR CONTROL

P1-G-178 *When do nonlinear control models matter in human reaching movements*

Alexandre Thyrion [1], Gianluca Bianchin [1], Frederic Crevecoeur [2]

[1] *Université Catholique Louvain,* [2] *Université Catholique de Louvain*

P1-G-179 *Hierarchical organization of motor memories in bimanual movements*

Anvesh Naik [1], Carlos Velázquez-Vargas [1], Sabyasachi Shivkumar [1], James Ingram [2], Máté Lengyel [2], Daniel Wolpert [1]

[1] *Columbia University,* [2] *University of Cambridge*

P1-G-180 *No evidence of dual-rate learning in speech sensorimotor adaptation*

Hung-Shao Cheng [1], Caroline Niziolek [1], Ben Parrell [1]

[1] *University of Wisconsin, Madison*

P1-G-181 *From motor intention to control: Longitudinal neural decoding with electrocorticography*

Dai Shimizu [1], Huixiang Yang [1], Ryohei Fukuma [1], Tomoyuki Namima [1], Shinji Nishimoto [1], Haruhiko Kishima [1], Takufumi Yanagisawa [1]

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P1-G-182 *Two distinct mechanisms of temporal precision*

Dipesh Shrestha [1], Alexander Eperon [1], Roberto Bottini [1], Sujaya Neupane [2]

[1] *University of Trento,* [2] *York University*

P1-G-183 *Causal inference in action and perception supports sensorimotor learning*

Dusty Fox [1], Jack Darley [1], Michael S. Landy [2], Romeo Chua [1], Hyosub Kim [1]

[1] *The University of British Columbia,* [2] *New York University*

P1-G-184 *Corticospinal mechanisms underlying non-compositional motor unit recruitment during finger control*

Irene Mendez Guerra [1], Claudia Clopath [1], Juan Álvaro Gallego [2]

[1] *Imperial College London,* [2] *Champalimaud Foundation*

P1-G-185 *Causal inference in closed-loop motor control*

James Cooke [1], W. Pieter Medendorp [2]

[1] *Radboud University,* [2] *Radboud University Nijmegen*

P1-G-186 *From motor units to muscles: Evidence for synergy degeneracy in human motor control*

Minglei Bai [1], Yanjuan Geng [2], Vincent Chi Kwan Cheung [1]

[1] *The Chinese University of Hong Kong,* [2] *Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences*

P1-G-187 *Standardized and automated pipeline for processing chronic sparse multielectrode array data*

Narges Moradi [1], Soraya Rahimi [1], Stephane Quessy [1], Numa Dancause [1]

[1] *Université de Montréal*

P1-G-189 *Damage-dependent neural computation reveals opportunities for restoring spinal locomotor CPG function*

Sergiy Yakovenko [1], Yuriy Pryyma [2]

[1] *West Virginia University,* [2] *Ukrainian Catholic University*

P1-G-190 *Involuntary visuomotor feedback responses reflect the competitive and collaborative context of sensorimotor interactions*

Seth Sullivan [1], Matthew Short [1], Truc Ngo [1], John Bugglen [1], Jan Calalo [1], Nicholas Muscara [1], Joshua Cashaback [1], Michael Carter [2]

[1] *University of Delaware,* [2] *McMaster University*

P1-G-191 *Modeling fear-induced effects on postural control*

Tahmineh A. Koosha [1], Fabian Hahne [2], Alap Kshirsagar [2], Nick Augustat [3], Jan Peters [2], Dominik Endres [4]

[1] *Marburg University,* [2] *Technische Universität Darmstadt,* [3] *Differential Psychology and Personality Research,* [4] *Philipps-University Marburg*

P1-G-192 *Opposite biases reveal distinct mechanisms to achieve both efficient and accurate motor planning*

Tianhe Wang [1], David Whitney [1], Richard Ivry [2]

[1] *University of California, Berkeley,* [2] *University of California*

P1-G-193 *Adaptive ILC model integrating sensorimotor and reward learning*

Tjasa Kunavar [1], Jan Babic [1]

[1] *Jozef Stefan Institute*

P1-G-194 *Decoding epidural ECoG signals for motor control across human and non-human primates*

Wanlin Yang [1]

[1] *Chinese Institute for Brain Research*

P1-G-195 ***Motor-unit center and territory estimation in the forearm cross-section from HD-EMG for control and visual biofeedback***

Younggeol Cho [1], Laura Ferrante [1], Pranav Mamidanna [1], Dario Farina [1]

[1] *Imperial College London*

H – NEUROREHABILITATION

Poster Cluster (P1-H-196 & P1-H-197)

P1-H-196 ***Brain-controlled transcutaneous spinal cord stimulation enhances corticospinal excitability and lower-limb motor performance in chronic incomplete spinal cord injury***

Atsushi Sasaki [1], Rizaldi Fadli [2], Akiko Yuasa [3], Zachary Boogaart [2], Hiroki Saito [4], Hikaru Yokoyama [5], Matija Milosevic [2]

[1] *The University of Tokyo,* [2] *University of Miami,* [3] *Fujita Health University,* [4] *Tokyo University of Technology,* [5] *Tokyo University of Agriculture and Technology*

P1-H-197 ***Harnessing cortical intent to drive corticospinal plasticity using brain-computer interface-controlled epidural neuromodulation after chronic Tetraplegia***

Rizaldi Fadli [1], Atsushi Sasaki [2], Akiko Yuasa [3], Zachary Boogaart [1], Hiroki Saito [4], Roberto De Freitas [5], Nicolo Macellari [5], Elvira Pirondini [5], James D. Guest [1], Marco Capogrosso [5], Joacir Graciolli Cordeiro [1], Matija Milosevic [1]

[1] *University of Miami,* [2] *The University of Tokyo,* [3] *Fujita Health University,* [4] *Tokyo University of Technology,* [5] *University of Pittsburgh*

P1-H-198 ***EEG classification of grasp force – neural correlates of weight during object lifting***

Benjamin Berkhout [1], Ivo De Jong [2], Andreea Ioana Sburlea [3]

[1] *Rijkuniversiteit van Groningen,* [2] *University of Groningen,* [3] *Institute of Neural Engineering*

P1-H-199 ***Intracortical microstimulation modulates neurons across the cortical reach to grasp network with rapidly evolving dynamics***

Brandon Ruszala [1], David Bjånes [1], Kelsie Pejsa [1], Brian Lee [2], Charles Liu [3], Marc Schieber [4], Richard Andersen [1]

[1] *California Institute of Technology,* [2] *USC Neurorestoration Center,* [3] *Rancho Los Amigos National Rehabilitation Center,* [4] *University of Rochester*

P1-H-200 ***Functional integration and segregation of brain-heart networks underlie motor imagery in health and disease***

Diego Candia-Rivera [1], Mario Chavez [2], Fabrizio De Vico Fallani [3], Marie-Constance Corsi [3]

[1] *Paris Brain Institute,* [2] *Centre National de la Recherche Scientifique,* [3] *Institut National de Recherche en Informatique et en Automatique*

P1-H-201 ***A biomimetic iBCI decoder for restoring hand function in people with spinal cord injury***

Fabio Rizzoglio [1], Maximilian Carvajal [1], Pouyan Firouzabadi [2], Vikram Darbhe [3], Alexandriya Emonds [4], Anton Sobinov [4], Giacinto Luigi Cerone [5], Alberto Botter [5], Wendy Murray [1], Lee Miller [1]

[1] *Northwestern University,* [2] *Student,* [3] *Shirley Ryan Ability Lab,* [4] *University of Chicago,* [5] *Politecnico di Torino*

P1-H-202 ***Stroke and neural dynamics: Exploring recovery from focal ischemic infarcts in the latent space***

Federico Barban [1], Matthew Nishimoto [2], Heather Hudson [3], Michela Chiappalone [4], Randolph Nudo [3], David Guggenmos [3]

[1] *University of Genoa,* [2] *University of Kansas,* [3] *University of Kansas Medical Center,* [4] *University of Genova*

P1-H-203 ***Spinal cord stimulation targets circuit dysfunction to improve upper-limb function in non-ambulatory adults with SMA***

Genis Prat Ortega [1], Serena Donadio [2], Julia Ostrowski [3], Luigi Borda [3], Douglas Weber [3], Peter Gerszten [1], George Mentis [4], Elvira Pirondini [1], Marco Capogrosso [1]

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P1-H-204 ***Distinct mechanisms and functional efficacy of epidural versus transcutaneous spinal stimulation in complete cervical spinal cord injury***

Jeonghoon Oh [1], Jay Drake [1], Alexander Steele [1], Catherine Martin [1], Michelle Scheffler [1], Alejandra Valdivia-Padilla [1], Argyrios Stampas [2], Radha Korupolu [2], Christof Karmonik [1], Timea Hodics [1], Yevgeniy Freyvert [1], Michael Manzella [3], Amir Faraji [1], Phillip Horner [1], Dimitry Sayenko [1]

[1] *Houston Methodist Research Institute,* [2] *TIRR Memorial Hermann,* [3] *Bostion Scientific*

P1-H-205 ***Social comparison speeds up motor adaptation and increases effort during hands-on assisted gait training in artificially impaired adults***

Julia Manczurowsky [1], Sheng-Che Yen [1], Lester Leung [2], Peter Whitney [1], Charles Hillman [1], Christopher Hasson [1]

[1] *Northeastern University,* [2] *Tufts University School of Medicine*

P1-H-206 *Synchronized NMES–voluntary contraction coupling improves corticospinal excitability efficiency*

Keita Takano[1], Sarasa Najima[1], Tomofumi Yamaguchi[2], Toshiyuki Fujiwara[2], Kei Masani[1]

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P1-H-207 *Non-invasive stimulation of muscle receptors in order to substitute lost sensory function in anterior cruciate ligament reconstructed patients*

Kevin Soter[1], Mauro Nardon[1], Celia L. Blanchet[1], Marco Bigoni[1], Marco Turati[1], Antonio Zaza[1], Cecilia Perin[1], Cristiano Alessandro[1]

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P1-H-208 *Neurological determinants of bimanual motor control in children with unilateral cerebral palsy*

Louise Hocke[1], Alexandra Kalkantzi[1], Lize Kleeren[2], Els Ortibus[3], Lisa Mailleux[1], Katrijn Klingels[4], Hilde Feys[1]

[1] *KU Leuven,* [2] *KU Leuven; Hasselt University,* [3] *University Hospitals Leuven; KU Leuven,* [4] *Hasset University; KU Leuven*

P1-H-209 *Biomechanical effects of transcutaneous spinal cord stimulation amplitude on gait in children with Cerebral Palsy*

Madeleine Mccreary[1], Katie Landwehr-Prakel[1], Anna Fragomeni[1], Heather Feldner[1], Katherine Steele[1]

[1] *University of Washington*

P1-H-210 *Appearance and treatment of abnormal arm muscle synergies early after Stroke*

Abed Khorasani[1], Cynthia Gorski[1], Richard Harvey[2], Jinsook Roh[3], Marc Slutzky[1]

[1] *Northwestern University,* [2] *Shirley Ryan AbilityLab,* [3] *University of Houston*

P1-H-211 *High-frequency transcranial random noise stimulation enhances motor training and neural adaptation for virtual prosthesis control*

Elena Fenoglio[1], Vanessa Zanelli[2], Vittorio Rispoli[3], Devide Enrico [4], Federica Conto[5], Claudia Casadio[2], Giulia Ellena[4], Antonino Casile[6], Salvatore Maria Li Gioi[7], Roberto Billardello[7], Mirea Bagigalupo[4], Francesca Cordella[7], Loredana Zollo[7], Fausta Lui[2], Francesca Benuzzi[2], Lorella Battelli[8], Marianna Semprini[4]

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P1-H-212 *Kinematic analysis of motor responses evoked by circumferential stimulation of the lumbar spinal cord in cats*

Oriane Herviault[1], Oussama Eddaoui[1], Jonathan Harnie[1], Khaled Ashkar[1], Alain Frigon[1], Christian Iorio-Morin[1]

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P1-H-213 *Using statistical models of healthy behaviour to quantify static balance impairment in Stroke*

Sachitha Wijekoon[1], Jereme Outerleys[1], Benjamin Ritsma[2], Scott Selbie[3], Kevin Deluzio[1], Vincent Depaul[2], Stephen Scott[1]

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P1-H-215 *Explaining the dissociation between motor performance and arm use: A latent-state computational simulation model*

Sujin Kim[1], Byeongchang Jeong[2], Han E. Cheol[3]

[1] *Jeonju University,* [2] *CyberBrain Research Section, Electronics and Telecommunications Research Institute,* [3] *Korea University*

P1-H-216 *Motor correction characteristics of unilateral spatial neglect to a sudden target shift*

Yuki Ito[1], Yiming Liu[2], Clara Günter[2], Sae Franklin[2], Taiki Yoshida[3], Kazuki Ushizawa[3], Shintaro Uehara[3], Yohei Otaka[3], David Franklin[2], Rieko Osu[1]

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P1-H-217 *Effectiveness of bilateral proprioceptive-motor coupling to induce muscle activity in a passively moved hand and its neural substrates*

Yuki Sato[1], Yandi Tang[1], Hideki Nakano[2], Gen Miura[1], Jihoon Park[3], Tomoyo Morita[3], Eiichi Naito[3]

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POSTER SESSION 2

THURSDAY, APRIL 23, 2026

A – CONTROL OF EYE & HEAD MOVEMENT

P2-A-1 ***Multifunctional neural control of the songbird beak***

César Vargas [1], Abigail Grassler [1], Leila May Pascual [1], Samuel Sober [1]

[1] *Emory University*

P2-A-2 ***Primary visual cortex integrity is needed for normal auditory and visually-driven pupil dynamics***

Ekaterina Sapozhnikova [1], Tatiana Malevich [2], Ziad Hafed [3]

[1] *Tübingen University,* [2] *University of Tübingen,* [3] *Centre for Integrative Neuroscience*

P2-A-3 ***Individual predictive protocols in eye–hand coordination: Modeling saccade–hand dynamics from measured behavior***

Emiko Shishido-Higashijima [1]

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P2-A-4 ***Functional role of eye and head movements in gaze shifts during a soccer scanning task***

Junki Saito [1], Seiji Ono [2], Tomohiro Kizuka [2]

[1] *University of Tsukuba,* [2] *Institute of Health and Sport Sciences, University of Tsukuba*

P2-A-5 ***Behavioral and neural variability reveal mechanisms of saccadic fatigue and adaptation***

Junya Inoue [1], Akshay Markanday [2], Peter Thier [2]

[1] *University Tübingen,* [2] *Hertie Institute for Clinical Brain Research*

P2-A-6 ***Neural representations of the Quiet Eye during a precision aiming task***

Nicholas Kreter [1], Jackson Zenti [2], Brady Decouto [3], Deborah Barany [4], Michelle Marneweck [2]

[1] *University of North Carolina, Greensboro,* [2] *University of Oregon,* [3] *Florida State University,* [4] *University of Georgia*

P2-A-7 ***Countermanding model of microsaccadic inhibition suggests a preserved role for latent visual signals when primary visual cortex is impaired***

Tatiana Malevich [1], Ziad Hafed [2]

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P2-A-8 ***The dependence of perceptual saccadic suppression on spatial frequency is dramatically different for ON-type versus OFF-type stimuli***

Wenbin Wu [1], Ekaterina Sapozhnikova [2], Ziad Hafed [3]

[1] *University of Tübingen,* [2] *University of Tuebingen,* [3] *Centre for Integrative Neuroscience*

P2-A-10 ***Effects of prosthesis stimulation on compensatory saccades during the En-bloc head impulse test in vestibular-impaired monkeys***

Yoshiko Kojima [1], Leo Ling [1], James Phillips [1]

[1] *University of Washington*

B – FUNDAMENTALS OF MOTOR CONTROL

P2-B-11 ***Steroid hormone levels significantly impact brain-network activity and cognitive-motor integration (CMI) performance in working-aged adults with persisting symptoms following concussion***

Tooba Shahzad [1], Lauren Sergio [1], Nicole Smeha [1], Kiran Bumra [1], Miracle Ozzoude [1], Madison Reiter [1], Sara Weinberg [1]

[1] *York University*

P2-B-12 ***M1 is modulated by motor but not tactile imagery, while S1 reflects vividness of both***

Aigul Nasibullina [1], Nikolay Syrov [2], Lev Yakovlev [1]

[1] *Skolkovo Institute of Science and Technology,* [2] *Ruhr University Bochum*

P2-B-13 ***Dual descending pathways control the initiation of skilled reaching movements***

Akimasa Ishida [1], Fumiyasu Imai [2], Teruko Danjo [2], Jay Bikoff [3], Amanda Jacob [4], Matthew Williams [4], Kyle Thomas [4], Samuel Sober [4], Yutaka Yoshida [1]

[1] *Okinawa Institute of Science and Technology,* [2] *Weill Cornell,* [3] *St.Jude Children's Research Hospital,* [4] *Emory University*

P2-B-14 ***Differential coupling of motoneuron subpopulations with high-frequency common inputs***

Alejandro Pascual Valdunciel [1], Javier Yanguas Mayo [2], Natalia T. Cónsul [3], Emanuele Abbagnano [3], Filipe Nascimento [4], M. Gorkem Ozyurt [4], Dario Farina [3], Jaime Ibáñez [2]

[1] *University of Zaragoza,* [2] *Universidad de Zaragoza,* [3] *Imperial College London,* [4] *University College London*

P2-B-15 ***Multivariate fMRI reveals the representation of unimanual and bimanual reaching movements in humans***

Ali Ghavampour [1], Jean-Jacques Orban De Xivry [2], Atsushi Yokoi [3], Jörn Diedrichsen [1]

[1] *Western University,* [2] *Katholieke Universiteit Leuven,* [3] *National Institute of Information and Communications Technology*

P2-B-16 ***Robotic manipulation of balance states reveals state-dependent vestibular control of standing balance***

Amin Mohammadinasrabadi [1], Calvin Kuo [1], Patrick Forbes [2], Jean-Sébastien Blouin [1]

[1] *University of British Columbia,* [2] *Erasmus University Medical Center*

P2-B-17 ***Evolution of object identity information in sensorimotor cortex throughout grasp***

Anton Sobinov[1], Yuke Yan[1], James Goodman[1], Sliman Bensmaia[1], Lee Miller[2]

[1] *University of Chicago,* [2] *Northwestern University*

P2-B-18 ***The role of motor timing in movement variability and the laterality of the hands and feet***

Atsushi Takagi[1], Noriyuki Tabuchi[2], Wakana Ishido[2], Chikako Kamimukai[2], Sho Ito[1], Kazuaki Honda[1], Hiroaki Gomi[1], Naotoshi Abekawa[1]

[1] *NTT Communication Science Laboratories,* [2] *Mizuno Corporation*

P2-B-19 ***Superior colliculus generates motor-performance dependent signals underlying forelimb reaching adaptation***

Aya Takeoka[1]

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P2-B-20 ***Spinal cord interneuronal population activities coordinate muscle activities through a low-dimensional communication subspace***

Borong He[1], Vincent Chi Kwan Cheung[1]

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P2-B-21 ***Building motor repertoires through reward and punishment contingencies***

Carlos Velázquez-Vargas[1], Sabyasachi Shivkumar[1], James Ingram[2], Máté Lengyel[2], Daniel Wolpert[1]

[1] *Columbia University,* [2] *University of Cambridge*

P2-B-22 ***Effect of explicit awareness on the motor and spatial representations following motor imagery practice***

Charlène Truong[1], Elise Van Caenegem[1], Baptiste Waltzing[1], Marcos Moreno-Verdú[1], Robert Hardwick[1]

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P2-B-23 ***Unpaced tapping motor control is more precise during exhalation***

Charles-Etienne Benoit[1], Narimane Zeghoudi[2], Xin Kang Yee[3], Simon Pla[4], Alice Baudry[3], Connor Spiech[5], Floris T. Van Vugt[6]

[1] *Université Claude Bernard Lyon1,* [2] *Laboratoire Interuniversitaire de Biologie de la motricité,* [3] *Université Claude Bernard Lyon,* [4] *Université de Montpellier,* [5] *Concordia University,* [6] *University of Montréal*

P2-B-24 ***A feedback scaffold for predictive control in de novo motor learning***

Chen Avraham[1], Firas Mawase[1]

[1] *Technion - Israel Institute of Technology*

P2-B-25 ***Behavioral and neural constraints on motoneuron control in humans***

Ciara Gibbs[1], Vishal Rawji[1], Tristan Choo[1], Simon Avrillon[2], Agnese Grison[1], Lara Gouveia Vila[1], Peter Bryan[1], Dario Farina[1], Juan Gallego[3]

[1] *Imperial College London,* [2] *Nantes Université,* [3] *Champalimaud Foundation*

P2-B-26 ***Transcutaneous vagus nerve stimulation and reward shape reflex responses during reaching movements***

Clara Braconnier[1], Julie Duque[1], Frederic Crevecoeur[1]

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P2-B-27 ***Phase-specific effects of reward context on motor performance, consolidation, and interlimb transfer***

Cong Yin[1]

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P2-B-28 ***Motor cortical dynamics of broadband signal-extracted neural features across spatial electrode configurations during reaching arm movements***

Cong Zheng[1], Yongxiang Xiao[1], He Cui[1]

[1] *Chinese Institute for Brain Research*

P2-B-29 ***Linking single corticomotoneuron activity to population geometry in dexterous finger control***

Daniel Katz[1], Marc Schieber[2], Firas Mawase[1]

[1] *Technion - Israel Institute of Technology,* [2] *University of Rochester*

P2-B-30 ***The role of individual vigor in human-human physical interaction***

Dorian Verdel[1], Bastien Berret[2], Etienne Burdet[3]

[1] *Imperial College of Science, Technology and Medicine,* [2] *Université Paris,* [3] *Imperial College London*

P2-B-31 ***The effects of caffeine on motor unit discharge modulation and fatigue resistance in young and older adults during sustained submaximal contractions***

Elsa Greed[1], Ned Jenkinson[1], Catarina Rendeiro[1], Gareth Wallis[1], Eduardo Martinez-Valdes[1]

[1] *University of Birmingham*

P2-B-32 ***Force control by human spinal motor neurons***

Ethan Corey[1], Mathew Piasecki[2], Samuel Sober[3]

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P2-B-33 *Cortical dynamics underlying temporal extraction of kinematic evidence and predictive coding during observation of imminent actions*

Filippo Zappasodi[1], Camilla Scaramuzza[1], Sergio Costa[2], Pierpaolo Croce[3], Marika Berchicci[1], Maurizio Bertollo[1]

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P2-B-35 *Context-dependent effects of grip force on dexterous force control*

Giuseppe Missale[1], Spencer Arbuckle[2], Michelle Chan-Cortès[3], Sylvain Träger[4], Meret Branscheidt[5], Naveed Ejaz[6]

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P2-B-36 *Internal selective attention and motor working memory*

Hanna Hillman[1], Taylor Mcclure[1], Anna Christina Nobre[1], Samuel Mcdougle[1]

[1] *Yale University*

P2-B-37 *Preparing grasping movements under target size and location uncertainty*

Kevin A. Leblanc[1], Anne T.D. Lacroix[1], Jada Benwell[1], Brett Feltmate[1], Heather Neyedli[1]

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P2-B-38 *The role of cross-area premotor–somatosensory dynamics in reach-to-grasp control and stroke recovery*

Ian Heimbuch[1], Aviv Mizrahi-Kliger[1], Nikhilesh Natraj[1], Preeya Khanna[2], Lisa Novik[3], Robert Morecraft[4], Karunesh Ganguly[1]

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P2-B-39 *Increasing task dimensionality reshapes common synaptic input to deltoid motoneurones during two-degree-of-freedom shoulder force production*

J Greig Inglis[1], Silvia Rio[1], Hélio V. Cabral[2], Milena A. Dos Santos[1], Elmira Pourreza[1], Caterina Cosentino[1], Francesco Negro[1]

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P2-B-40 *Compensatory reflexes for tongue posture stabilization in speech: A case study with a deafferented patient in the orofacial region*

Jean-François Patri[1], Morgane Bourhis[2], Christophe Savariaux[2], Pascal Perrier[2], Fabrice Sarlegna[1], Takayuki Ito[3]

[1] *CNRS,* [2] *GIPSA-Lab,* [3] *University Grenoble Alpes, CNRS, Grenoble-INP, GIPSA-lab*

P2-B-41 *Rapid cognitive-motor algorithms in pianists*

Juliana Trach[1], Samuel Mcdougle[1]

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P2-B-42 *Effects of feedback delay duration on neural processing of valence-dependent augmented feedback during motor practice*

Linda Margraf[1], Daniel Krause[1], Lisa Maurer[2], Matthias Weigelt[1]

[1] *Psychology and Movement Science, Paderborn University,*
[2] *Training and Movement Science, University of Kassel*

P2-B-43 *Virtual brush illusion paradigm reveals importance of disembodiment in multisensory integration*

Lyndah Lovell[1], Ethan Brown[1], Sarah Derrick[1], Mohit Singhala[2], Jeremy Brown[3]

[1] *Johns Hopkins University,* [2] *University of Pittsburgh,* [3] *Johns Hopkins School of Medicine*

P2-B-44 *Sensory expectations and prediction error during feedback control in the human brain*

Marco Emanuele[1], Paul Gribble[2], J. Andrew Pruszynski[2], Jonathan Michaels[3], Jörn Diedrichsen[2]

[1] *University of Western Ontario,* [2] *Western University,* [3] *York University*

P2-B-45 *Tractographic description of the course of cortico-facial fibers in healthy humans: evidence for a dorsal pathway in the brainstem*

Marco Tagliaferri[1], Jan Van Dijk[2], Davide Giampiccolo[2], Luigi Cattaneo[3]

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P2-B-46 *Chemogenetic activation of convergent spinal pathways augments forelimb sensorimotor performance in nonhuman primates*

Michiaki Suzuki[1], Osamu Yokoyama[1], Kenta Kobayashi[2], Steve Perlmutter[3], Yukio Nishimura[1]

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P2-B-47 *Deeplabcut 3.0: Efficient deep learning for single and multi-animal pose tracking with foundation models*

Alexander Mathis [1], Mackenzie Mathis [1], Atsushi Iriki [2], Dlcdev Team [1]

[1] *Ecole Polytechnique Federale de Lausanne,* [2] *RIKEN Center for Brain Science*

P2-B-48 *Cutting out the middle man: low-dimensional invariance, stability, and drift in motor cortex*

Muhammad Abdulla[1], Liz Jun[1], Stephen Clarke[1], Paul Nuyujukian[1]

[1] *Stanford University*

P2-B-49 *Sex hormones differentially alter brain networks for Uni- and bimanual movement control*

Nicole Smeha[1], Sara Weinberg[1], Diana Gorbet[1], Lauren Sergio[1]

[1] *York University*

P2-B-50 *Concurrent facilitative tDCS to primary motor cortex and right inferior parietal lobe augments kinesthetic illusory awareness*

Ozge Ozlem Saracbasi[1], Tomoyo Morita[2], Jihoon Park[2], Eiichi Naito[2]

[1] *National Institute of Information and Communications Technology (NICT),* [2] *National Institute of Information and Communications Technology*

P2-B-51 *Holistic planning of sequential motor actions*

Poppy Aves[1], Katja Kornysheva[1], Joseph Galea[1]

[1] *University of Birmingham*

P2-B-52 *Identifying motor unit properties from high-density EMG recordings using simulation based inference*

Pranav Mamidanna[1], Dario Farina[1]

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P2-B-53 *Engaging working memory following skill memory reactivation has a time-dependent impact on skill generalization*

Rahul Pal[1], Goldy Yadav[2], Neeraj Kumar[1]

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P2-B-54 *Unveiling neural codes from motion tracking to action planning in posterior parietal cortex*

Ruichen Zheng[1], Yong Gu[2], He Cui[1]

[1] *Chinese Institute for Brain Research,* [2] *Center for Excellence in Brain Science and Intelligence Technology*

P2-B-55 *Motor memory is tuned to the level of uncertainty in decision making*

Shiina Takano[1], Nobuhiro Hagura[2]

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P2-B-56 *Regional-dependent rate coding of deltoid motor units across one and two degrees-of-freedom tasks*

Silvia Rio[1], J Greig Inglis[1], Hélio V. Cabral[2], Elmira Pourreza[1], Caterina Cosentino[1], Francesco Negro[1]

[1] *Università degli Studi di Brescia,* [2] *Universidade Federal do Rio de Janeiro*

P2-B-58 *Motor working memory for complex reach trajectories*

Taylor Mcclure[1], Hanna Hillman[1], Samuel Mcdougle[1]

[1] *Yale University*

P2-B-59 *Evidence of both compositional reuse and distinct subskills in speech motor cortex*

Tyler Singer-Clark[1], Maitreyee Wairagkar[1], Elizaveta Okorokova[1], Nicholas Card[1], Xianda Hou[1], Carrina Iacobacci[1], Leigh Hochberg[2], David Brandman[1], Sergey Stavisky[1]

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P2-B-60 *PreSMA and M1 mechanisms underlying stopping and switching revealed by intraoperative human recordings*

Jeong Woo Choi[1], Dev Laxman Subramanian[1], Shan Zhong[2], Clayton Mosher[3], Jan Wessel[4], Ueli Rutishauser[3], Vasileios Christopoulos[2], Nader Pouratian[5]

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P2-B-61 *Neural mechanisms underpinning the voluntary suppression of involuntary movements*

Yu Hu[1], Binyu Luo[2], Marco Davare[2], Ricci Hannah[2]

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P2-B-62 *Neuromuscular control strategies preserve force output across the menstrual cycle despite muscle-specific changes in motor unit behavior*

Yuichi Nishikawa[1], Allison Hyngstrom[2]

[1] *Kanazawa University,* [2] *Marquette University*

P2-B-64 *Midbrain dopaminergic projections to the forelimb motor cortex: Anatomical, molecular, and sex-specific insights*

Zohreh Vaziri[1], Lydia Saïdi[1], Quentin Lejeune[2], Simone Gosselin[1], Christian Ethier[3]

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C – POSTURE AND GAIT

P2-C-65 *Activation of plantarflexors in generating different speeds of walking in humans*

Bridgette Damewood[1], Thomas Sinkjær[2], Aiko Thompson[3]

[1] *Emory University School of Medicine,* [2] *Aalborg University,* [3] *Medical University of South Carolina*

P2-C-66 *Direction-dependent performance in functional center of pressure metrics during visually guided multidirectional control in sitting*

Boqun Liu[1], Taisei Sugiyama[1], Akiko Yuasa[1], Hirofumi Ota[1], Kazuki Ushizawa[1], Shintaro Uehara[1], Yohei Otaka[1]

[1] *Fujita Health University*

P2-C-67 *Temporal structure and adaptation of therapist-applied gait assistance*

Soumitra Sitole[1], Julia Manczurowsky[1], John Whitney[1], Christopher Hasson[1]

[1] *Northeastern University*

P2-C-68 *Fear markers of the perceptual motor style during locomotion: The Richie's plank model*

Danping Wang[1], Ioannis Bargiotas[2], Lise Haddouk[3], Nicolas Vayatis[3], Pierre-Paul Vidal[3]

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P2-C-69 *A quality control-driven pipeline for GRINminiscope calcium imaging of cerebellar nuclei during naturalistic movement*

Dmitriy Sakharuk[1], Marylka Uusisaari[1], Bogna M Ignatowska-Jankowska[1], Hugo Hoedemaker[1]

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P2-C-70 *Dynamic evolution of brain structure-function coupling asymmetry and its relationship with motor function after spinal cord injury and treatment*

Feng Ting[1]

[1] *Beihang University*

P2-C-71 *Region-specific changes in neural states across locomotor regimes in mice*

Ioana Lazar[1], Martin Esparza[1], Catia Fortunato[1], Mostafa Safaie[1], Juan Gallego[2]

[1] *Imperial College London,* [2] *Champalimaud Foundation*

P2-C-72 *Task-dependent modulation in EMG-EMG coherence during gait in Parkinson's disease*

Jessica Hubbard[1], Julia Choi[1]

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P2-C-73 *Activation of hypothalamic-pontine-spinal pathway promotes locomotor initiation and functional recovery after spinal cord injury in mice*

Ji Chengyue[1]

[1] *Institute of Neuroscience (ION), Chinese Academy of Sciences*

P2-C-74 *Quantifying mutual hesitation and identifying kinematic predictors in near-collision avoidance in walking*

Kazuyuki Sato[1], Johannes Keck[1], Rouwen Cañal-Bruland[1]

[1] *Friedrich Schiller University Jena*

P2-C-75 *Differential synergistic strategies between quadriceps and plantar flexors during gait*

Kyubin Chun[1], Seungbum Koo[1]

[1] *Korea Advanced Institute of Science and Technology*

P2-C-76 *Reduced reliance on ankle proprioception for postural control in Diabetes Mellitus*

Manami Fujii[1], Sophia Chirumbole[1], Jaclyn Caccese[1], Ajit Chaudhari[1], Dan Merfeld[1]

[1] *The Ohio State University*

P2-C-77 *Before movement: signatures of human emotion in the micromotor structure of stillness*

Simo Järvelä[1], Bojan Kerous[2], Juho Hamari[1], Marylka Uusisaari[3]

[1] *Tampere University,* [2] *Research Centre of Gameful Realities, Tampere University, Finland,* [3] *Okinawa Institute of Science and Technology*

P2-C-78 *Reticulospinal and Vestibulospinal response to PPN microstimulation cell population study*

Shusei Fukuyama[1], Kaoru Tkakusaki[2], Mirai Takahashi[2]

[1] *NCNP,* [2] *Asahikawa Medical University*

P2-C-79 *Neurochemical and brain fluid exchange mechanisms underlying walking in cognitively-impaired older adults*

Sumire Sato[1], Regena Darbouze[1], Arkaprava Roy[1], David J. Clark[1], Daniel P. Ferris[1], Chris J. Hass[1], Todd M. Manini[1], Gregory M. Pontone[1], Eric S. Porges[1], Rachael D. Seidler[1]

[1] *University of Florida*

P2-C-80 *Mapping the development of motor-social behavior in young rats*

Ugne Klibaite[1]

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D – INTEGRATIVE CONTROL OF MOVEMENT

Poster Cluster (P2-D-81 & P2-D-82)

P2-D-81 *Flexible exploitation of muscular and kinematic redundancy for learning novel control dimensions*

Julien Rossato[1], Bernardo Brogi[2], Tommaso Lisini Baldi[2], Elodie Hinnekens[3], Domenico Prattichizzo[4], Andrea D'avella[5]

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P2-D-82 *Somatosensory feedback of muscular null space signals enhances control of redundant motor dimensions*

Lucas Dal'bello[1], Sylvain Famié[2], Elodie Hinnekens[1], Julien Rossato[3], Sergio Gurgone[4], Daniele Borzelli[5], Denise Berger[1], Priscilla Balestrucci[1], Alessandro Moscatelli[6], Andrea D'avella[7]

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P2-D-83 *Ventral premotor–primary motor cortex pathways shape temporal coordination in dexterous actions*

Andrea Casarotto[1], Elisa Dolfini[2], Luciano Fadiga[3], Giacomo Koch[4], Alessandro D'ausilio[3]

[1] Italian Institute of Technology, [2] University of Ferrara, [3] University of Ferrara; Italian Institute of Technology, [4] Santa Lucia Foundation

P2-D-84 *Dissociation between online control behavior and adaptation in visually-guided goal-directed movements in patients with Schizophrenia*

Alexandra Reichenbach[1], Marie-Luise Otte[2], Laura Hole-Holz[3], Robert Christian Wolf[2]

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P2-D-85 *Mixed-selective organization of reach and grasp in the primate fronto-parietal network*

Alireza Fathian[1], Jonathan Michaels[2], Sebastian Lehmann[3], Hans Scherberger[4]

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P2-D-86 *A platform for large-scale, single-neuron spinal recordings during skilled forelimb movements in mice*

Alzahraa Amer[1], Lee Miller[1], Andrew Miri[1]

[1] Northwestern University

P2-D-87 *Feature space identification and reward function estimation by inverse reinforcement learning for aikido techniques based on EMG and motion capture data*

Azumi Shimatani[1], Taishin Nomura[1]

[1] Kyoto University

P2-D-88 *The effect of action on auditory signal detection*

Bianca Van Kemenade[1], Lukas Menzel[1], Juan Carlo Cabato[1]

[1] Justus Liebig University Giessen

P2-D-89 *Disentangling indirect versus direct effects of somatosensory cortex microstimulation on neurons in primary motor and ventral premotor cortex*

Brandon Ruszala[1], Kevin Mazurek[2], Marc Schieber[2]

[1] California Institute of Technology, [2] University of Rochester

P2-D-90 *The contribution of observed kinematics and outcomes in observation-induced contagions in pointing movements*

Carrie Peters[1], Christopher Gray[1], Romeo Chua[1], Sarah Kraeutner[1], Nicola Hodges[1]

[1] University of British Columbia

P2-D-91 *Hybrid VR object lifting matches real-object manipulation*

Catherine Sager[1], Michelle Marneweck[1]

[1] University of Oregon

P2-D-92 *Decoding tool-extended tactile representations in the human brain*

Chiu-Yueh Chen[1], Eric Koun[2], Frédéric Volland[3], Luke Miller[4], Alessandro Farne[5], Claudio Brozzoli[5]

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P2-D-93 *Cross-modal convergence of digit-specific representations in human somatosensory cortex during imagined movement, natural touch, and electrical stimulation after spinal cord injury*

David Bjånes[1], Luke Bashford[2], Sanne Kikkert[3], Ingrid Odermatt[7] Kelsie Pejsa[4], Brian Lee[5], Charles Liu[6], Richard Andersen[4]

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P2-D-94 *Neuronal computations in the primate spinal cord during the preparation of volitional forelimb movements*

Enrique Contreras[1], Trevor Smith[1], Woranan Hasegawa[1], Yuta Soga[2], Amit Yaron[1], Saeka Tomatsu[3], Shinji Kubota[4], Kazuhiko Seki[1]

[1] *National Center of Neurology and Psychiatry,* [2] *The University of Electro-Communications,* [3] *National Institute for Physiological Sciences,* [4] *National Institute of Neuroscience*

P2-D-95 *Effects of ageing on hand choice in a bimanual task*

Fan Liu[1], Nicholas Holmes[1], David Punt[2]

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P2-D-97 *Anticipating action intentions in dynamic interactions relies on context more than kinematics*

Johannes Keck[1], Kazuyuki Sato[1], Rouwen Cañal Bruland[1]

[1] *Friedrich Schiller University Jena*

P2-D-98 *Task difficulty modulates the effects of transcutaneous vagus nerve stimulation on perceptual decision-making*

Thomas Vanvoorden[1], Shiyong Su[1], Lucien Delforge[1], Julie Duque[1]

[1] *Université Catholique de Louvain*

P2-D-99 *Gyroscopic dynamic perturbations reveal feedback corrective responses during overhand throwing*

Kosei Masuda[1], Daichi Nozaki[1]

[1] *The University of Tokyo*

P2-D-100 *Decoding others' action goals in the human brain with EEG*

Maryam Vaziri-Pashkam[1], Mohammadreza Shahsavari[2], Sina Mansouri[3], Sarah Marshall[1], Philip Gable[1]

[1] *University of Delaware,* [2] *Khaje Nasir Toosi University of Technology,* [3] *George Mason University*

P2-D-101 *Rapid online corrections for proprioceptive and visual perturbations recruit similar circuits across pmd and m1, with a proprioceptive bias in the sulcal bank*

Matthew Jacobs[1], Kevin P. Cross[2], Stephen Scott[3]

[1] *Queen's University,* [2] *University of North Carolina at Chapel Hill,* [3] *Queen's University*

P2-D-102 *Cross-modal matching is not bidirectionally invertible: Implications for multisensory representation*

Michael West Jr.[1], Berk Kasimcan[1], Anway Pimpalkar[2], Jing Xu[3], Jeremy Brown[4]

[1] *Johns Hopkins University,* [2] *Harvard University,* [3] *University of Georgia,* [4] *Johns Hopkins School of Medicine*

P2-D-104 *Cortical state during preparation predicts movement performance differently in adolescent and adult pianists*

Pei-Cheng Shih[1], Masato Hirano[1], Shinichi Furuya[1]

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P2-D-105 *Beyond reach-to-grasp: Neural encoding of object placement*

Petros Georgiadis[1], Erez Freud[1], Peter J. Kohler[2], J Douglas Crawford[1]

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P2-D-107 *Kinematic adaptation to expected sensory feedback during uni- and bimanual motor sequences*

Roy Mukamel[1]

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P2-D-108 *Development of a VR reaching task to detect age-related declines in sensorimotor integration and validation of associated brain activity*

Satoru Inagaki[1], Hirokazu Matsuura[1], Kazuki Sakurai[1], Ludovico Minati[2], Natsue Yoshimura[3]

[1] *Institute of Science Tokyo,* [2] *University of Electronic Science and Technology of China,* [3] *Tokyo Institute of Technology*

P2-D-109 *Using a cognitively challenging reaching task to assess the effects of augmented visual and auditory feedback on motor performance*

Shanie Jayasinghe[1], Joshua Cheng[2], Pramisha Thapa[2]

[1] *The University of Minnesota-Twin Cities,* [2] *University of Minnesota, Twin Cities*

P2-D-110 *Syllable representations in cerebellar speech areas*

Sivan Jossinger[1], Bassel Arafat[1], Jörn Diedrichsen[2]

[1] *University of Western Ontario,* [2] *Western University*

P2-D-111 *Same arm, different plan? Comparing motor planning for static reaches and moving-target interception*

Angus Muttee[1], Rishvanth Amsaraj[1], Jason Friedman[2], Tarkeshwar Singh[1]

[1] Pennsylvania State University, [2] Tel Aviv University

P2-D-112 *Intrinsic spinal circuits can control dexterous manipulation*

Theodore Milner[1], Hamza Ahmad[1]

[1] McGill University

P2-D-113 *Patched and parallel networks encode visual and tactile spatial information in effector-based and transformed reference frames in Macaques*

Wei-An Sheng[1], Maxime Gaudet-Trafit[2], Clément Garin[1], Simon Clavagnier[1], Serge Pinède[1], Franck Lamberton[3], Mojtaba Alavi[1], Tobias Heed[4], Suliann Ben Hamed[1]

[1] Institut des Sciences Cognitives Marc Jeannerod, [2] University of Lyon, [3] CERMEP-Imagerie du vivant, [4] University of Salzburg

P2-D-114 *Causal manipulation of neural activity using a brain-computer interface during a working memory task*

Asma Motiwala[1], William Noll[1], Juliana Couras[2], Erinn Grigsby[3], Alan Degenhart[4], Steven Chase[1], Aaron Batista[2], Byron Yu[1], Emily Oby[5]

[1] Carnegie Mellon University, [2] University of Pittsburgh, [3] University of Montréal, [4] Starfish Neuroscience, [5] Queen's University

P2-D-115 *Context-dependent sensorimotor encoding in the secondary motor cortex*

Yue Huang[1], Jianing Yu[1]

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E – DISORDERS OF MOTOR CONTROL

Poster Cluster (P2-E-116 & P2-E-117)

P2-E-116 *Trauma exposure patterns shape movement strategies under rule reversal*

Céann Marks[1], Anthony Machula[1], Lauren Sergio[1]

[1] York University

P2-E-117 *Frontal and parietal regions maintain resilient relationships to visuomotor control across age, sex, and brain health conditions*

Kiran Bumra[1], Tooba Shahzad[1], Madison Reiter[1], Miracle Ozzoude[1], Nicole Smeha[1], Diana Gorbet[1], Lauren Sergio[1]

[1] York University

P2-E-118 *Dysfunction of cortical inhibitory interneurons in amyotrophic lateral sclerosis*

Alexandra Lackmy-Vallee[1], Crisitina Benetton[2], Pierre-François Pradat[3], Veronique Marchand-Pauvert[4]

[1] Sorbonne Université, [2] Sorbonne Université, Inserm U1146, CNRS UM7371, [3] Hôpitaux de Paris (AP-HP), [4] INSERM

P2-E-119 *Early behavioral manifold dynamics predict rehabilitation response in persistent post-concussion syndrome*

Anthony Machula[1], Lauren Sergio[1]

[1] York University

P2-E-120 *Locomotor phenotyping reveals double dissociation in animal models of autism*

Antoine De Comite[1], William Menegas[1], Guoping Feng[1], Nidhi Seethapathi[1]

[1] Massachusetts Institute of Technology

P2-E-121 *Automated kinematic scoring of tool-use pantomime gestures in limb apraxia*

Daanish Mulla[1], Laurel Buxbaum[2], Aaron Wong[3], Jonathan Michaels[1]

[1] York University, [2] Moss Rehabilitation Research Institute, [3] Thomas Jefferson University

P2-E-122 *Motor variability and reduced specialization reveal altered neural control of movement in autism*

Erez Freud[1], Mario Costantino[1], Maryam Vaziri Pashkam[2], Tzvi Ganel[3], Batsheva Hadad[4]

[1] York University, [2] Harvard University, [3] Ben Gurion University, [4] University of Haifa

P2-E-123 *Freezing of upper limbs in Parkinson's disease: A reaching study*

Jennifer Stevenson[1], Leah J. Steinke[1], Liana E. Brown[1]

[1] Trent University

P2-E-124 *Binocular horizontal saccade velocity patterns in mTBI*

John Anderson[1]

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P2-E-125 *Anxiety disorders alter cognitive-motor integration during visuomotor adaptation and retention*

Leonardo Barzi[1], Christopher Hill[1], Matt Wilson[2]

[1] Louisiana State University, [2] Northern Illinois University

P2-E-126 *Network responses related to subthalamic nucleus deep brain stimulation in the cortico-basal-ganglia circuit*

Muhammad Shan Sohail [1], Tristan Lawson [2], Lorraine Kalia [3], Suneil K Kalia [1], Luka Milosevic [4]

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P2-E-127 *EEG-based deep learning reveals cortical sensitivity to small changes in deep brain stimulation parameters*

Nicolas Calvo Peiro [1], Mathias Haugland [1], Alena Kutuzova [1], Cosima Graef [1], Aminata Bocum [2], Yen Foung Tai [1], Anastasia Borovykh [1], Shlomi Haar [1]

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P2-E-128 *Sex moderates the effect of concussion history on cognitive-motor integration in working-age adults*

Sonia Vovan [1]

[1] *York University*

P2-E-129 *Stretching the ankle: Differential impacts on postural control in Parkinson's disease, older adults, and young adults*

Taylor Gauss [1], Graham Mizell [1], Nicholas Gonzalez [1], Alyssa Hightower [1], Scott Ducharme [2], Jan Hondzinski [1]

[1] *Louisiana State University,* [2] *California State University, Long Beach*

P2-E-130 *Afferent-driven modulation of spinal interneuron circuits across disease stages in amyotrophic lateral sclerosis*

Veronique Marchand-Pauvert [1], Sina Sangari [2], Alexandra Lackmy-Vallée [3], Iseline Peyre [3], Pierre-François Pradat [4]

[1] *INSERM,* [2] *Shirley Ryan Ability Lab,* [3] *Sorbonne University,* [4] *Hôpitaux de Paris (AP-HP)*

P2-E-131 *Normal motor execution in Parkinson's disease implies bradykinesia is due to impaired motor planning*

Vishal Rawji [1], Cosima Graef [1], Thomas Foltynie [2], Aminata Bocum [3], Shlomi Haar [1], Yen Tai [1], Mark Edwards [4], Dario Farina [1]

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F – ADAPTATION & PLASTICITY IN MOTOR CONTROL

Poster Cluster (P2-F-132 & P2-F-133)

P2-F-132 *Is auditory-motor adaptation of speech influenced by the search for intelligibility?*

Sarah Rochas Ben Lalou [1], Maeva Garnier [2]

[1] *GIPSA-Lab,* [2] *GIPSA Lab - CNRS*

P2-F-133 *Balancing effort and intelligibility in speech auditory-motor adaptation*

Maeva Garnier [1], Sarah Rochas Ben Lalou [2], Elodie Ronayette [3], Fabien Cignetti [4], Pascal Perrier [2]

[1] *GIPSA Lab - CNRS,* [2] *GIPSA-Lab,* [3] *GIPSA-lab, Grenoble,* [4] *GIN, Grenoble*

P2-F-134 *Self-perceived effort as a possible source of inter-individual variability in speech adaptation to altered auditory feedback*

Elodie Ronayette [1], Fabien Cignetti [2], Pascal Perrier [3], Maeva Garnier [4]

[1] *GIPSA-lab, Grenoble,* [2] *GIN, Grenoble,* [3] *GIPSA-Lab,* [4] *GIPSA Lab CNRS*

P2-F-135 *Examining the underlying neural changes during the asymmetric recalibration of bimanual coordination*

Ada Kanapskyte [1], Jesus Alejandro Garcia Arango [2], Weiwei Zhou [1], Lee Miller [1], Sanjay Joshi [1], Wilsaan Joiner [1]

[1] *University of California, Davis,* [2] *University of Washington*

P2-F-136 *Consolidation drives flexible, task-specific expression of implicit and explicit motor memory*

Adith Deva Kumar [1], Adarsh Kumar [2], Neeraj Kumar [1]

[1] *Indian Institute of Technology Hyderabad,* [2] *Queen's University*

P2-F-137 *Involvement of excitatory and inhibitory primary somatosensory cortex activity in motor skill performance and adaptation in underwater environments*

Akane Ito [1], Daisuke Sato [1], Yasuo Sengoku [1]

[1] *University of Tsukuba*

P2-F-138 *The embodied clock: How Visuomotor control, spatial interaction, and tool embodiment dynamically shape subjective time*

Jahanian Najafabadi [1], Christoph Kayser [1]

[1] *Bielefeld University*

P2-F-139 *Temporal representation shapes motor memory separation*

Apoorva Sharma [1], Samuel Mcdougle [1]

[1] *Yale University*

P2-F-140 ***Indirect touch conveys distinct tactile information that can be used to program movements to tactile targets on an artificial body part***

Celia Foster[1], Martina Giancane[2], Andrew Dott[1], Eva Chapman[1], Mario Kleiner[3], Calogero Maria Oddo[2], Dani Clode[1], Tamar R. Makin[1]

[1] *University of Cambridge,* [2] *The Biorobotics Institute, Scuola Superiore Sant'Anna,* [3] *Psychtoolbox Project, Tuebingen*

P2-F-141 ***Longitudinal changes in hand dominance in normal aging and mild cognitive impairment (MCI): A kinematic study***

Olena Vasylenko[1], Ottar M. Bakke[1], Claudia Rodríguez-Aranda[1], Claudia Rodríguez-Aranda[2]

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P2-F-142 ***Cortico-cerebellar dynamics underlie flexible control of sensorimotor timing in humans***

Coen Zandvoort[1], Charlotte Wissing[2], Jonathan Winter[1], Anna Kowalczyk[1], Ole Jensen[3], Chris Miall[1], Devika Narain[2], Katja Kornysheva[1]

[1] *University of Birmingham,* [2] *Erasmus University Medical Center,* [3] *University of Oxford*

P2-F-143 ***Speech motor learning with visual-acoustic feedback: Evidence of a guidance effect***

Cassie Anderson[1], Meghan Clayards[2], Douglas Shiller[1]

[1] *Université de Montréal,* [2] *McGill University*

P2-F-144 ***Children born without a hand show signs of typical motor development in the missing limb***

Eden Winslow[1], Justin Fitzgerald[1], Marcus Battraw[1], Anita Bagley[2], Michelle James[2], Wilsaan Joiner[1], Jonathon Schofield[1]

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P2-F-145 ***Ageing influences motoneuron excitability during acquisition and retention of a force-matching skill***

Evie Harms[1], Ned Jenkinson[1], James Beauchamp[2], Francesco Negro[3], Eduardo Martinez-Valdes[1]

[1] *University of Birmingham,* [2] *Carnegie Mellon University,* [3] *Università degli Studi di Brescia*

P2-F-146 ***The many faces of motor learning research***

Eric Grießbach[1], Alfredo Hernández[1]

[1] *Champalimaud Foundation*

P2-F-147 ***Expansion of working memory capacity explains online gains during naturalistic skill learning***

Fumiaki Iwane[1], Ethan Buch[2], Leonardo Cohen[3]

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P2-F-148 ***Modeling neural adaptation to permanent musculoskeletal reconfiguration***

Genji Kawakita[1], Juan Gallego[2]

[1] *Imperial College London,* [2] *Champalimaud Foundation*

P2-F-149 ***Whole-body motor adaptation during learning for prosthetic limb usage***

Halla Hakami[1], Bruno Grandi Sgambato[1], Alison H Mcgregor[1], Dario Farina[1]

[1] *Imperial College London*

P2-F-150 ***Effects of multimodal passive training on predictive control of musical meter***

Hiroki Murayama[1], Yuya Haga[1], Hinako Matsufuji[2], Shinichi Furuya[2], Kazumasa Uehara[1]

[1] *Toyohashi University of Technology,* [2] *Sony Computer Science Laboratories*

P2-F-151 ***Humans optimally integrate vision and proprioception during continuous movement***

Pam Villavicencio [1], Mabel Ziman [2], Dominik Straub [3], Matthias Will [4], Cristina De La Malla [1], Jonathan Tsay [2]

[1] *University of Barcelona,* [2] *Carnegie Mellon University,* [3] *University of Cambridge,* [4] *University of California, Berkeley*

P2-F-152 ***Motor adaptation and intermanual transfer do not support the dynamic dominance theory***

Indranil Nyamsuren[1], Ashley Statham[1], Elise Mitchell[1], Phoebe Lam[1], Jonathan Tsay[1]

[1] *Carnegie Mellon University*

P2-F-153 ***Reduced cortical flexibility during balance perturbations may underlie balance dysfunction in Parkinson's disease***

Isaiah Lachica[1], Michael Borich[1], Lena Ting[2], Jasmine Mirdamadi[3]

[1] *Emory University,* [2] *Emory University & Georgia Institute of Technology,* [3] *University of Vermont*

P2-F-154 ***Cerebellar contributions to savings in visuomotor adaptation***

Jessica Korte[1], Audrey Fan[1], Wilsaan Joiner[1]

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P2-F-155 ***Implicit and explicit motor adaptation processes vary between morning and afternoon***

Célia Ruffino[1], Charlène Truong[2], Charalampos Papaxanthis[3], Johanna Mathiot[4]

[1] *Université marie et louis pasteur,* [2] *Université Catholique Louvain,* [3] *Université de Bourgogne Europe, INSERM,* [4] *Université Bourgogne Europe*

P2-F-156 ***A counterintuitive effect of rewards on implicit adaptation***

Jost Hausendorf[1], Hyosub Kim[1], Romeo Chua[1], Nicola Hodges[1]

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P2-F-157 ***Who's in control? Agency for an augmentation finger with autonomous perception***

Julien Russ[1], Dongshuo Han[1], Payton Kang[1], Zhera Merchant[1], Dani Clode[1], Tamar Makin[1]

[1] *University of Cambridge*

P2-F-158 ***Effect of exogenous dopamine on implicit and explicit sensorimotor adaptation***

Antonio Harris[1], Timothy Carroll[2], Scott Albert[3], Welber Marinovic[4], Li-Ann Leow[1]

[1] *Edith Cowan University,* [2] *The University of Queensland,* [3] *UNC Chapel Hill,* [4] *Curtin University*

P2-F-159 ***Movement paired with nerve stimulation generates plasticity in the human motor system***

Lillian Clements[1], Stuart N Baker[1]

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P2-F-160 ***Exploring the neurocognitive basis of phantom limb sensations and pain***

Malgorzata Szymanska[1], Hristo Dimitrov[1], Vicky Root[2], Guan Yu Seng[1], Rani Moran[2], Nicholas Holmes[3], Flavia Mancini[1], Tamar Makin[1]

[1] *University of Cambridge,* [2] *University College London,* [3] *University of Birmingham*

P2-F-161 ***Perceptual sensitivity supports online control, while perceptual errors drive predictive control in walking***

Marcela Gonzalez-Rubio[1], Pablo Iturralde[2], Gelsy Torres-Oviedo[1]

[1] *University of Pittsburgh,* [2] *Universidad Católica del Uruguay*

P2-F-162 ***The physiological aging of the proprioceptive system: Insights from behavioral performance and cortical functional connectivity***

Ambra Bisio[1], Francesco Mirabelli[1], Marco Bove[1], Andrea Albergoni[1], Marco Fassone[1], Elisa Pelosin[1], Laura Avanzino[1]

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P2-F-163 ***Predictive sensorimotor signaling during recovery of fine hand movements after spinal cord injury***

Masahiro Mitsuhashi[1], Reona Yamaguchi[1], Tadashi Isa[1]

[1] *Kyoto University*

P2-F-164 ***Thalamic deep brain stimulation restores motor adaptation in essential tremor***

Matthias Will[1], Jonas Luthe[2], Betina Korka[3], Doreen Gruber[4], Lars Büntjen[5], Richard Ivry[6], Jonathan Tsay[7], Max-Philipp Stenner[5]

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P2-F-165 ***Context dependent protection of reactivated motor memory***

Sumit Sannamath[1], Adarsh Kumar[2], Adith Deva Kumar[1], Rajneet Kaur[1], Neeraj Kumar[1]

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P2-F-166 ***Walking on the Moon reveals a conserved motor control strategy for adaptive locomotion in hypogravity***

Alessandro Santuz [1], Francesco Luciano [2], Valentina Natalucci [2], Dario Cazzola [3], Steffi Colyer [3], James Cowburn [4], Kirsten Albracht [5], Björn Braunstein [5], Verena Schungel [6], Jörn Rittweger [7], Nolan Herssens [8], Tobias Weber [8], David A. Green [8], Joriene de Nooij [9], Alberto E. Minetti [2], Gaspare Pavei [2], Niccolò Zampieri [1]

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P2-F-167 ***The effect of continuous theta-burst stimulation (cTBS) to posterior parietal cortex in a visuomotor adaptation task***

Paul Ruelos[1], Nick Kitchen[1], Manasi Wali[1], Mathew Yarossi[2], Eugene Tunik[2], Robert Sainburg[1]

[1] *Pennsylvania State University,* [2] *Northeastern University*

P2-F-168 ***Practice makes precision: Motor execution improvements in a 2-D racing task are retained and generalized but depend on movement direction***

Raphael Gastrock[1], Setayesh Nezakatiolfati[1], Andrew King[1], Denise Henriques[1]

[1] *York University*

P2-F-169 ***Large-scale plasticity associated with motor recovery from severe spinal cord injury in macaques***

Reona Yamaguchi[1], Toshinari Kawasaki[1], Zenas Chao[2], Satoko Ueno[1], Masahiro Mitsuhashi[1], Kaoru Isa[1], Kohei Matsuda[1], Tomohiko Takei[3], Hirotaka Onoe[1], Tadashi Isa[1]

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P2-F-170 ***A human motor learning circuit outside primary motor cortex***

Shahryar Ebrahimi[1], Mohammad Darainy[1], Timothy Manning[1], Emmett Lewis-Hoeber[1], David Ostry[1]

[1] *McGill University*

P2-F-171 ***A forward approach to understand how implicit and explicit perturbations shape/contribute to motor adaption***

Somesh Shingane[1], Aditya Murthy[2]

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P2-F-172 ***Reward-driven emergence of auditory pattern encoding in the primate motor system***

Sujaya Neupane[1], Rhonda Kersten[2], Mehrdad Kashefi[2], Jessica Grahn[2], Andrew Pruszynski[2], Jonathan Michaels[1]

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P2-F-173 ***An arbitrary olfactory stimulus can become a sensory cue to form context-dependent memories in visuomotor adaptation***

Taisei Sugiyama[1], Shintaro Uehara[1], Yohei Otaka[1]

[1] *Fujita Health University*

P2-F-174 ***Origin of interindividual variability in movement: early motor exploration constrains sensorimotor maps during redundant de novo learning***

Tomoya Kawano[1], Shota Hagio[1]

[1] *Kyoto University*

P2-F-175 ***Are sensorimotor memories generated by task errors independent from those driven by sensory prediction errors?***

Vaheh Nazari[1], Eugene Poh[2], Paul Dux[1], Reza Shadmehr[3], Timothy Carroll[1]

[1] *The University of Queensland,* [2] *University of Wollongong,* [3] *Johns Hopkins School of Medicine*

P2-F-176 ***Contextual cues signaling upcoming perturbations attenuate implicit feedback movement correction***

Wei-Po Wu[1], Takuji Hayashi[1], Daichi Nozaki[1]

[1] *The University of Tokyo*

P2-F-177 ***Effects of three-month tool-use practice on grasping kinematics and bodily perception***

Yoshihiro Itaguchi[1]

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P2-F-178 ***Learning reconfigures temporal dynamics of preparatory activity in the secondary motor cortex***

Zhuohao Zhang[1], Jianing Yu[1]

[1] *Peking University*

G - THEORETICAL & COMPUTATIONAL MOTOR CONTROL

P2-G-179 ***Averaging versus selection of motor memories under contextual uncertainty***

Anvesh Naik[1], Sabyasachi Shivkumar[1], James Ingram[2], Máté Lengyel[2], Daniel Wolpert[1]

[1] *Columbia University,* [2] *University of Cambridge*

P2-G-180 ***Preserved neural dynamics across arm and brain-controlled movements***

Chenyang Li[1], Xinxiu Xu[1], Tianwei Wang[2], Yun Chen[1], Cong Zheng[1], Yiheng Zhang[3], Qifan Wang[4], He Cui[1]

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P2-G-181 ***Learning embodied neuromechanical control for realistic walking and flying from 3D kinematics***

Elliott Abe[1], Charles Zhang[2], Bence Olveczky[2], Talmo Pereira[3], Bingni Brunton[1]

[1] *University of Washington,* [2] *Harvard University,* [3] *Salk Institute for Biological Studies*

P2-G-182 ***A computational account of tactile suppression during reaching movements***

Fabian Tatai[1], Dominik Straub[2], Dimitris Voudouris[3], Katja Fiehler[4], Constantin Rothkopf[1]

[1] *Technical University of Darmstadt,* [2] *University of Cambridge,* [3] *Justus Liebig Universität Giessen,* [4] *University of Giessen*

P2-G-183 ***Submovement modelling of conflict tasks: effect of the previous trial***

Jason Friedman[1]

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P2-G-184 ***Identification of orthogonal subspaces that concurrently encode current and future movement directions***

Julio Rodino[1], Nicolas Merhaeghe[2], David Dahmen[1], Alexa Riehle[2], Thomas Brochier[2], Junji Ito[1], Sonja Grün[1]

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P2-G-185 ***An open-source musculoskeletal hand model in ArtiSynth for simulating diverse hand dexterity tasks***

Kavya Mothukuri [1], John E. Lloyd [2], Grace Zhang [2], Bryan Gick [2], Sidney Fels [2], Jing Xu [1]

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P2-G-186 ***Asymmetric bilateral effects in rapid bimanual coordination: Nondominant hand facilitation and extended coupled oscillator model integrating hand dominance***

Kazumi Azuma-Takeshita [1], Kohei Miyata [1], Wataru Kurebayashi [2], Kazutoshi Kudo [1]

[1] *The University of Tokyo,* [2] *The University of Osaka*

P2-G-187 ***Learning stable endpoint control in a musculoskeletal arm via internal models and discrete reinforcement learning***

Kenshin Takeuchi [1], Yasuharu Koike [1]

[1] *Institute of Science Tokyo*

P2-G-188 ***Network mechanisms for selective engagement in motor control***

Mahdiyar Shahbazi [1], Emil Warnberg [1], Kiah Hardcastle [1], Bence Olveczky [1]

[1] *Harvard University*

P2-G-189 ***A reasonable misjudge: Bayesian sensory integration explains the ball-count-specific bias in major league baseball home plate umpires' decision making***

Masahiro Shinya [1], Mitsuto Tomomura [1]

[1] *Hiroshima University*

P2-G-191 ***Postural representations associated with motor commands may contribute to limiting real-time compensation for altered auditory feedback in speech production***

Ny Tsiky Rakotomalala [1], Pierre Baraduc [2], Pascal Perrier [3]

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P2-H-199 ***A continuous control paradigm for motor brain-computer interfaces***

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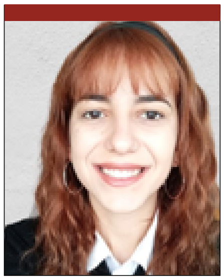
Scholarship Winners

New investigators and faculty are essential for the future of any field of scientific inquiry. NCM has historically encouraged conference participation by graduate students and post-doctoral fellows. The scholarship program is designed to provide partial support for them to participate in the conference and is open to student and post-doc members in good standing. Our scholarship program is funded through the support of our sponsors.



Celia Bougou, *California Institute of Technology*

Celia Bougou is a postdoctoral researcher in the Andersen Lab at the California Institute of Technology. Her work uses human intracranial recordings to investigate action representations and motor cognition in the frontoparietal cortex, with a focus on both single unit activity and population level coding.

Arianna Damiani, *University of Pittsburgh*

Arianna Damiani obtained her Bachelor's and Master's degrees in Bioengineering from the Polytechnic University of Turin. She conducted her Master's thesis at the Neuroengineering Laboratory at ETH Zurich, where she worked on the development of a brain–computer interface for pain. She is currently a fourth-year PhD student in Neural Engineering at RNEL (Pittsburgh), focusing on thalamic DBS for the treatment of upper-limb motor deficits after stroke.

Dominique Delisle-Godin, *Universite de Sherbrooke*

Dominique is a PhD candidate in the NeuroCTRL Lab at the Université de Sherbrooke. Her research investigates neural mechanisms of motor preparation and sensorimotor control, focusing on EEG markers associated with the modulation of responses to sensory feedback.

Martin Esparza, *Imperial College London*

Martín Esparza-Iaizzo is an engineer and neuroscientist, PhD student at Imperial College London (Be.Neuro Lab) studying neural dynamics at a population level, and a neuroengineer at INBRAIN Neuroelectronics working at the intersection of computational neuroscience, machine learning and neurotechnology.

Benjamin Filio, *National Institute of Neurological Disorders and Stroke*

Ben Filio is a PhD candidate in the NIH-Brown Graduate Partnership Program. His work with Dr. Mark Wagner examines how cerebellar circuits encode reward using 2-photon in vivo imaging in mice.

Samantha Johnson, *University of Chicago*

Sami is a fourth-year PhD student at the University of Chicago in the lab of Nicho Hatsopoulos, where she uses functional network approaches to investigate motor learning and generalization in marmosets. She also studies motor control in brain-computer interfaces, comparing imagined, active, and passive motor states in humans.

Nicolo Macellari, *University of Pittsburgh*

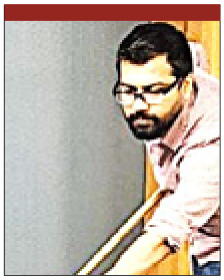
Nicolo is a postdoctoral scholar at the University of Pittsburgh working on neuroprosthetic therapies to restore mobility in neurological disorders, including Stroke, Spinal Cord Injury, and Parkinson's disease. His research focuses on neuromodulation approaches, particularly deep brain stimulation and spinal cord stimulation.

Anjuli Niyogi, *Carnegie Mellon University*

Anjuli is a Cognitive Neuroscience Ph.D. student at Carnegie Mellon University, working under Jonathan Tsay. Her research centers on understanding how cognitive strategies guide motor adaptation, integrating computational modeling with patient and behavioral studies.

Dominika Radziun, *Donders Institute for Brain, Cognition and Behaviour, Radboud University*

Dominika Radziun is a postdoctoral researcher at the Donders Institute studying computational mechanisms of plasticity in spatial body representations, including how exoskeletons alter somatosensory-to-hand representations. She earned her PhD in Neuroscience at the Karolinska Institute researching body perception and brain plasticity.

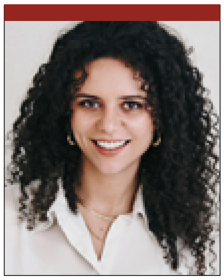


Nishant Rao, *Yale University*

Nishant is interested in determining how neurons facilitate the interaction among cognition, sensory input, and motor output to enable our behavioral repertoire. His work with human participants employs noninvasive brain stimulation (e.g., TMS) and neuroimaging (e.g., EEG) to characterize neural underpinnings of speech, grasp, pain, and balance control.

Hansol Ryu, *Georgia Institute of Technology, Emory University*

Hansol Ryu is a postdoctoral fellow at Georgia Tech and Emory University, bridging physiology and control theory in human sensorimotor adaptation. Current research examines how muscle cross-bridge dynamics shape balance control, how joint physiological properties influence adaptation to exoskeletons, and how post-stroke neuromechanical constraints shape responses to biofeedback interventions.



Alessia Sepe, *KU Leuven*

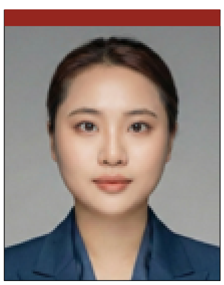
Alessia is a postdoctoral researcher at KU Leuven with a PhD in Neuroscience, currently investigating visuomotor population dynamics during brain-machine interface control in non-human primates. Her research dissects cortical and subcortical visuomotor circuits that enable action without overt movement or conscious vision (blindsight).

Nirvik Sinha, *Hebrew University of Jerusalem*

Nirvik Sinha is a dual PhD candidate at Northwestern University and the Hebrew University of Jerusalem.Trained as a physician and biomedical engineer, he is interested in the neural and biomechanical underpinnings of movement disorders. His dissertation investigates cerebellar contributions to reaching movements, leveraging a primate model of cerebellar ataxia.

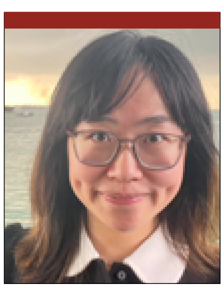
Eleni Sinopoulou, *University of California, San Diego*

Dr. Eleni Sinopoulou is an Assistant Project Scientist in Neurosciences at UC San Diego, specializing in spinal cord injury, neuromodulation, stem cell–based repair strategies and motor systems organization. Her published work in Neuron (2022), “Rhesus macaque versus rat divergence in the corticospinal projectome”, mapped and compared corticospinal connections across species and provided important insights into the field of motor system organization. Furthermore, her research integrates electrophysiology, primate and rodent SCI models, and neural circuit regeneration to advance translational therapies for functional recovery.



Yiping Sun, *Kyoto University*

Yiping Sun is a final-year doctoral student at Kyoto University (Advisor: Tadashi Isa). She studies the reticulospinal tract's role in hand dexterity using primate chemogenetics and electrophysiology. She aims to uncover the brainstem mechanisms controlling fine motor function.



Zekun Sun, *Yale University*

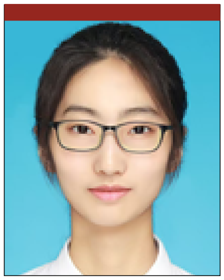
Zekun Sun is a postdoctoral researcher at Yale University. Sun’s research investigates the fundamental structures the mind constructs to represent what we see, direct how we act, and guide how we learn. Recently, she has explored how the mind abstract writing movements, and how such representational abstractions contribute to novel skill learning.

Lucas Tian, *Rockefeller University*

Lucas is systems neuroscientist studying motor cognition in macaques. He studies how the brain solves novel problems by constructing novel behavior--specifically, by sequencing action primitives using internalized procedural rules (a grammar). He is a postdoc with Winrich Freiwald (Rockefeller), and collaborates with Josh Tenenbaum (MIT) and Xiao-Jing Wang (NYU).

Frank Wandler, *University of Oregon*

Frank Wandler studied physics for his PhD before pivoting to computational neuroscience in his postdoc in the University of Oregon's NeuroAI group. He researches how to build computational models of biological neural circuits, currently focusing on the network-level mechanism responsible for dynamical rhythm generation in the spinal locomotor circuit.



Di Zhu, *Shanghai Jiao Tong University*

Di Zhu is a Ph.D. student in Biomedical Engineering at Shanghai Jiao Tong University. Her research aims at elucidating the neural mechanisms of motor control, specifically investigating the flexibility of sequential movements via neural recordings in non-human primates and patients with Parkinson's disease.

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