NCM 27th Annual Meeting

Society for the Neural Control of Movement

Satellite Meeting
May 1, 2017

Annual Meeting
May 2-5, 2017

Dublin, Ireland

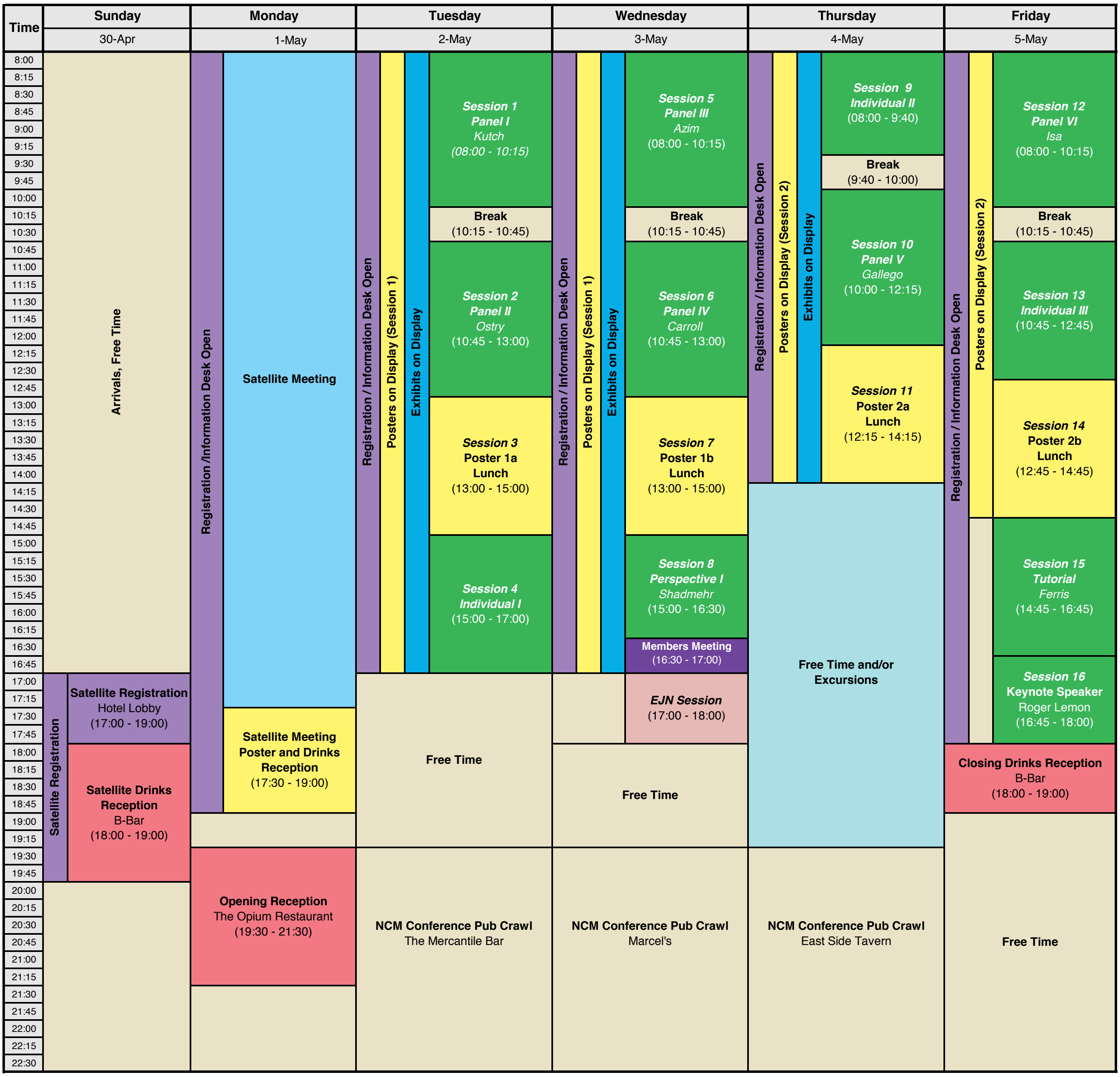
The Clayton Hotel Burlington Road

www.ncm-society.org

2017 At-A-Glance Satellite and Annual Conference Schedule

The Clayton Hotel Burlington Road,
Dublin, Ireland

Society for the
Neural Control of Movement
NCM



Time	Sunday 30-Apr	Monday 1-May	Tuesday 2-May	Wednesday 3-May	Thursday 4-May	Friday 5-May
8:00	Arrivals, Free Time	Registration /Information Desk Open Satellite Meeting	Registration / Information Desk Open Posters on Display (Session 1) Exhibits on Display ***Session 1*** ***Panel I*** *Kutch* *(08:00 - 10:15)*	Registration / Information Desk Open Posters on Display (Session 1) Exhibits on Display ***Session 5*** ***Panel III*** *Azim* (08:00 - 10:15)	Registration / Information Desk Open Posters on Display (Session 2) Exhibits on Display ***Session 9*** ***Individual II*** (08:00 - 9:40)	Registration / Information Desk Open Posters on Display (Session 2) ***Session 12*** ***Panel VI*** *Isa* (08:00 - 10:15)
8:15						
8:30						
8:45						
9:00						
9:15						
9:30					**Break** (9:40 - 10:00)	
9:45						
10:00					***Session 10*** ***Panel V*** *Gallego* (10:00 - 12:15)	
10:15			**Break** (10:15 - 10:45)	**Break** (10:15 - 10:45)		**Break** (10:15 - 10:45)
10:30						
10:45			***Session 2*** ***Panel II*** *Ostry* (10:45 - 13:00)	***Session 6*** ***Panel IV*** *Carroll* (10:45 - 13:00)		***Session 13*** ***Individual III*** (10:45 - 12:45)
11:00						
11:15						
11:30						
11:45						
12:00						
12:15					***Session 11*** **Poster 2a** **Lunch** (12:15 - 14:15)	
12:30						
12:45						***Session 14*** **Poster 2b** **Lunch** (12:45 - 14:45)
13:00			***Session 3*** **Poster 1a** **Lunch** (13:00 - 15:00)	***Session 7*** **Poster 1b** **Lunch** (13:00 - 15:00)		
13:15						
13:30						
13:45						
14:00						
14:15					**Free Time and/or Excursions**	
14:30						
14:45						***Session 15*** ***Tutorial*** *Ferris* (14:45 - 16:45)
15:00			***Session 4*** ***Individual I*** (15:00 - 17:00)	***Session 8*** ***Perspective I*** *Shadmehr* (15:00 - 16:30)		
15:15						
15:30						
15:45						
16:00						
16:15						
16:30				**Members Meeting** (16:30 - 17:00)		
16:45						***Session 16*** **Keynote Speaker** Roger Lemon (16:45 - 18:00)
17:00	Satellite Registration **Satellite Registration** Hotel Lobby (17:00 - 19:00)		**Free Time**	***EJN Session*** (17:00 - 18:00)		
17:15						
17:30		**Satellite Meeting Poster and Drinks Reception** (17:30 - 19:00)				
17:45						
18:00	**Satellite Drinks Reception** B-Bar (18:00 - 19:00)			**Free Time**		**Closing Drinks Reception** B-Bar (18:00 - 19:00)
18:15						
18:30						
18:45						
19:00						**Free Time**
19:15						
19:30		**Opening Reception** The Opium Restaurant (19:30 - 21:30)	**NCM Conference Pub Crawl** The Mercantile Bar	**NCM Conference Pub Crawl** Marcel's	**NCM Conference Pub Crawl** East Side Tavern	
19:45						
20:00						
20:15						
20:30						
20:45						
21:00						
21:15						
21:30						
21:45						
22:00						
22:15						
22:30						

Program Contents

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 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 400) 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.

Welcome

To the Society for the Neural Control of Movement 27th Annual Meeting

Lee Miller, President

It is my distinct pleasure to welcome you to Dublin and the 27th annual meeting of the Society for the Neural Control of Movement! Despite the considerable political turmoil of the past year, it is reassuring to note that NCM continues to be a vibrant meeting and gathering of new and old friends. This year's registration passed the 400 mark – a new record! We also had record numbers of submissions for both group and individual presentations, and a record number of posters. There are registrants from 23 countries, including 135 trainees. Eleven of these trainees (listed later in the program) have received a travel award to attend the meeting. These awards are supported both by exhibitors here at the meeting and a range of other advertisers. Please take time to visit their booths during lunch and poster sessions.

We welcome a new officer this year as Rachael Seidler replaces Steve Scott after his five years as Secretary / Treasurer. Five new members will join the board or be returned for another term. These include Max Berniker, Florian Kagerer, Jean-Jacques Orban de Xivry, Gelsy Torres, and Rob Turner. Officers are elected from the board, and the board from the general membership. Among other responsibilities, the board reviews all the proposal submissions, doing the basic groundwork for a successful program. The large number of submissions this year increased their work, but augers well for another outstanding program. However, the board's choice of Roger Lemon, Sobell Professor of Neurophysiology at the UCL Institute of Neurology as this year's keynote speaker, was easy and unanimous. Roger will close the meeting on Friday with a talk entitled, "Primate Specific Features of Corticospinal Control".

This year we have partnered informally with both the Journal of Neurophysiology (and editor Bill Yates), and John Foxe at the European Journal of Neuroscience. JNP has promoted our meeting in their newsletter and this year EJN will be on site with us in Dublin. John Foxe and NCM board member Andrew Pruszynski will help us continue the informal evening sessions begun last year in Jamaica by leading a discussion on EJN submissions and their new "Registered Reports" initiative. The session will begin right after the short members' meeting beginning at 5:00. EJN has also agreed to publish an NCM highlights article shortly after the meeting. Juan Gallego, Robert Hardwick, and Emily Oby, will write a first draft, then work with EJN editors to produce a final version. I hope this will become another NCM tradition that will continue with JNP when we return next year to the US.

We have another exciting satellite meeting this year: "The roles of Proprioception and Vision in Perception and Action", organized by Robert Sainburg and Richard Nichols. The day of talks and posters is launched by keynote speaker, Jonathan Cole, neurologist and author of "Pride and a Daily Marathon" and "Losing Touch". Cole will discuss his work with Ian Waterman, a patient who has learned to live without proprioception. Jonathan will be with us throughout the meeting for anyone who would like to hear more of his fascinating stories and clinical insights.

With the heart of Dublin only a 15 minute walk away, I'm not expecting everyone to stick around the hotel each evening. In an effort to mingle the scientific and Irish spirits, we are sponsoring the first ever NCM pub crawl. We've selected a different pub each night, all within walking distance and each with slightly different Irish flavor. Flash your name badge (you don't have to wear it all night) and receive discounted drinks until last call. Don't forget sessions start bright and early a 8:00 each morning!

I am proud to announce that I now have my own twitter account. I'm not as prolific as Mr. Trump, but with coaching from Andrew Pruszynski and Jean-Jacques Orban de Xivry, I've tweeted 13 times. Follow @PresNCM #NCMDub.

As always, I am grateful for all the behind the scenes work by Marischal De Armond and Podium Conference Specialists. Michelle Smith has joined Podium this year in support of NCM. Drop by and say hello and thank them for their support of the meeting.

Finally some trivia. At least two veteran NCMers present at this meeting had a honeymoon in Dublin. See if you can find them at one of the pub crawls.

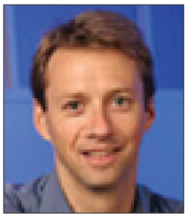
Fáilte go mBaile Átha Cliath, NCM 2017!

Cordially,
Lee Miller, President

NCM Leadership


Kathleen Cullen


Brian Corneil


Steve Scott

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
Lee Miller (president@ncm-society.org)

Vice President & Scientific Chair
Kathleen Cullen (vpprogram@ncm-society.org)

Treasurer & Secretary
Steve Scott (treasurer@ncm-society.org)

Development Officer
Brian Corneil (bcorneil@uwo.ca)

Board Members

Name	**Institution**	**Country**	**Term**
Jeroen Smeets[2]	VU University	Netherlands	2014 – 2017
Jean-Jacques Orban de Xivry[1]	Catholic University of Louvain	Belgium	2014 – 2017
Rob Turner[1]	University of Pittsburgh	USA	2016 - 2017
Alaa Ahmed[1]	University of Colorado	USA	2015 - 2018
Scott Grafton[1]	UCSB	USA	2015 - 2018
Dagmar Sternad[1]	Northeastern University	USA	2015 - 2018
Andrew Pruszynski[2]	University of Western Ontario	Canada	2015 – 2018
Pieter Medendorp[1]	Donders Institute for Brain, Cognition and Behaviour	Netherlands	2016 – 2019
Lena Ting[2]	Emory University	USA	2016 – 2019
John van Opstal[2]	Donders Institute	Netherlands	2016 – 2019
Rachael Seidler[1]	University of Michigan	USA	2016 – 2019

Incoming Board Members

The following members will begin their term at the 2017 Annual Meeting:

Max Berniker[1]	University of Illinois at Chicago	USA
Florian Kagerer[1]	Michigan State University	USA
Jean-Jacques Orban de Xivry[2]	Catholic University of Louvain	Belgium
Gelsy Torres[1]	University of Pittsburgh	USA
Rob Turner[1]	University of Pittsburgh	USA

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 Treasurer@NCM-Society.org.

NCM Administration

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

Podium Conference Specialists
Michelle Smith
Marischal De Armond
Laurie De Armond

General Meeting Information

Meeting Venue

Clayton Hotel Burlington Road
Upper Leeson Street, Dublin, 4 D04 A318 Ireland

Check in: 15:00   Check out: 12:00

All conference sessions will take place in this location.

The Opening Reception will be off-site at the Opium Restaurant.

Satellite Meeting

Satellite Meeting registration fees include a complimentary drink during a drop in gathering on Sunday April 30, access to the full day meeting with refreshment breaks, a buffet lunch and a poster reception at the end of Monday May 1.

Annual Meeting

Annual Conference registration fees include access to all sessions including panel, individual, and poster sessions. Registration also includes daily refreshment breaks, grazing lunches, the Opening Reception at The Opium Restaurant 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 Buffet Lunches 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 wear it at all times. 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, student delegates have blue edged badges. All other delegates have clear badges. NCM Officers and Board Members, Exhibitors and Staff will be identified by appropriate ribbons.

Dress Code

Dress is casual for all NCM meetings and social events.

Registration and Information Desk Hours

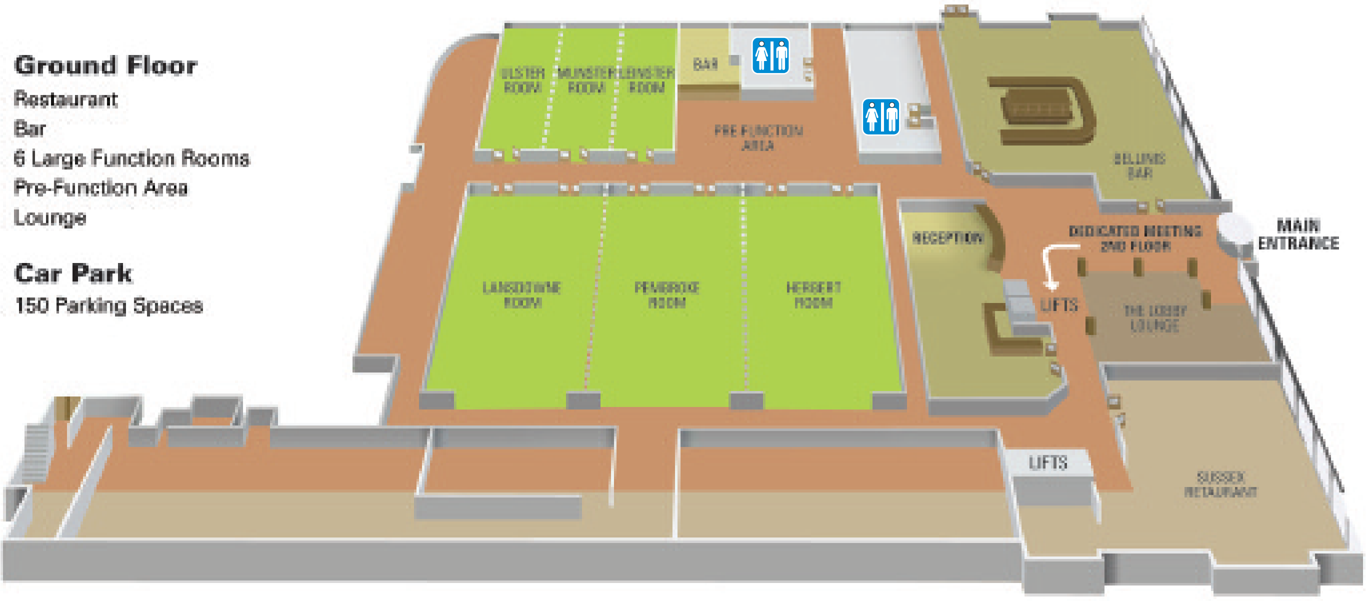
The NCM Registration and Information Desk, located outside Fitzwilliam Suites, will be open during the following dates and times:

Sunday, April 30	17:00 - 19:00
Monday, May 1	07:00 – 18:00
Tuesday, May 2	07:00 – 15:00
Wednesday, May 3	07:30 – 17:00
Thursday, May 4	07:30 – 14:15
Friday, May 5	07:30 – 17:00

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

Meeting Venue Floor Plan

The Clayton Hotel Burlington Road



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. Simply choose the Clayton Hotel WiFi network and agree to the terms and conditions. No password is required. 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 #NCMDub @ncm_soc when referring to the meeting.
We ask all NCM delegates to respect no live tweeting of presentations and no photography in the poster hall. We encourage social tweets 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.

Bedrooms booked through NCM's group room block includes complimentary wireless internet on the same network.

No Smoking Policy

The Clayton Hotel Burlington Road is a completely non-smoking facility. Smoking areas are located outside the front entrance to the hotel.

Poster Information

Set-Up / Removal • Satellite Meeting

Satellite Meeting poster presenters must set-up and remove their Satellite Meeting posters during the following times:

Set-up: Monday, May 1, 07:00 – 08:00

Remove: Monday, May 1, between 19:00 – 19:30

Set-Up / Removal • Annual Meeting

Poster Session 1

Set-up: Tuesday, May 2, 07:00 – 10:00

Remove: Wednesday, May 3, between 17:00 – 18:30

Poster Session 2

Set-up: Thursday, May 4, between 07:00 – 9:30

Remove: Friday, May 5, between 17:00 – 19:00

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

Information on Poster Authors (Lead), Poster Numbers and Poster Titles begins on page 38. 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.

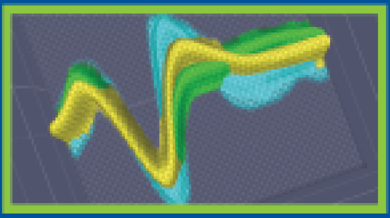
Easy reference Poster floor plans for each session can be found on the inside back cover of this program.

PLEXON®

Plexon is the pioneer and global leader in custom, high performance, and comprehensive data acquisition and behavioral analysis solutions specifically designed for neuroscience research.

Your trusted research partner providing more than 30 years support in neuroscience labs globally featuring:

OmniPlex®

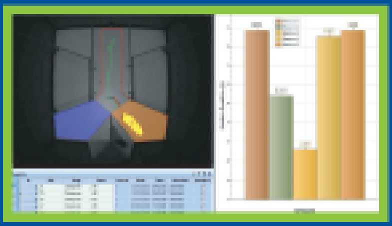


- 16-512 channels of 40 kHz neural data acquisition
- Flexible, low-latency, online spike sorting, filtering, detection, and visualization
- Support for digital or analog headstages
- Supported by Plexon Offline Sorter™

CinePlex®

- Video recording, tracking and behavior analysis
- Synchronized with external neural recording
- Real-time behavioral statistics and event-triggered digital outputs
- Online and offline position tracking - 2D and 3D

CineLAB®



- Real-time behavioral analysis and output
- Easily track in a wide variety of experiments
- Inputs and outputs integrate with external devices
- Complete solutions for optogenetics & operant chambers

PlexBright®

- New: Ultra-small PlexBright® Head-Mounted LEDs
- 17 colors: new IR (740–800nm) and UV (365–405nm)
- Custom patch cables for optimizing durability and performance
- Radiant control software

6500 Greenville Avenue
Suite 700
Dallas, TX 75206 USA

T: +1 (214) 369-4957
F: +1 (214) 369-1775
E: info@plexon.com

www.plexon.com

NCM History

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

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.

Meeting	Dates	City	Country	Hotel
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

NCM 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.

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.

Special Meetings & Events

Sunday, April 30

18:00 – 19:00

Satellite Drinks Reception
(Satellite Meeting Registrants)

B-Bar in the Clayton Hotel
Burlington Road

Monday, May 1

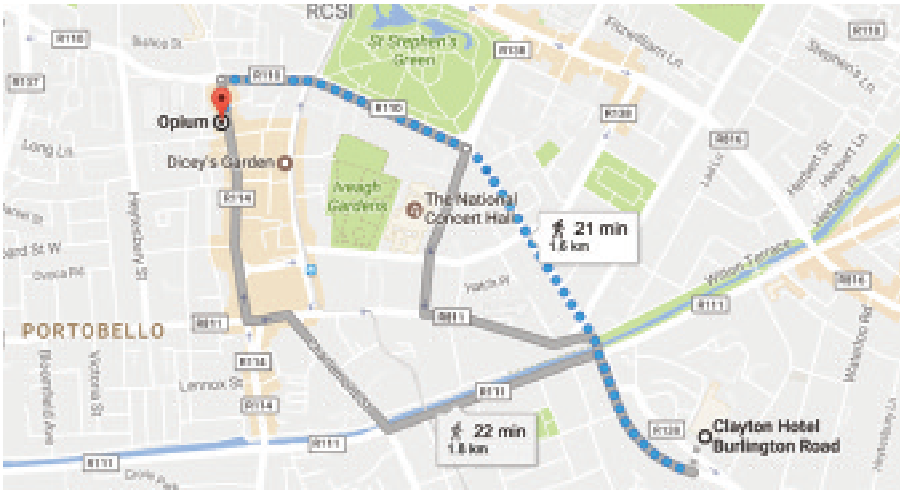
17:30 – 19:00
Satellite Poster and Drinks Reception
(Satellite Meeting Registrants)
Pembroke Room

Monday, May 1

19:30 – 21:30
Opening Reception

The Opium Restaurant
(please see map at right for details)

Join us at the Opium Restaurant, 26 Wexford Street, Dublin 2. Opium is Dublin's finest Pan Asian Restaurant and Cocktail Bar. With a unique laid back vibe, Opium is the perfect location to get reacquainted with colleagues and meet new ones.



Join us for appetizers, cocktails and good Irish entertainment!

Directions: Head west on **Leeson Street Upper** toward **Darrmouth Road** for 950 meters. Continue straight on **St Stephen's Green** for another 600 meters. Turn left on **Wexford Street** and Opium will be on your right hand side. The walk should take approximately 20 minutes from the hotel

Wednesday, May 3

16:30 – 17:00
NCM Members' Meeting
Fitzwilliam Hall

Friday, May 5

18:00 – 19:00
Closing Drinks Reception
B-Bar in the Clayton Hotel
Burlington Road

Notes

Conference Pub Crawl

Join us each evening in a different Dublin pub as we explore the nightlife of this exuberant city! Show your name badge at the locations below to receive a reduced price on beer, wine, and basic highballs.

1 • Tuesday May 2 19:30 – Last Call

The Mercantile Bar 28 Dame Street

Step back in time and immerse yourself in Nineteenth century Dublin at The Mercantile, the former workplace of Leopold Bloom in James Joyces' *Ulysses*. It was in *Ulysses* that Bloom was employed by Wisdom Hely of Hely & Co Ltd which was situated where the current Mercantile Bar resides.

2 • Wednesday May 3 19:30 – Last Call

Marcel's 13 Merrion Row

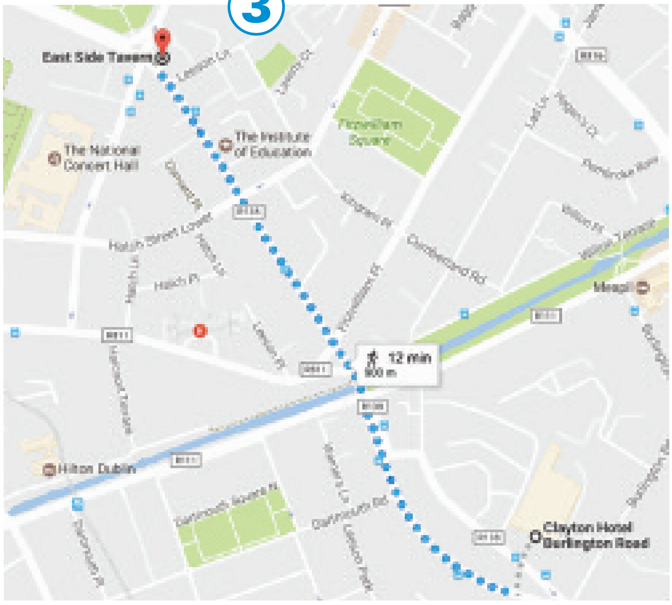
Marcel's Bar combines old world Ireland with typical traditional Irish pub features throughout. Enter through the authentic pub entrance and find yourself immersed in Irish history and experience a warm Irish welcome. With three homely snugs to choose from, they are perfect for relaxing with colleagues in the comfort of the open fire and the handcrafted timber features throughout.

3 • Thursday May 4 19:30 – Last Call

East Side Tavern 104-105 Leeson St Lower

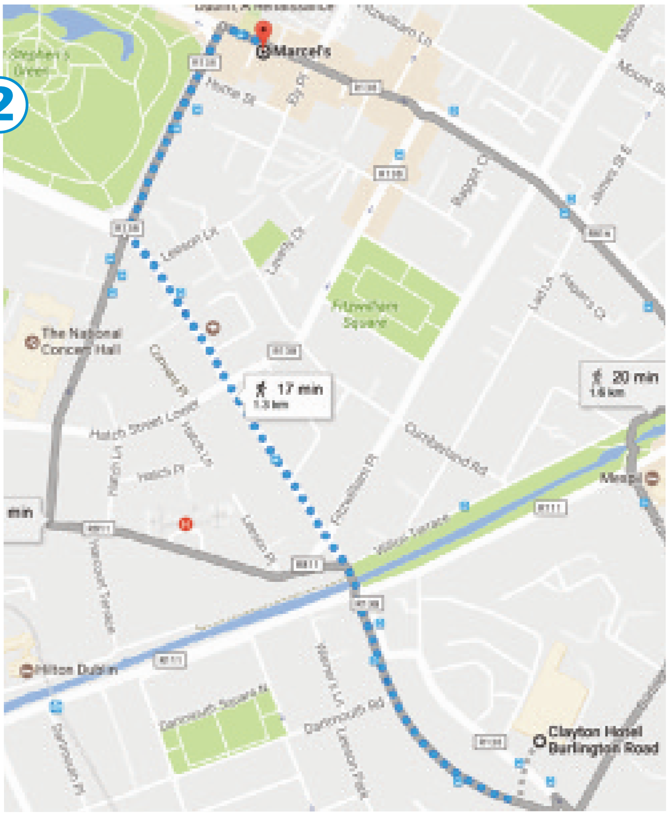
East Side Tavern embodies all that one would expect from a classic Dublin bar, with an international style and service injection. The showpiece bar showcases over 250 whiskies and spirits of the world, along with the best in craft beer and bespoke cocktails, providing a dramatic focal point.

③



①

②



Be sure to see page 11 for NCM discounts on select beer and spirits tours.

NCM Conference Excursions

NCM invites you

to take advantage of your visit to Dublin by exploring what this wonderful city and its surroundings have to offer!

NCM has engaged local tour operators to arrange a variety of packages for NCM guests that are custom designed to fit with the program. A limited number of spaces remain for our NCM Excursions. If you are interested in joining one of these trips, please inquire at the Registration Desk.

● Wicklow Tour

Thursday May 4 • 14:30–18:30

You will be met at the Clayton Hotel Burlington Road and via deluxe coach you will be taken southwards to Wicklow, the "Garden of Ireland" to visit **Powerscourt Gardens**. Beautiful formal gardens, stretching over 47 acres offer visitors a sublime blend of formal gardens, steeping terraces, flamboyant fountains, ornamental lakes and rambling walks.

Enjoy 300 years of garden design and development including the walled gardens, the Italian garden, the dolphin pond, the Japanese gardens, pets cemetery, pepperpot tower and the dramatic backdrop of the Sugar Loaf Mountain making Powerscourt Estate one of the loveliest gardens in Ireland.

Following two hours of time at the Powerscourt Estate, you will board the coach for return to the Clayton Hotel Burlington Road. **$55 US per person**

● 1916 Rebellion Tour

Thursday May 4 • 15:00–18:00

You will meet your guide at the gates of Trinity College where there will be a short introduction from the Great Hunger up to Easter Monday morning. You will then experience an amazing tour to see the most significant

places, such as: GPO, O'Connell Statue (lots of bullet holes), Larkin Statue, Moore Street.

In 1916 in Dublin, seven visionaries led a small army of Irish men and women in a revolutionary enterprise. Their vision was that Ireland might be free. The United Irishmen gave it substance; Wolfe Tone delineated it, Emmet, the Young Irelanders and the Fenians strove to achieve it. The battle of Easter 1916 raged for six days and resulted in the destruction of many parts of Dublin city. Following the Rising, the bloody executions of the leaders by the British awakened future generations to the cause of Irish freedom.

Lorcan Collins and Conor Kostick, authors of "The Easter Rising" will take you to the relevant sites of the Rebellion in Dublin, Ireland, to give you an understanding of this historic occasion which precipitated the formation of the Irish Republic.

Walking along the streets of the city you are transported back in time, to relive the events of Easter week 1916. Rather than chronologically detailing every event, the guides explain this important part of Irish history through the places visited.

This tour begins and ends in downtown Dublin, approximately 15 – 20 minutes from the Clayton Hotel Burlington Road. **$25 US per person.**

Dublin Discounts

Guinness Storehouse

Embark on a self-guided tour of the iconic Guinness Storehouse! The Guinness Storehouse is Ireland's #1 visitor attraction and a must see on any tour of Dublin. The tour is located at the Guinness brewery at St James's Gate but please note there is no access to the working brewery.

Housed in an old fermentation plant the now seven-storey visitor experience tells the story of Ireland's iconic drink and brings to life the heritage of this world famous beer. The experience starts standing at the bottom of the world's largest pint glass, which rises through the building. It is a dramatic story that begins over 250 years ago and ends in Gravity® Bar, Dublin's highest bar where visitors will receive a complimentary pint of GUINNESS® while relaxing and enjoying spectacular views over Dublin.

See the 9000 year lease signed by Arthur Guinness, the ingredients used to make Guinness, the Cooperage Exhibit and the Arthur Guinness Gallery. Visit the Taste Experience on Level Two, the new World of Advertising on Level Three and try the Guinness inspired Food available in the restaurants on Level Five.

2 hours are recommended to enjoy the full experience and it concludes with a complimentary Guinness or soft drink. Self-guided tour tickets can be purchased on line in advance to receive a discount.

www.guinnessstorehouse.com/en /TicketSelection.aspx

Jameson Distillery

Few things go together better than whiskey and a good story, **The Bow St Experience** brings the stories of Jameson's rich heritage to life in an immersive, 40 minute tasting tour of the home of Ireland's best-selling Irish whiskey.

Discover how John Jameson's focus on the highest quality ingredients, triple distillation process, and constant innovation resulted in an exceptionally smooth whiskey that is celebrated and enjoyed all around the globe. The Jameson Bow St Experience will, of course, end on a good note as an expert Jameson Ambassador leads you in a comparative whiskey tasting and a celebratory toast to Jameson Barrelmen everywhere.

Tickets are being offered to NCM delegates at a reduced rate of €15 per person when conference name badge is shown when purchasing tickets.

NCM Satellite Meeting Detailed Daily Program

NCM Satellite Meeting, Dublin, Ireland
April 30 & May 1, 2017

All sessions will be held in the Clayton Hotel Burlington Road.

This satellite symposium is designed to develop an interactive environment among leaders in the field addressing sensory control of movement in order to identify critical scientific and clinical directions for the future. The symposium will start off with a Keynote presentation by Jonathan Cole, author of "Pride and a Daily Marathon", who will discuss his work with Ian Waterman, a patient who has learned to live without proprioception. Four sessions, will address the following topics:

1 – The role of proprioception in perception or action

2 – The role of vision in perception or action

3 – The integration of vision and proprioception for perception and action

4 – Clinical applications to stroke, cancer, Parkinson's disease, and amputations.

Each session will be followed by a panel discussion. Posters will be presented during lunch and following the symposium, during a cocktail session.

The satellite symposium is organized by T. Richard Nichols and Robert Sainburg.

Sunday, April 30

17:00 – 19:00	Satellite Registration
18:00 – 19:00	Satellite Drinks Reception, Bbar, Clayton Hotel Burlington Road

Monday, May 1

07:30 – 08:00	Registration
08:00 – 08:15	**Welcome and Introduction by Robert Sainburg, T. Richard Nichols**
08:15 – 9:15	**Keynote Address: The Neuroscience of Human Deafferentation** Jonathan Cole, University of Bournemouth
9:15 – 10:30	**Session 1: The role of proprioception in perception and action** Moderator: Robert Sainburg, Penn State University **Sensory physiology and central pathways for proprioceptors** Richard Nichols, Georgia Institute of Technology **The roles of proprioception in action** Simon Gandevia, Prince of Wales Medical Research Institute **Somatosensory control of movement and visual compensatory mechanisms: Insights from deafferented individuals** Fabrice Sarlegna, Aix-Marseille University
10:30 – 10:45	Coffee Break
10:45 – 12:30	**Session 2: The role of vision in perception and Action** Moderator: Melvyn Goodale, The University of Western Ontario **Introduction** Melvyn Goodale, The University of Western Ontario **The role of the early visual cortex in action: contribution of Vision, Imagery and Touch** Simona Monaco, Center for Mind/Brain Sciences **Neural representations for action in human occipitotemporal cortex** Jason Gallivan, Queen's University **Sensory contributions to the control of reach-to-grasp** Scott Frey, University of Missouri

12:30 – 13:30	Lunch and Satellite Meeting Poster Session
13:30 – 15:30	**Session 3: Integration of vision and proprioception for perception or action** Moderator: T.Richard Nichols, Georgia Institute of Technology **Toward artificial proprioception** Philip Sabes, University of California, San Francisco **Task dependent use of visual feedback during reaching** Stephen Scott, Queen's University **What limb drift reveals about the independence of Vision and proprioception in motor control** Robert Sainburg, Penn State University **Action stability with and without vision** Mark Latash, Penn State University
15:30 – 15:45	Coffee Break
15:45 – 17:30	**Session 4: The effects of vision and proprioceptive deficits on clinical conditions** Moderator: Lee Miller, Northwestern University **Proprioceptive loss and recovery in the upper limb following stroke** Seann Dukelow, University of Calgary **The effect of amputations on proprioception and proprioceptive-visual integration** Lewis Wheaton, Georgia Institute of Technology **Chemotherapy for colorectal cancer produces proprioceptive deficits by changing muscle spindle properties: A clinical model of spindle-dysfunction** Tim Cope, Georgia Institute of Technology **The relationship between proprioceptive and motor deficits in Parkinson's disease and focal dystonia** Juergen Konczak, University of Minnesota
17:30 – 19:00	Closing Comments, Poster Session and Cocktails
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 reception, tickets can be purchased at the registration desk.

Satellite Meeting Poster Sessions | Authors, Titles and Affiliation

Monday, May 1, 2017

All sessions held in the Pembroke Room

A - Proprioception

S-A-1 Characterizing kinesthesia with and without the use of vision after stroke

Jennifer Semrau[1], Troy Herter[2], Stephen Scott[3], Sean Dukelow[1]

[1]University of Calgary, [2]University of South Carolina, [3]Queen's University

S-A-2 Does the loss of proprioception result in advantages or deficits when wearing prisms? Implications for movement planning and adaptation

Alix Renault[1], Chris Miall, Jonathan Cole, Jean-Louis Vercher[1], Fabrice Sarlegna[1]

[1]ISM - UMR CNRS 7287

S-A-3 Relative elbow angle influences perceived effort in a contralateral, upper extremity effort-matching task

Lindsey Logan[1], Jennifer Semrau[1], Tyler Cluff[1], Stephen Scott[2], Sean Dukelow[1]

[1]University of Calgary, [2]Queen's University

S-A-4 Predicting chronic proprioceptive deficits post-stroke

Sonja Findlater[1], Jennifer Semrau[1], Jeffrey Kenzie[1], Amy Yu[1], Troy Herter[2], Stephen Scott[3], Sean Dukelow[1]

[1]University of Calgary, [2]University of South Carolina, [3]Queen's University

S-A-5 Feedback responses to muscle vibration depend on task and reach direction

Johannes Keyser[1], Rob E. F. S. Ramakers[1], W. Pieter Medendorp[1], Luc P. J. Selen[1]

[1]Radboud University Nijmegen

S-A-6 Estimated muscle fiber forces predict history-dependent muscle spindle spike rates

Kyle Blum[1], Paul Nardelli[2], Timothy Cope[2], Lena Ting[1]

[1]Georgia Tech/ Emory University, [2]Georgia Tech

B – Sensorimotor Integration

S-B-7 Assessement of kinesthesia in individuals with chronic upper limb pain using robotics and virtual reality

Clémentine Brun[1], Nicolas Giorgi[1], Martin Gagné[1], Candida McCabe[2], Catherine Mercier[1]

[1]Center for Interdisciplinary Research in Rehabilitation and Social Integration, [2]Royal National Hospital for Rheumatic Diseases

S-B-8 Hand choice and the role of posterior parietal cortex

Aoife Fitzpatrick[1], Kenneth Valyear[1]

[1]Bangor University

S-B-9 Exploring the role of motor areas processing affordance in movement planning after stroke: an insight into Limb Apraxia

Elisabeth Rounis[1], Dante Mantini[2], Gloria Pizzamiglio[3], Zuo Zhang[4]

[1]University of Oxford, [2]KU Leuven, [3]University College London, [4]Tongji University

S-B-10 The effect of tonic pain and motor learning on corticospinal excitability

Erin Dancey[1], Paul Yielder[1], Bernadette Murphy[1]

[1]University of Ontario Institute of Technology

S-B-11 Increased accuracy and differential changes in early somatosensory evoked potentials in response to novel motor training for the non-dominant hand relative to the dominant hand

Ryan Gilley[1], Bernadette Murphy[2], Danielle Andrew, Paul Yielder[2]

[1]UOIT, [2]University of Ontario Institute of Technology

S-B-12 Comparing neurophysiological and behavioural outcomes between distal and proximal upper limb muscles in response to novel motor skill acquisition

Sinead O'Brien[1], Paul Yielder[1], Danielle Andrew[2], Bernadette Murphy[1]

[1]University of Ontario Institute of Technology, [2]University of Waterloo

S-B-13 Spinal manipulation for mild recurrent neck pain influences upper limb biomechanics: A four-week randomized controlled trial

Julianne Baarbé[1], Bernadette Murphy[2], Heidi Haavik[3], Michael Holmes[4]

[1]University of Toronto, [2]University of Ontario Institute of Technology, [3]New Zealand College of Chiropractic, [4]Brock University

S-B-14 Grasping movements directed towards visual, haptic and visuo-haptic objects

Ivan Camponogara[1], Robert Volcic[1]

[1]New York University Abu Dhabi

S-B-15 Upper limb motor performance is not predicted by proprioceptive acuity in younger or older adults

Nick Kitchen[1], Chris Miall[1]

[1]University of Birmingham

S-B-16 Visual and somatosensory contributions to the feedback control of movement: Evidence from a clinical model of sensory neuronopathy

Fabrice Sarlegna[1], R Miall[2], J Cole[3], Jean-Louis Vercher[1], David Franklkin [4], Marion Forano[4]

[1]ISM - UMR CNRS 7287, [2]University of Birmingham, [3]Poole Hospital & University of Bournemouth, [4]Technical University of Munich

S-B-17 Downscaling of error feedback improves retention of motor adaptation

Robert van Beers[1], Eli Brenner[1], Jeroen Smeets[1], Katinka van der Kooij[1]

[1]VU University Amsterdam

S-B-18 Gaze-dependent updating of somatosensory reach targets after eye movements in depth

Stefanie Mueller[1], Katja Fiehler[1]

[1]Giessen University

S-B-19 Neural circuits mediating transfer of motor knowledge

Roy Mukamel[1], Ori Ossmy[1]

[1]Tel-Aviv University

C – Sensory Integration

S-C-21 Spatial Proximity Determines the Strength of Multi-finger Interactions

Jeffrey Yau[1], Md. Shoaibur Rahman[1], Akshat Patel[2]

[1]Baylor College of Medicine, [2]Rice University

D Visual-Motor Integration

S-D-22 Intrinsic and extrinsic contributions to submovement kinematics

Damar Susilaradeya[1], Thomas Hall[1], Ferran Galán[1], Kai Alter[1], Andrew Jackson[1]

[1]Newcastle University

S-D-23 Moving together synchronously in rhythmic motion is only possible at certain frequencies

Jason Friedman[1], Lior Noy[2]

[1]Tel Aviv University, [2]Weizmann Institute of Science

S-D-24 Have we been looking at motor variability in old age all wrong? An example of when motor errors improve performance of older adults

Shelly Levy-Tzedek[1]

[1]Ben Gurion University

S-D-25 Where one hand meets the other: effector-invariant movement encoding in the human motor system

Shlomi Haar[1], Ilan Dinstein[1], Opher Donchin[1]

[1]Ben Gurion University

S-D-26 Like master like dog. Brain correlates of action- and movement discrimination and the identification of species-typical kinematics

Waltraud Stadler[1]

[1]Technical University of Munich

S-D-27 Approaches to identification and analysis of control patterns in motorcycle emergency braking response

Marilee Nugent[1], Pedro Huertas-Leyva[1], Simon Rosalie[1]

[1]University of Florence

E – Visual-Proprioceptive Integration

S-E-28 Sensory matching errors

Irene Kuling[1], Eli Brenner[1], Jeroen Smeets[1]

[1]VU University, Amsterdam

S-E-29 Neck muscle fatigue affects performance of a tracking task performed using shoulder rotation

Mahboobeh Zabihhosseinian [1], Bernadette Murphy [1], Michael WR Holmes [2]

[1]University of Ontario Institute of Technology, [2]Brock University

S-E-30 Effectiveness of visual and kinaesthetic imagery on hip abductors muscle strength: results from a randomised controlled trial and implications for musculoskeletal physiotherapy

Majid ALenezi [1], Amy Hayes [1], Gavin Lawrence[1]

[1]Bangor University

Notes

2018 Annual Meeting

SANTA FE, NEW MEXICO

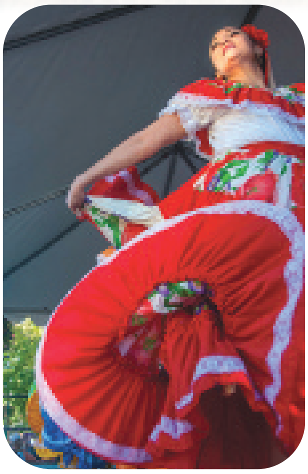
April 30 - May 4, 2018

Society for the
Neural Control of Movement
NCM

We are pleased to announce that the 2018 Annual Meeting will take place in Santa Fe, New Mexico, USA!

The **28th Annual Meeting** will take place **April 30 – May 4, 2018 at the Hilton Santa Fe Buffalo Thunder,** in Santa Fe, New Mexico.

Please plan to attend the 28th Annual Meeting in Santa Fe, The City Different! Santa Fe is a city that embodies Southwestern splendor and inspires innovation, reinvention and clear thinking. It is a magical, exuberant and colorful journey at any time of the year with legendary history and culture, world class cuisine and multiple recreation opportunities. The Hilton Buffalo Thunder is situated under the picturesque Sangre de Cristo Mountains, only 15 minutes from downtown Santa Fe and is surrounded by three golf courses, each taking advantage of the natural features of the landscape. Information about the meeting and the hotel (including reservation information) will be available on the NCM website shortly.



Satellite Meetings

NCM's Board welcomes suggestions for one or two-day Satellite Meetings in conjunction with future Annual Meetings. Please discuss your ideas with NCM Board Members to formulate an early plan/proposal, and bring this to the NCM President for further consideration (email: President@NCM-Society.org).

Keynote Speakers

NCM provides the opportunity for members to suggest prominent colleagues in the field of neuroscience who would be suitable candidates to provide a Keynote Address during an Annual Meeting. The Keynote is an invited lecture delivered by a prominent colleague whose contributions to neuroscience are widely acknowledged. Individuals and topics outside the normal NCM community are encouraged. If you wish to recommend a colleague as a future keynote presenter, please discuss with a NCM Board Member or Officer or send an email to President@NCM-Society.org

See you in Santa Fe!

Annual Meeting Detailed Daily Program

NCM Annual Meeting, Dublin, Ireland
May 2–5, 2017

All sessions will be held in The Fitzwilliam Hall
Posters and Exhibits will be located in Landsdowne Suite

DAY 1 Monday, May 1

19:30 – 21:30 Opening Drinks Reception at the Opium Restaurant

---

DAY 2 Tuesday, May 2

08:00 – 10:15 **Session 1, Panel I**

The motor system in acute and chronic pain
Organizer: Jason Kutch
Participants: Jason Kutch, Stephen Coombes, Paul Hodges, Karen Søgaard

10:15 – 10:45 Break

10:45 – 13:00 **Session 2, Panel II**

How do we learn sensorimotor maps from scratch?
Organizer: David Ostry
Participants: David Ostry, Floris T van Vugt, Megan Thompson, Philip Sabes, Ferdinando A Mussa-Ivaldi

13:00 – 15:00 **Session 3, Poster 1a and Lunch**

15:00 – 17:00 **Session 4, Individual Presentations I**

Task-relevant motor variability is dynamically regulated by reward history
Participants: Ashesh K Dhawale, Yohsuke R Miyamoto, Maurice A Smith, Bence P Ölveczky

Unmasking the emergence of automaticity through practice by limiting reaction times
Participants: Robert M Hardwick, Alexander D Forrence, John W Krakauer, Adrian M Haith

The speed of neural population dynamics as a neural code for motor timing
Participants: Mehrdad Jazayeri

The magnitude of implicit adaptation is limited by constant forgetting
Participants: Ryan Morehead, Maurice A Smith

Lasting clinical gains from stimulation-enhanced visuomotor adaptation in chronic stroke
Participants: Jacinta O'Shea, Patrice Revol, Helena Cousijn, Jamie Near, Pierre Petitet, Sophie Jacquin-Courtois, Heidi Johansen-Berg, Gilles Rode, Yves Rossetti

Brain network adaptations evidenced by changes in spectral electroencephalography estimates correlate with acquisition and consolidation of a manual visuomotor skill
Participants: Menno P Veldman, Natasha M Maurits, Chris Mizelle, Tibor Hortobágyi

Annual Meeting Detailed Daily Program

DAY 3 Wednesday May 3

08:00 – 10:15	**Session 5, Panel III** **Presynaptic inhibition for sensory-motor control** Organizer: Eiman Azim Participants: Eiman Azim, Nikolaos Balaskas, Pablo Rudomin, Jing Wang, Kazuhiko Seki, Thomas M Jessell, Elzbieta Jankowska
10:15 – 10:45	Break
10:45 – 13:00	**Session 6, Panel IV** **Error, energy and reward: what drives sensorimotor adaptation?** Organizer: Timothy Carroll Participants: Timothy J Carroll, Max Donelan, Alaa Ahmed, Li-Ann Leow, Joe Galea
13:00 – 15:00	**Session 7, Posters 1b and Lunch**
15:00 – 16:30	**Session 8, Perspective I** **Distinct neural circuits for control of movement vs. holding still** Organizer: Reza Shadmehr Participants: Reza Shadmehr, Robert Scheidt, Yifat Prut
16:30 – 17:00	**NCM Members' Meeting** All Members of the Society for the Neural Control of Movement are invited to attend
17:00 – 18:00	**European Journal of Neuroscience Session** **Reproducibility, transparent reviews, and the myth of the impact factor** John Foxe **A primer on publishing registered reports** Andrew Pruszynski

DAY 4 Thursday May 4

08:00 – 9:40	**Session 9, Individual Presentations II** **Representation of visuomotor delay with current state information** Participants: Guy Avraham, Raz Leib, Assaf Pressman, Lucia S Simo, Amir Karniel, Lior Shmuelof, Ferdinando A Mussa-Ivaldi, Ilana Nisky **Vestibular prosthetic stimulation induces plasticity within vestibular reflex pathways that guides changes in motor performance** Participants: Diana E Mitchell, Charles C Della Santina, Kathleen E Cullen **Visual processing for saccades in rostral premotor cortex compared with frontal eye field** Participants: Jeffrey D Schall, Joshua D Cosman, Kaleb Lowe, Michelle S Schall, Wolf Zinke **Simultaneous recording from 96 extracellular electrodes in thalamus and basal ganglia of awake children during evaluation for deep-brain stimulation surgery for secondary dystonia** Participants: Terence D Sanger **Association of BDNF and dopaminergic polymorphisms with cognitive and sensorimotor functions in older adults** Participants: Kathleen E Hupfeld, Rachael D Seidler
9:40 – 10:00	Break

10:00 – 12:15 **Session 10, Panel V**

From single neurons to neural manifolds: A new framework for understanding neural control of movement
Organizer: Juan Gallego

Participants: Juan A Gallego, Emily R Oby, Surya Ganguli, Christian K Machens, Marius Pachitariu

12:15 – 14:15 **Session 11, Posters 2a and Lunch**

14:15 – 18:30 Free Time and Ticketed Excursions

DAY 5 Friday May 5

08:00 – 10:15 **Session 12, Panel VI**

Neural control and recovery of hand function
Organizer: Tadashi Isa
Participants: Tadashi Isa, Stuart N Baker, Robert Brownstone, Monica A Perez

10:15 – 10:45 Break

10:45 – 12:45 **Session 13, Individual III**

Principles underlying feed-forward control of multi-jointed limbs
Participants: Vikas Bhandawat, Cynthia Hsu

Dorsal premotor cortex recruits primary motor cortex to compensate for altered dynamics
Participants: Matthew G Perich, Juan A Gallego, Lee E Miller

Characterizing percepts evoked via intracortical microstimulation delivered to human somatosensory cortex
Participants: Sharlene N Flesher, Jeffrey M Weiss, Elizabeth C Tyler-Kabara, Sliman J Bensmaia, Michael L Boninger, Jennifer L Collinger, Robert A Gaunt

Coding of hand postures and movements in somatosensory cortex
Participants: Sliman J Bensmaia, James J Goodman, Gregg A Tabot, Aneesha K Suresh, Nicholas G Hatsopoulos

Subcortical LFPs as an assistive control signal for brain-machine interfaces
Participants: Huiling Tan, Petra Fischer, Syed A Shah, Peter Brown

Neural limits in tracking high bandwidth movements
Participants: Shreya Saxena, Sridevi V Sarma, Munther Dahleh

12:45 – 14:45 **Session 14, Posters 2b and Lunch**

14:45 – 16:45 **Session 15, Tutorial**

What can mobile brain imaging with electroencephalography tell us about the neural control of movement?
Organizer: Daniel Ferris

Participants: Daniel P Ferris, Johanna Wagner, Klaus Gramann

16:45 – 18:00 **Session 16, Keynote Address**

Primate specific features of corticospinal control
Roger Lemon, PhD FMedSci, UCL Institute of Neurology, Queen Square

18:00 – 19:00 **Closing Drinks Reception**


Pegasus
ATLAS

Session 1, Panel I

Tuesday, May 2 8:00 – 10:15

The motor system in acute and chronic pain

Jason Kutch[1], Stephen Coombes[2], Paul Hodges[3], Karen Søgaard[4]

[1]University of Southern California, [2]University of Florida, [3]University of Queensland, [4]Syddansk Universitet

Pain is understood as an ascending process that transmits nociceptive signals, a descending process that modulates nociceptive signalling, and a cognitive/affective process that generates the pain experience by evaluating the threat of nociceptive signals. In this view, pain and motor control processes are considered largely separate. However, there is expanding evidence that both acute and chronic pain processes involve substantial motor adaptations. To explain the importance of these motor adaptations, the panel brings together several investigators in neuroscience – specializing in imaging, physiology, and motor control. Dr. Kutch will introduce the topic, and present neuroimaging evidence that brain motor networks are profoundly altered in chronic pain. Specifically, he will show that changes in cortical and subcortical motor systems are potential diagnostic factors that separate patients with chronic pelvic pain from healthy individuals, are important factors that stratify chronic pelvic pain patients based on widespread body pain, and are key features that predict future longitudinal progression of chronic pelvic pain. Dr. Coombes will describe convergence of pain and motor systems. Specifically, using experimental pain paradigms he will show that motor control and pain processing engage similar regions of the cingulate motor areas and cerebellum, and that a pain-related suppression of beta oscillations in premotor areas facilitates voluntary movement; using clinical pain paradigms, he will show that functional activity in motor circuits is altered when voluntary muscle contractions evoke pain. Dr. Kulig will demonstrate that recurrent pain results in altered motor behavior during pain-free periods. Specifically, she will show that this motor behavior may be an attempt to modify movement strategies to avoid pain. She will discuss how these results may guide targeted intervention approaches delivered during non-painful periods to reduce recurrence. Finally, Dr. Hodges will relate motor system changes to altered movement control in chronic pain, and underscore the importance of these movement control changes to pain perpetuation. Specifically, he will show how pain and injury can interfere with motor function at multiple levels from the molecular changes in muscle to reorganisation of higher brain centres. He will show how motor adaptation to pain is consistent with a strategy to protect tissues from further pain and injury, but with negative long-term consequences; and pain may reduce if it is "perceived" that sufficient motor action has been taken regardless of actual tissue benefit. He will also highlight that, through a process of classical conditioning, movement might evoke pain without nociceptive discharge. Overall, we demonstrate that the motor system is a critical component of the pain system, and we suggest future work to determine whether maladaptation in the motor system is a critical factor in the development of chronic pain.

Session 2, Panel II

Tuesday, May 2 10:45 – 13:00

How do we learn sensorimotor maps from scratch?

David Ostry[1], Floris van Vugt[1], Megan Thompson[2], Philip Sabes[2], Ferdinando Mussa-Ivaldi[3]

[1]McGill University, [2]University of California San Francisco, [3]Northwestern University

One of the puzzles of learning a skilled movement such as learning to dance or to play a musical instrument is how we learn which movement to use in order to produce a particular sensory state: a sensorimotor map. There is a substantial understanding of how existing sensorimotor maps are adjusted in situations in which these maps are already well-learned at the outset, such as when subjects respond to visual rotations during reaching or auditory perturbations during speech. These perturbations require subjects to make relatively minor (remapping) adjustments to previously acquired mappings and therefore may not provide insight into the process by which maps are acquired in the first place. This panel will focus on basic properties of map learning (Houde lab), show that once learned, these maps can participate in multisensory integration following the same rules as for existing maps (Sabes lab). The learning process capitalizes on topological properties of the mapping (Mussa-Ivaldi lab). However, even mappings that have no orderly sensorimotor relation still can be readily learned (Ostry lab). Thompson, Houde, and Nagarajan describe learning to produce vowel sounds with a novel plant: a touchscreen mapping touch locations to vowel formants. Subjects learned this mapping and produced desired vowel targets, rapidly improving their accuracy and consistency. Subjects also partly generalized their learning to untrained vowels, and showed sensorimotor adaptation to formant-altered feedback. Sabes and colleague studied the acquisition of novel sensorimotor mappings in macaque monkeys, where sensory input is delivered via intracortical microstimulation (ICMS) to primary somatosensory cortex (S1). Animals are able to learn these non-biomimetic mappings. By selectively degrading the quality of the ICMS signal and by studying how it is combined with visual feedback, they model how the ICMS is interpreted (or "decoded") by the sensorimotor pathway. They find that the signal is processed in a statistically optimal fashion, as would be the case for natural sensory feedback. Mussa-Ivaldi and colleagues investigate how geometry, mechanics and noise contribute to the formation of coordinated movements when we face an entirely new relation between body motions and their sensory consequences. Experimental evidence reveals a trend to form and organize movements that reflect the Euclidean properties of ordinary space and the Riemannian geometry associated with the dynamical objects being manipulated. van Vugt and Ostry present a set of studies and simulations also using movements to auditory targets which show that map learning is not based on error, and does not even require targets. Further, complex mappings can be learned where there is no orderly relation between movements and sounds. These results suggest that learning may rely on building a history of movements and their sensory effects in a structure as simple as a look up table or code-book.

Session 4, Individual Presentations I

Tuesday, May 2 15:00 – 17:00

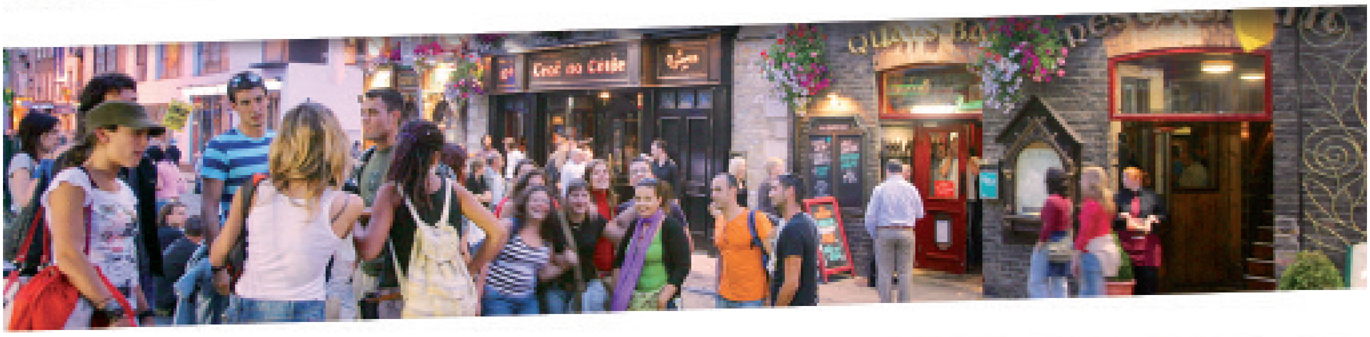
Task-relevant motor variability is dynamically regulated by reward history

Ashesh Dhawale[1], Yohsuke Miyamoto[1], Maurice Smith[1], Bence Ölveczky[1]

[1]Harvard University

Variability in motor output underlies trial-and-error motor learning. It allows the brain to explore in motor space and can help discover efficient solutions to the task at hand. To maximize its utility for learning, levels of variability should be tightly regulated to allow exploitation of successful actions when reward rates are high, while favoring exploration of motor space when reward rates are low. To determine if the reward context has changed, the motor system needs to contrast past and present performance but the computations underlying this comparison and the timescales over which reward information is integrated are unknown. Furthermore, since exhaustive exploration of high-dimensional motor space is impractical, it may be more efficient for variability to be principally regulated along dimensions of motor space that are meaningful for task performance. However, little is known about whether the motor system indeed dynamically regulates variability in a 'task-relevant' manner. To address these outstanding questions, we developed a novel

International Society of
Electrophysiology and Kinesiology
UCD / Dublin / Ireland
30th June-2nd July 2018
www.isek.org



Bringing together researchers in human movement and the neuromuscular system

Fifty years after the inaugural meeting of the International Society of Electrophysiology and Kinesiology, and building on the success of the XXI Congress in Chicago, ISEK 2018 will bring together multidisciplinary delegates from basic scientists to practising clinicians specialising in human movement and the neuromuscular system. The programme will include key-note lectures from distinguished international speakers and a range workshops, in addition to plenary sessions spanning diverse topics including sensorimotor control, motor performance, movement disorders, rehabilitation, neuromechanics, neural engineering, modelling and data analysis. The congress will be held at University College Dublin within easy access of the rich cultural and historical heritage of Dublin city.

Call for abstracts
September 2017

Early registration
September 2017

Deadline for
submission of Abstracts
December 2017

Acceptance of oral
presentations & posters
February 2018

Conference Dates
30 June – 2 July 2018

CONFERENCE LOGISTICS
Conference Partners Ltd
T: +353 (0) 1 296 8688
E: isek2018@conferencepartners.ie

CONFERENCE PROGRAMME
Professor Madeline Lowery
T: +353 1 7161911
E: madeleine.lowery@ucd.ie

SPONSORSHIP & EXHIBITION
Colm O'Grady, Conference Partners Ltd
T: +353 (0)1 2968688
E: isek2018sponsorship@conferencepartners.ie

behavioral paradigm in which rats are trained by reinforcement learning to displace a 2-d joystick to match specific target angles. Over the course of their training rats performed ~200,000 trials, enabling high-powered statistical analyses. Determining the temporal relationship between reward history and variability is complicated by large autocorrelations in task performance which make it difficult to establish whether, say, a decrease in reward rates led to an increase in variability, rather than vice versa. One way to overcome this confound is to control for long-term performance history. Taking advantage of our large datasets, we carried out a matching analysis where we compared differences in variability between subsets of trials that had identical long-term reward history but distinct reinforcement on a single trial. Surprisingly, we found that the presence/absence of reward on even single trials significantly modulated motor variability over the next 20 trials, with reward delivery decreasing variability and absence of reward increasing variability. We also observed an identical result when we probabilistically administered or withheld reward on single 'catch' trials, demonstrating that single trial reinforcement causally regulated subsequent motor variability. Extending such analysis beyond single trials revealed that the reward effect on variability sums non-linearly across trials. Finally, we found that such modulation of motor variability was restricted to the task-relevant feature - the press angle - and not observed in task-irrelevant features such as press distance and velocity. Our results demonstrate that the motor system can use single trial reinforcement information to regulate movement variability in a sophisticated and temporally precise manner, and lay the foundation for future studies aimed at understanding how these computations are implemented in neural circuitry.

Unmasking the emergence of automaticity through practice by limiting reaction times

Robert Hardwick[1], Alexander Forrence[1], John Krakauer[1], Adrian Haith[1]

[1]Johns Hopkins University

It has long been proposed that extensive training on a task leads behavior to become automatic, which is critical for supporting expert performance. Automaticity is most commonly characterized in terms of dual-tasking - once a behavior becomes automatic, cognitive resources are freed, allowing another demanding task to be performed simultaneously. However, automatic behavior is also posited to exhibit other hallmarks: being expressible at low latency, and being expressed involuntarily even following a change in task requirements (i.e. becoming habitual; Ashby, Turner & Horvitz, 2010). These aspects of automatic behavior are relatively unexplored, likely because such effects could easily be masked at prolonged reaction times that permit more cognitive control over responses (Keramati et al., 2016). We hypothesized that automaticity might only be revealed at relatively low response latencies. In a first experiment, 22 participants practiced an association between four symbols and four buttons over four days (4,000 reaction time trials). The mapping was then changed by swapping the buttons associated with two symbols. Participants rapidly learned to perform this revised map accurately. We subsequently probed their performance at different reaction times using a timed-response paradigm (Ghez et al., 1997; Haith, Pakpoor & Krakauer, 2016). When a long reaction time (>600 ms) was permitted, participants performed the newly instructed mapping nearly perfectly. However, when reaction times were limited to ~400ms, 40% of responses corresponded to the previously trained association, rather than the new, switched association. Notably, this habit effect was absent in a control condition in which participants trained minimally on the original map until they reached a steady accuracy criterion (~50 trials) before learning the switched map. Thus, limiting reaction time unmasked an automatic habitual response that had been established through practice. In a second experiment, we tested whether a longer period of training might further strengthen this habitual response. 14 new participants practiced a similar task for four weeks (20,000 trials). This extended practice had modest effects on the speed-accuracy trade-off for response selection. However, it had a pronounced effect on the likelihood of generating habitual responses; at RTs of ~400 ms, participants reverted to the initially trained mapping 60% of the time. In summary, assessing automaticity based on whether short-latency responses became habitual revealed the emergence of automatic behavior within a week of practice. Subsequent weeks of practice led to a significant increase in automaticity, despite limited improvement in performance on the task (the speed-accuracy trade-off). This characterization of automaticity complements conventional dual-task approaches, while highlighting further fundamental changes in behavior that occur with practice.

The speed of neural population dynamics as a neural code for motor timing

Mehrdad Jazayeri[1]

[1]Massachusetts Institute of Technology

Medial frontal cortex plays a fundamental role in the temporal control of movements and has been implicated in the initiation, coordination and sequencing of voluntary actions. However, the computational principles and dynamics of neural responses that control movement initiation remain largely unknown. We recorded from the medial frontal cortex of monkeys trained to flexibly produce different time intervals with different effectors. The activity profile of individual neurons was complex and heterogeneous. However, responses displayed an unexpected form of invariance: response profiles were stretched or compressed in time in correspondence with the produced interval. This property allows motor timing to be understood in terms of a simple and novel neural code: the speed with which population neural dynamics unfold in time. Analysis of a recurrent neural network model trained on the same task revealed that the control of speed could be readily achieved by an external input reorganizing the geometry of the network's attractor dynamics. These findings highlight the potential for a novel and general computational scheme whereby the brain sets the speed with which neural responses evolve in order to flexibly control movement initiation time.

The magnitude of implicit adaptation is limited by constant forgetting

Ryan Morehead[1], Maurice Smith[1]

[1]Harvard University

There has been considerable recent interest in the types of error and learning processes that are involved in sensorimotor adaptation tasks. Here we focus on implicit adaptation to sensory prediction errors, which is thought to be the principal component of motor adaptation (Shadmehr et al., 2010; Huberdeau et al., 2015). To assay this type of adaptation, we provided task-irrelevant clamped feedback: a cursor moves in sync with each point-to-point reaching movement, but at a fixed angular offset relative to the target. Critically, participants are fully informed of the manipulation and instructed to ignore it, and to move their hands directly to the target. Despite these instructions, participants reliably adapt to the clamped feedback. Interestingly, this method is different from standard adaptation tasks in that the error signal that drives adaption is held constant as adaptation proceeds and is not affected by adaptation-induced changes in the participant's behavior. In conventional adaptation protocols, an adaptive change in behavior will reduce the size of the error, reducing the drive for adaptation. However, with task-irrelevant clamped feedback, the error signal is constant, which might cause learning to continue unabated until the perturbation is removed. We exposed participants (n=50) to task-irrelevant clamped feedback while they reached to a set of eight targets spaced in 45° increments around the workspace. Initially, there was rapid learning in response to the clamped feedback, but these changes in hand angle slowed and appeared to have reached an asymptote after approximately 70 movement cycles (8 targets/cycle). After 240 cycles, the total amount of adaptation

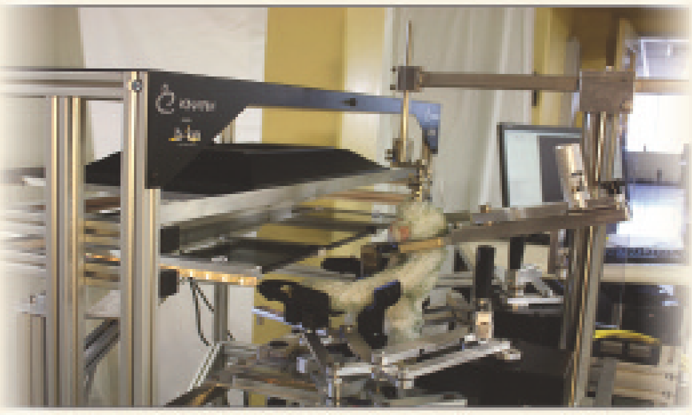
KINARM

The trusted standard in behaviour measurement

It's here! The *NEW* KINARM Exoskeleton

The classic Scott KINARM was great, but now it is even better...

- **Stiffer:** A completely new linkage design has increased both vertical and in-plane mechanical stiffness by 2-3 times. Stiff force channels are now possible.
  Vertical out-of-plane stiffness: 8,500 N/m
  End-point in-plane mechanical stiffness: ~16,400 N/m
- **Greater Accessibility to the Head:** The motors are mounted below the shoulders thus enabling full access to the head. Now you can use TMS - and any other head-mounted peripheral- without having to "squeeze it in".
- **25% More Torque:** 16.5 Nm (peak), 5.5 Nm (continuous)
- **No More Analog:** The electronics have been upgraded to all digital communication using the EtherCAT protocol.
- **Quiet and Smooth:** With EtherCAT, we've changed the servo amps, eliminating the audible noise and slight jitter felt with the Classic. Subjects perceive smoother movements.



The NHP KINARM Exoskeleton Lab is also better...

The new design was introduced in 2015 and reviews have been excellent.

- **Greater Stiffness:** End-point mechanical stiffness 10 times better
- **Greater peak torque pulse:** 4Nm at shoulder, 3Nm at elbow
- **Improved Operator Access to the NHPs:** the NHPs are happier!

Come visit us at NCM Dublin

www.bkintechnologies.com
BKIN Technologies, 140 Railway St. Kingston, ON K7K 2L9 Canada
Tel: +1(613) 507-4393 **Toll Free:** +1(888) 533-4393
Email:info@bkintechnologies.com

created by b·kin TECHNOLOGIES

remained unchanged from that observed at 70 cycles, 27.5° ± 3.6°. This indicates a fundamental limit to the magnitude of implicit adaptation, a limit which may arise from the learning process itself. In order to further understand why this implicit adaptation is limited, we performed a set of experiments where participants (N=77) first reached asymptotic learning with 190 cycles of clamped feedback. Following this, we altered the feedback and observed how the asymptote changed over an additional 240 cycles. Specifically, we either altered the size of the clamp offset, flipped its sign, or removed feedback on all or some of the cycles. Our feedback manipulations amounted to a net change in the learning drive, which caused asymptotes to change in a manner consistent with a learning process whose steady-state behavior is determined by a dynamic equilibrium of learning and forgetting. In particular, our results rule out several possible hypotheses for explaining why implicit adaptation asymptotes, including habituation of learning and cancelation of sensory predictions by a forward model. Our results suggest that changes in behavior than the limit we observe may require processes other than implicit adaptation to a sensory prediction error.

Lasting clinical gains from stimulation-enhanced visuomotor adaptation in chronic stroke

Jacinta O'Shea[1], Patrice Revol[2], Helena Cousijn[1], Jamie Near[1], Pierre Petitet[1], Sophie Jacquin-Courtois[3], Heidi Johansen-Berg[1], Gilles Rode[3], Yves Rossetti[2]

[1]University of Oxford, [2]Lyon Neuroscience Research Center, [3]Hospices Civils de Lyon Hôpital Henry Gabrielle

It is often argued that facilitating the acquisition or retention of motor learning should enhance rehabilitative gains following stroke. Here we tested this prediction in the case of visuomotor adaptation. It is known that adaptation to a rightward prismatic shift can improve neglect symptoms after right hemisphere stroke (Rossetti et al., 1998, Nature). However, not all patients respond to prism therapy, and in those that do the therapeutic benefits are transient (typically ~ 1 day). We predicted that stimulation of left sensorimotor cortex would potentiate memory formation in circuits controlling the adapting right arm, and thus enhance consolidation of both the prism after-effect and the transfer gains for cognition. We performed a proof-of-concept test of this hypothesis using an experimental medicine approach. Experiments in healthy volunteers were conducted first to identify the optimal brain stimulation protocol, which was then translated to patients to assess clinical response. In a series of experiments in healthy volunteers, we identified a protocol that enhanced consolidation of the prism after-effect, in a manner that was polarity-specific, functionally-specific, anatomically-specific and cognitive state dependent. Stimulation increased prism after-effect persistence from < 24 hours to a timescale of multiple days. By what mechanism did this effect occur? The stimulation-induced change in retention could be explained by means of a modified two-state learning model of adaptation (Smith et al. 2006, PLOS Biology). By assessing inter-individual covariance in multimodal brain imaging data we could also identify structural, functional and neurochemical correlates of the stimulation-induced behavioural change. When the stimulation protocol was translated to neglect patients, we observed both enhanced retention of the prism after-effect and a significant increase in the magnitude and longevity of therapeutic response. We conducted four longitudinal patient case series with chronic severe treatment-resistant neglect. When exposed to prism therapy combined with sham stimulation, patients showed no improvement. However, when the therapy was combined with stimulation, all patients exhibited significant improvements in neglect that lasted for weeks to months and did not return to baseline. These findings challenge consensus in the literature that because the left hemisphere is pathologically over-excited in neglect it should be suppressed. They further demonstrate that the normally transient after-effect of prism adaptation can be transformed into a long-lasting memory trace that is therapeutically significant. Excitation of left sensorimotor circuits during visuomotor adaptation can unmask latent plastic potential in the damaged brain to durably improve cognitive function after right hemisphere stroke.

Brain network adaptations evidenced by changes in spectral electroencephalography estimates correlate with acquisition and consolidation of a manual visuomotor skill

Menno Veldman[1], Natasha Maurits[1], Chris Mizelle[2], Tibor Hortobágyi[1]

[1]University Medical Center, University of Groningen, [2]East Carolina University

Acute, repetitive motor practice improves movement quality, yielding adaptations that eventually become resistant to external interference. Use-dependent adaptations in the central nervous system facilitate motor skill acquisition and consolidation evidenced by increases in neuronal excitability and blood-oxygen-level-dependent responses. However, the involvement of multiple brain structures in complex motor learning raises the question whether plasticity of the connections between these structures rather than activation of these structures individually is more relevant for increasing motor performance. Therefore, our aim was to compare the importance of changes in activity and connectivity in relation to motor performance after motor practice. We used electroencephalography (EEG) to derive activity and connectivity estimates through event-related desynchronization (ERD) and resting-state coherence, respectively, in the alpha (8-12 Hz), low-beta (13-19 Hz), and high-beta (20-30 Hz) bands before, immediately, and 24 hours after after a 15-minute manual visuomotor practice or a Control intervention. We observed motor skill acquisition (29%) and motor memory consolidation (24%) relative to Control. Immediately after MP, increased parietal ERD in the low-beta band (9%) correlated with increases in motor performance. Alpha coherence between the dorsolateral prefrontal cortex and the primary motor cortex (M1) and between the supplementary motor cortex and M1 in the high-beta range increased on Day 2. Adaptations in coherence correlated not only with skill acquisition, but also with consolidation. That is, skill acquisition correlated with coherence between M1 and the parietal cortex, premotor cortex, supplementary motor cortex, and the dorsolateral prefrontal cortex. Skill consolidation correlated with coherence in a network consisting of M1, premotor cortex, and the dorsolateral prefrontal cortex. In addition, multivariate regression revealed that adaptations in coherence were more important for increasing motor performance than adaptations in ERD. The present results suggest that functional connectivity in a brain network involving structures associated with motor planning and execution, sensorimotor integration, and dorsolateral prefrontal areas associated with working memory, sensory memory, and motor planning are important for skill acquisition. With early consolidation, shifts in brain activation did not yet occur, but coherence in a network consisting of M1, the premotor cortex, and the dorsolateral prefrontal cortex correlated with skill consolidation. Additionally, not plasticity of individual brain structures, but plasticity in a widespread neural network is important for visuomotor skill acquisition and consolidation. In summary, EEG-derived spectral measures but especially functional connectivity can provide insights into neural adaptations associated with unilateral motor learning.

SUTTER INSTRUMENT

AMPLIFIERS
The latest addition to our expanding line is the **Double IPA®**, a dual headstage integrated patch clamp amplifier with onboard D/A conversion and data acquisition via high-speed USB, along with **SutterPatch™**, a comprehensive software package built on the foundation of Igor 7. Best suited for whole-cell patch clamp recordings and optimized to enable the experimenter to set up and perform routine tasks quickly, yet highly configurable to meet the demands of the experienced electrophysiologist.

MICROMANIPULATION
Continuing to build on our extensive line of micromanipulators, we introduce the **TRIO**, a highly-stable 3-axis manipulator system with synthetic 4th axis that can be set in software as any angle between 0 and 90 degrees for diagonal movement. The compact design of the integrated Rotary Optical Encoder (ROE) controller requires minimal bench space.
Quality. Precision. Reliability.

OPTICAL PRODUCTS
Our latest imaging products include the **Lambda 421** Optical Beam Combiner, a newly patented concept for combining separate light sources with different spectra into a single output beam, and **BOB**, a flexible open architecture upright microscope for slice electrophysiology. Other products include high-powered LED, Xenon and plasma light sources, the **MOM** two-photon resonant scanning microscope, wavelength switchers, filter wheels, and the ***SmartShutter®***.

MICROINJECTION
The **XenoWorks®** microinjection system has been designed to meet the needs of a wide variety of applications that require the manipulation of cells and embryonic tissues including ICSI, ES Cell Microinjection, and Adherent Cell Microinjection. Highly responsive movement and excellent ergonomics intuitively link the user with the micropipette, improving yield – saving time and resources.

Precision Instrumentation for the Sciences

ONE DIGITAL DRIVE, NOVATO, CA. 94949 PHONE: 415.883.0128 | FAX: 415.883.0572
EMAIL: INFO@SUTTER.COM | WWW.SUTTER.COM

Session 5, Panel III

Wednesday, May 03 08:00 – 10:15

Presynaptic inhibition for sensory-motor control

Eiman Azim[1], Nikolaos Balaskas[2], Pablo Rudomin[3], Jing Wang[4], Kazuhiko Seki[5], Thomas Jessell[2], Elzbieta Jankowska[6]

[1]Salk Institute for Biological Studies, [2]Columbia University, [3]Centro de Investigación y Estudios Avanzados del IPN, [4]UC San Diego, [5]National Institute of Neuroscience, National Center of Neurology and Psychiatry, [6]University of Gothenburg

Movement and sensory feedback are inextricably intertwined. Defining how the nervous system orchestrates behavior demands an understanding of how feedback reports, modulates and refines motor output. Presynaptic inhibition (PSI) represents a specialized system for the regulation of sensory feedback implemented across diverse species and sensory modalities. The defining feature of PSI is its modulation of transmission at the central terminals of sensory neurons. One of the more compelling reasons for constructing presynaptic inhibitory circuits, in addition to the more prevalent postsynaptic inhibitory constraints, is its target specificity. Axo-axonic inhibition provides an anatomical substrate for selective and modular regulation of discrete feedback channels, enabling flexible tuning of sensory-motor circuit activity. Thus, characterizing the organizational and functional logic of PSI represents a critical step in defining the neural basis of movement. By describing impressive progress in our understanding of PSI across species and behavioral repertoire, this panel will provide insight into how to integrate diverse approaches into a more complete description of motor control. Five speakers were selected for their central contributions to our understanding of PSI and motor systems. Pablo Rudomin will present a historical perspective, a task for which he is uniquely qualified. He will describe his neurophysiological work on the functional organization of the spinal cord, focusing on the detailed exploration of presynaptic control of synaptic efficacy at the central terminals of sensory fibers (reviewed in Rudomin, P., Exp. Brain Res., 2009). Elzbieta Jankowska will discuss her seminal work exploring presynaptic sensory afferent modulation, including recent experiments describing the effects of direct current polarization on PSI in rats and the implications for human motor recovery (Kaczmarek, D et al., J. Physiol., 2017). Jing Wang will describe his work on olfactory processing in Drosophila, addressing how PSI at discrete olfactory channels guides the expression of innate behaviors (Root, C.M. et al., Neuron, 2008). Kazuhiko Seki will discuss the role of PSI at cutaneous sensory inputs in primates during voluntary movement, work that has advanced our understanding of this circuit in behaving mammals (Seki, K. et al., Nat. Neurosci., 2003). Thomas Jessell will discuss his recent work using sophisticated mouse genetic tools to demonstrate that a discrete group of inhibitory spinal interneurons mediates PSI at proprioceptive sensory afferents, modulating feedback gain and ensuring the stability of the limb (Fink A.J. et al., Nature, 2014). Finally, two junior scientists, Eiman Azim and Nikolaos Balaskas, will lead a panel discussion focused on three key themes: 1) How do we extend what we have learned to a more comprehensive description of the role of PSI across sensory modalities? 2) What pathways recruit PSI during behavior, and how can this recruitment be tuned to ensure flexible behavioral output? 3) What lessons can PSI teach us about strategies to emphasize (and avoid) as we bridge seemingly disparate conceptual and methodological approaches in the motor field?

Session 6, Panel IV

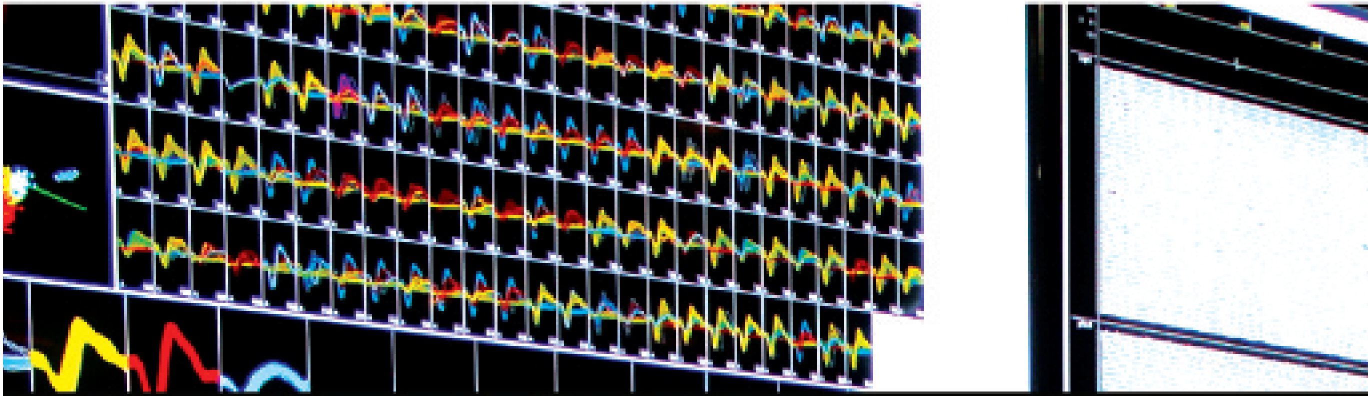
Wednesday, May 3 10:45 - 13:00

Error, energy and reward: what drives sensorimotor adaptation?

Timothy Carroll[1], Max Donelan[2], Alaa Ahmed[3], Li-Ann Leow[1], Joe Galea[4]

[1]The University of Queensland, [2]Simon Fraser University, [3]The University of Colorado, [4]The University of Birmingham

Control of movement is hard because the states of our bodies and the world are never the same from one action to the next. Thus, effective control requires that we continually adapt the neural systems that translate sensory information into motor commands. But what internal signals drive adaptation, and how do these interact to determine behaviour? We address this issue through the lens of three questions that the brain might consider after each action: 1) How rewarding was the movement outcome? Future actions are strongly influenced by whether or not past goals were achieved, and the value of success or failure. 2) Did the movement proceed as predicted? The CNS appears to invariably correct discrepancies between expected and perceived sensory consequences of motor commands, irrespective of task success. 3) How much effort was expended? Our movements tend to be highly economical, implying that the brain might seek to minimise energy expenditure when the state of the body or the world changes. Here we identify inter-relationships between reward, error correction and energy cost in sensorimotor adaptation via behavioural, computational and pharmacological approaches. DONELAN uses a novel exoskeleton for closed-loop manipulation of energy costs in walking. This perturbs the relation between motor commands and sensory feedback, but does not cause task failure. He shows that humans appear to rapidly learn a new relationship between step frequency and energy expenditure, but only when exposed to specific regions of a new energy cost landscape. AHMED directly links this work to classical reaching models of adaptation, using computational modelling and objective measures of energetic cost. She shows that humans tolerate increased energy expenditure when movements are perturbed, perhaps as a strategy to restore task success, but gradually reduce energetic cost thereafter. LEOW explores the role of task success as an intrinsic reward signal in sensorimotor adaptation. She uses a novel method that adjusts reach target location online to prevent task failure, but induces a stable perturbation of the relation between motor commands and sensory feedback. The task unmasks reversion to previously successful control policies, driven by sensory-prediction error alone. Thus, recall of successful policies, rather than an active search for economy, might underlie observed energy cost reductions. Finally, GALEA applies pharmacological interventions to explore the role of dopamine during reward-based adaptation. This work emphasises the critical role for dopaminergic reinforcement in adaptation and offers insight into how rewarded sensorimotor states might be encoded in the brain. Discussion points include: Does the brain represent effort as a state variable for sensorimotor control? Is reduction of energetic cost an epiphenomenon, or does it drive the learning process? Does dopaminergic reinforcement underlie sensorimotor memories for economy as well as success?



Session 8, Perspective I

Wednesday, May 3 15:00 - 16:30

Distinct neural circuits for control of movement vs. holding still

Reza Shadmehr[1], Robert Scheidt[2], Yifat Prut[3]

[1]Johns Hopkins School of Medicine, [2]Marquette University, [3]The Hebrew University of Jerusalem

In generating a point to point movement, the brain must do more than produce commands that move the body part from its current location to the new position; it must also produce commands that hold the body part still once it arrives at the new position. For the oculomotor system, these functions are mapped onto two distinct circuits: a pre-motor circuit that specializes in generating the transient neural activity that displaces the eyes, and a "neural integrator" that transforms that transient input into sustained activity that holds the eyes once the transient activity has subsided. Distinct parts of the cerebellum support the adaptive control of these two phases of action: the oculomotor vermis participates in fine-tuning the transient neural signals that move the eyes, monitoring the activity of the pre-motor circuit via efference copy, whereas the floculus participates in controlling the neural signals that hold the eyes, monitoring the activity of the neural integrator. In this presentation, we ask whether this separation of control between moving and holding may be a design principle that is shared with other modalities of motor control. To help answer this question, Shadmehr will consider neurophysiological and psychophysical data in various species during control of head movements, arm movements, and locomotion, focusing on the brainstem, the motor cortex, and the hippocampus, respectively. In support of the dual control hypothesis, Scheidt will present behavioral data derived from healthy humans and those with neurological disorders during arm movements. The review of the data raises the possibility that across movement modalities, circuits that are responsible for moving the body part may be distinct from those that hold the body part still once the movement has ended. Our Discussant will be Yifat Prut, a neurophysiologist interested in the motor system in normal and pathological states.deprivation age.

European Journal of Neuroscience Session

Wednesday, May 3 17:00 - 18:00

Reproducibility, transparent reviews, and the myth of the impact factor

John J Foxe, University of Rochester Medical Center

A primer on publishing registered reports

Andrew Pruszynski, Western University

A new generation of scientists are demanding a much more open and transparent system of scientific review. The European Journal of Neuroscience has moved to a fully open system whereby the names and affiliations of all editors and reviewers that have handled a manuscript, and a full accounting of all stages of the back-and-forth of the review process, are published as supplementary materials to each accepted paper in our pages. We will discuss the first 6 months of our experience with this system, the pros and cons, and the future of open scientific review. There has been considerable hand-wringing and agitation in our scientific community over the so-called "reproducibility crisis" in the life sciences, a crisis partially driven by the extreme pressures to publish in high-ranked journals and fueled by publishing practices that militate against a full detailing of materials, methods and analysis pathways. Journal editors and publishers have a key role to play in ensuring that the science in their pages is both rigorous and reproducible, and this begins with insistence on much more detailed descriptions of methodological and statistical approaches, and a de-emphasis of the latest faddish or glamorous science in favor of solid, rigorous, and appropriately powered studies. The goal of our work should not be to create headlines, but to produce real lasting knowledge. We will discuss approaches to ensuring that this is the case in serious scientific publishing. One such approach has been the introduction of pre-registration or "registered reports". The Registered Reports initiative, now offered at over 40 journals including the European Journal of Neuroscience, attempts to realign current publishing incentives by accepting articles in advance where authors elect to pre-register their study designs. Unlike conventional submissions, Registered Reports are peer-reviewed in two stages, both before and after results are known. Authors first submit an Introduction and Method – before undertaking their research – with the review process assessing the importance of the research question, validity of the hypotheses, and rigor of the proposed methodology. We will discuss the advantages of this approach and refute some of the arguments that are raised against it. Lastly, undoubtedly the main driving force in determining which journals most of us will send our papers to is the journal Impact factor (IF), and no discussion of the quality of a given journal is complete without somebody asking what its IF is. We will discuss this dangerous force in our midst, the fact that the IF bears almost no relationship to the quality of any given paper, and why it must be rejected flatly by all serious scientists.

Session 9, Individual Presentations II

Thursday, May 04 8:00 – 9:40

Representation of visuomotor delay with current state information

Guy Avraham[1], Raz Leib[1], Assaf Pressman[1], Lucia Simo[2], Amir Karniel[1], Lior Shmuelof[1], Ferdinando Mussa-Ivaldi[2], Ilana Nisky[1]

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

Time representation is important for sensory integration, and for movement planning and execution. Sensory signals are characterized by different transmission delays, and both movement planning and execution require additional processing time. Therefore, to enable animal's survival, the brain must take these delays into consideration. Here, we examine how the sensorimotor system represents a visuomotor delay. Participants played a pong game in which the paddle was delayed with respect to the movement of the hand. A Time Representation of the delay is an estimation of the hand and paddle locations, as well as the time lag between hand and paddle movements. A State Representation is a representation of delay using current state variables. There are different alternative state representations: the lag may be attributed to a mechanical resistance that influences paddle's movement - inertia, viscosity, and stiffness; the distance between the paddle and the ball originating from the delay may be attributed to a spatial shift; and the low sensitivity in the response of the paddle may be attributed to a minifying gain. Unlike Time Representation, a State Representation may influence the movement of the hand in transfer to other contexts. To investigate the way participants represent the experienced dynamics between the hand and the delayed paddle, we performed a set of experiments in which we examined transfer of the delay effects to blind reaching and blind tracking tasks that required movements without visual feedback. We found that the effects of a prolonged exposure to the delayed feedback cause participants to exhibit hypermetric movements in transfer to the both reaching and tracking tasks. Comparison of the results from these experiments to simulations of the abovementioned representations suggests that a State-based rather than a Time-based Representation of the delay is used, and that the delayed dynamics are not represented as a spatial shift. Understanding delay representation is critical for understanding the fundamental constructs of motor control: forward models and sensory integration. Our results suggest that, to overcome inherent feedback delays, the sensorimotor system utilizes information about the current state, rather than measures the actual time lag.


REVEAL THE
NEURAL CONTROL
OF MUSCLES

Vestibular prosthetic stimulation induces plasticity within vestibular reflex pathways that guides changes in motor performance

Diana Mitchell[1], Charles Della Santina[2], Kathleen Cullen[1]

[1]McGill University, [2]Johns Hopkins University

Whether it is the generation of a simple reflex behavior or an elaborate gymnastic routine, the vestibular system is an important sensory modality that is continually engaged as we go about our everyday activities. The important role that the vestibular system plays during everyday life becomes all too apparent for patients with severe vestibular dysfunction, who suffer from encumbering symptoms such as blurred vision, postural instability and vertigo. Although some patients do learn to compensate for their injury, there is no adequate treatment option for those who cannot. Vestibular prosthetic devices transmit head motion information to the brain, bypassing the damaged vestibular periphery through electrical stimulation of the vestibular nerve, and could provide a treatment option for patients enduring symptoms associated with vestibular loss. To date, our knowledge of how the brain responds and adapts to the stimulation delivered by these devices is limited. In order to link changes in neuronal activity with changes in motor performance, we recorded eye and head movements driven by the vestibulo-ocular reflex (VOR) and vestibulo-spinal reflexes, respectively, as well as the activity of neurons that drive these reflexes during prosthetic stimulation. Responses of neurons in direct VOR and vestibulo-spinal pathways were decreased following behaviorally relevant patterns of vestibular nerve activation in awake behaving animals. Specifically, stimulation of the vestibular nerve resulted in decrease in the monosynaptic response of first-order central neurons, whereas the response of their afferent input remained unchanged. These findings suggest that activation of the vestibular nerve results in a decreased efficacy of the synapse between vestibular afferents and first-order central neurons (i.e. long term depression (LTD)). The attenuation of these reflex pathways was sufficient to cause a reduction in evoked VOR and vestibulo-spinal reflex responses. Interestingly, we found evidence of nearly instantaneous complementary changes in the strength of indirect inhibitory brainstem pathways, which worked to offset the reduced sensitivity of first-order central neurons. Therefore, rapid plasticity at the first central vestibular synapse can fine-tune motor performance, while complementary plasticity within indirect inhibitory brainstem pathways ultimately contributes to ensuring a robust behavioral output. Taken together, these findings provide evidence that vestibular prosthetic stimulation induces LTD at the synapse between vestibular afferents and first-order central neurons. Fortunately, our results also reveal that changes at this synapse induced by stimulation are offset by the complementary enhancement of local inhibitory pathways within the vestibular nuclei that contribute to ensuring a relatively robust behavioral performance.

Visual processing for saccades in rostral premotor cortex compared with frontal eye field

Jeffrey Schall[1], Joshua Cosman[1], Kaleb Lowe[1], Michelle Schall[1], Wolf Zinke[1]

[1]Vanderbilt University

Guided by structural MRI, neural recordings were done in three monkeys (M. radiata) in the posterior and anterior bank at the genu of the arcuate sulcus, in agranular premotor cortex (area 6) and granular prefrontal cortex (area 8/FEF) while they earned fluid reward for making saccades to a remembered location or to a singleton target in a visual search display. Neurons were classified in three ways. One was the standard characterization of visual, visuomovement, and movement activity. The other two methods were based on hierarchical cluster analysis of spike shape or of response modulation patterns. Overall, the response characteristics of the premotor neurons were comparable to those of FEF neurons, and both regions showed similar proportions of target-selective neurons. We found similar proportions of standard neuron types in both areas, with slightly more visual neurons in the premotor area and more visuomovement neurons in FEF. We observed less transient visual responses and stronger pre-saccadic response in FEF as compared to premotor neurons. Both areas showed similar response latencies and predominantly contralateral receptive and movement fields. Results of the hierarchical clustering also demonstrate that the traditional functional categories underestimate the diversity of functional categories of FEF and premotor neurons. The independent classification of spike shape and response modulation revealed new relationships between putative anatomical neuron types and functional neuron types. Previous research located this region dorsal to the arcuate spur, but not all macaques express a clear spur. Therefore, we investigated the incidence of an arcuate spur in >200 hemispheres obtained from anatomical observations, MR images, and figures from the literature from 4 macaque species. In ~1/3 of both left and right hemispheres a large spur was present, another 1/3 exhibited a small spur, and the remaining 1/3 exhibited no spur. In ~2/3 of hemispheres the spur was symmetric across both hemispheres. Spur prevalence was similar in females and males; it was most common in M. mulatta and M. nemestrina, slightly less common in M. radiata and least common in M. fascicularis. Our findings demonstrate contributions of rostral premotor cortex to visual processing for saccade target selection, show the variety of biophysical and functional categories of neurons, and highlight the variation of cortical sulcal patterns that has unknown functional implications. Based on our finding of a region in the rostral premotor cortex with functional similarity to FEF we entertain the hypothesis that the region in the human superior precentral sulcus that commonly is identified as FEF may in fact be a premotor eye field, and that another location in the ventral precentral sulcus that sometimes is identified as ventral FEF may be the homologue to the macaque FEF. (Supported by R01-EY08890, R01 EY01988, P30-EY08126, and the Ingram Chair in Neuroscience).

Simultaneous recording from 96 extracellular electrodes in thalamus and basal ganglia of awake children during evaluation for deep-brain stimulation surgery for secondary dystonia

Terence Sanger[1]

[1]USC

Introduction: The optimal target for deep brain stimulation (DBS) in children with secondary dystonia is not known, and it is likely that the best target may vary depending on the etiology and anatomic distribution of injury in each child. In order to identify the correct target, we record for one week from multiple contacts in basal ganglia and thalamus. Methods: We present 5 cases of a new technique for determining optimal neuro-anatomical targets. Up to 10 depth electrodes are implanted in each child in multiple brain regions, including subthalamic nucleus (STN), internal globus pallidus (GPi), ventrolateral nucleus of the thalamus (VL), ventral intermediate nucleus of the thalamus (Vim), and ventroposterolateral nucleus of the thalamus (VPL). Each electrode has up to 10 high-impedance ?micro? contacts capable of identifying single unit firing, and 6 ?macro? contacts capable of identifying local field potentials and through which test stimulation can be performed. Awake children are monitored for up to 1 week in the epilepsy monitoring unit with continuous and simultaneous recording from 96 contacts. Results: No single consistent pattern of abnormality was found. Most often, single-unit recording showed high firing rates that were poorly localized in GPi, and activity correlated with dystonic movement could be found in VL or Vim. When awake and at rest, most areas showed very low firing rates. Activity in Gpi and STN correlated most closely with contralateral EMG, but lower levels of activity at differing delays were also seen in thalamic nuclei. The optimal stimulation target varied between children, in some cases with rapid improvement of dystonic postures during stimulation in either VL, Vim, or VPL. In agreement with the known clinical effect of pallidal stimulation, stimulation in GPi did not produce an effect during the recording period. Based on the recording and stimulation results, 4 of the children were implanted with up to 4 permanent stimulation leads connected to implanted pulse generators. Clinically optimal stimulation sites corresponded to regions in which activity correlated with dystonic EMG. Conclusions: In contrast with prior recordings in animals and adult humans, activity is highly correlated with movement (voluntary or involuntary) and is very low at baseline. This may reflect the fact that we place electrodes under general anesthesia, and thus we cannot select locations near actively-firing cells. If this is the case, it suggests that our results provide a more unbiased sample of basal ganglia and thalamic activity, in which relaxation corresponds to low firing rates. We found that patterns of activity associated with dystonic contractions differ between children. Since effective stimulation targets also differ, this likely reflects the varied neuroanatomic causes of this disorder and suggests that any computational model of dystonia must allow for multiple patterns of abnormal network activity.

Association of BDNF and dopaminergic polymorphisms with cognitive and sensorimotor functions in older adults

Kathleen Hupfeld[1], Rachael Seidler[1]

[1]University of Michigan

The declines in cognitive and motor abilities that occur with aging can severely limit an individual s independence. Various Brain Derived Neurotrophic Factor (BDNF) and dopaminergic genetic polymorphisms have been associated with individual differences in cognitive and motor performance across the lifespan, although much of this research has focused on cognitive measures in older adults. For this study, we examined five single nucleotide polymorphisms (SNPs) involved in dopaminergic metabolism: BDNF (Val66Met), which is involved in neuroplasticity, and four genetic variants directly involved in dopamine signaling--Catechol-O-Methyl Transferase (COMT Val158Met), Dopamine D3 Receptor (DRD3 Ser9Gly), Dopamine Beta-Hydroxylase (DBH rs1108580, A>G), and DBH (rs1611115, C>T). We analyzed data from the Health and Retirement Study (HRS), a representative longitudinal study of Americans ages 50 and older. The HRS is sponsored by the National Institute on Aging (grant number NIA U01AG009740) and is conducted by the University of Michigan. We analyzed data from a large sample (N=12,039) of healthy older adults and assessed the relationships between genotype and three cognitive measures (i.e., recall memory, delayed memory, and a subtraction task), as well as three motor measures (i.e., grip strength, balance time for various stances, and a timed walk). By incorporating survey weights, our results provide a representative assessment of the entire U.S. population over age 50. Preliminary results indicate multiple associations between subjects genetic profiles and their cognitive/motor task performance. Interestingly, several SNPs showed age x genotype interactions, indicating that "high performance" alleles differ for young and older adults, perhaps due to interactions with and compensation for age declines in dopaminergic transmission. For example, the oldest adults in our sample (i.e., those over 90 years old) who had the BDNF val/val genotype showed a pronounced decline in timed walk performance, but this effect was not apparent in younger age groups. As the val/val genotype is typically associated with greater BDNF protein activity and enhanced dopamine release/dopaminergic cell survival (as well as superior cognitive/motor task performance), this finding is surprising, but consistent with other studies that have suggested that the influence of BDNF on dopaminergic transmission and consequent task performance might vary across the lifespan. Further analyses will include examining longitudinal data to assess genetic predictors of change over time in cognitive/motor scores. This work has significant implications for better understanding individual differences in behaviors that rely upon dopaminergic pathways and for predicting risk of cognitive and motor decline in older adults

Session 10, Panel V

Thursday, May 4 10:00 - 12:15

From single neurons to neural manifolds: A new framework for understanding neural control of movement

Juan Gallego[1], Emily Oby[2], Surya Ganguli[3], Christian Machens[4] , Marius Pachitariu[5]

[1]Northwestern University, [2]University of Pittsburgh, [3]Stanford University, [4]Champalimaud Foundation, [5]University College London

For many decades, researchers studied brain function by relating the activity of single neurons to behavioral covariates. These studies provided the foundation for systems neuroscience, but with the advent of technologies that record hundreds of neurons we can now directly investigate how neural computations are performed at the population level. These methods require new conceptual frameworks to interpret the results, and to help design experiments that address testable hypotheses. Our panel is focused on one such framework, that of "neural manifolds." At its core is the observation that the activity of a population of neurons typically lies within a low dimensional surface, the neural manifold. This manifold is defined by patterns of correlated activity across neurons, called "neural modes." In this framework, the basic building blocks of neural activity are not individual neurons, but the time-varying activation of the neural modes. This population-centric viewpoint has already uncovered new mechanisms of brain function not observable at the single neuron level. We will use this framework to address many aspects of motor control, from visual processing, through decision making, to motor learning and movement execution. Kenneth Harris will present results from 10,000 cells recorded in mouse visual cortex (V1). He will show that the dimensionality of the manifold in V1 increases dramatically upon visual stimulation, and that this manifold and the spontaneous manifold are almost orthogonal. Christian Machens will talk about the representation of sensory stimuli in monkey prefrontal cortex and its role in decision making. This manifold has lower dimensionality than that in V1, and comprises one set of neural modes that reflect the stimulus, and another that represents the computations related to decision making. Juan Gallego will show that manifolds in motor cortex (M1) are low-dimensional and very similar across different motor tasks. These manifolds are spanned by both task-independent and a few task-specific neural modes. Emily Oby will address the question of how motor learning is constrained by the M1 manifold. Using a brain-computer interface paradigm, she will show how neural activity patterns change to facilitate the learning of control mappings that require new neural modes. Surya Ganguli will present his recent theory of neural dimensionality, which provides a mathematical explanation for why M1 has a remarkably low dimensionality during standard motor tasks. He will also discuss the implications of his theory for data analysis and experiment design. In summary, our panel will show that analysis based on the neural manifold framework holds great promise to further our understanding of the control of movement. We anticipate the panel will foster a lively discussion of the questions raised in our attempt to build a better understanding of brain function based on this population-centric view.

Session 12, Panel VI

Friday, May 05 08:00 - 10:15

Neural control and recovery of hand function

Tadashi Isa[1], Stuart Baker[2], Robert Brownstone[3], Monica Perez[4]

[1]Kyoyo University, [2]Institute of Neuroscience, Newcastle University, [3]University College London, [4]University of Miami

The recovery of hand function after CNS injury likely relies on contributions from multiple pathways that send motor commands to the spinal cord. This session will discuss the relative role of various CNS pathways to hand control in mice, non-human primates, and humans with and without injury and their role and interactions in the recovery of hand function. Dr. Robert Brownstone will review the role of inputs from cutaneous low-threshold mechanoreceptors on grasping behavior in mice. Distinct classes of spinal interneurons involved in the cutaneous control of grasping convey inputs to spinal motoneurons. It will be discussed how the ability to maintain grip strength in response to increasing load is lost after genetic silencing of dI3 interneurons. It is proposed that low-threshold mechanoreceptors are critical for normal motor function and for inducing plasticity in motor microcircuits following injury. Dr. Tadashi Isa will review the contribution from different hierarchical levels in the CNS to recovery of hand dexerity from spinal damage in non-human primates. Propriospinal neurons in the cervical cord contribute to the recovery. The ipsilateral motor cortex has a contribution in the early recovery stage, while the premotor cortex contributes during the late stage. Recent results demonstrate that during recovery, the nucleus accumbens, which regulates motivation-driven effort, is directly involved in the control of finger movements. Based on these data, it is suggested that different pathways make a different contribution to hand dexterity and appearance of hand motor deficits. Dr. Stuart Baker will show anatomical and electrophysiological evidence for changes in descending motor pathway connectivity after corticospinal tract lesion in macaque monkeys. Intracellular recording in anesthetized monkeys show that motoneurons receive monosynaptic and disynaptic reticulospinal inputs, including monosynaptic excitatory connections to motoneurons that innervate intrinsic hand muscles. It is argued that reticulospinal neurons are able to influence upper limb muscle activity after damage to the corticospinal system. Dr. Monica Perez will discuss contributions of the primary motor cortex, the corticospinal and reticulospinal pathway to the control of hand function in intact humans and in patients with chronic incomplete cervical spinal cord injury. Evidence indicate that a preferential recruitment of late synaptic inputs to corticospinal neurons may be achieved when intact humans perform a power grip but this is impaired following spinal cord injury. It is proposed that the contribution of the reticulospinal tract to hand control after spinal cord injury favors gross more than fine dexterous finger manipulations. Understanding the contributions of CNS pathways to hand control is critical for enhancing the efficacy of rehabilitative interventions aiming to promote the recovery of hand function, which highlights the significance of this proposal.

Session 13, Individual Presentations III

Friday, May 5 10:45 – 12:45

Principles underlying feed-forward control of multi-jointed limbs

Vikas Bhandawat[1], Cynthia Hsu[1]

[1]Duke University

The capacity to execute appropriate, fast and precise movements involves complex interaction between an animal's nervous system, its muscle body dynamics and its environment. In my lab, we take advantage of Drosophila as a model system to obtain insights into this problem. Like humans, Drosophila has also solved the problem of integrating multiple streams of information and controlling multi-jointed limbs, but does so with far fewer neurons which makes it an ideal system to understand principles of motor control at the level of single neurons. A central question in motor control is how to organize control of the high-dimensional joint space with "minimum intelligence" is also central to this talk. As a first step to examining this issue, we sought to delineate the role of feedforward and feedback processes in the control of movement. To this end, we compared leg kinematics in the load-free preparation to leg kinematics in a tethered preparation with substrate to leg kinematics during walking. We found that the leg-kinematics within a single-leg was surprisingly conserved across the different preparations: the same 6 movement types (reflecting motor primitives in a qualitative sense) dominate a fly's movement in all preparations. In contrast, inter-leg coordination is completely disrupted in the load-free preparation. This result implies that feedforward signals dominate the control of single legs, while sensoy feedback (likely from load sensors) is essential to inter-leg coordination. Next, we investigated whether the control of single-leg kinematics is dominated by local circuit within the leg or requires descending input. To investigate this issue, we employed genetic tools in the fly to either shut-down descending inputs or to perturb circuit elements, such as sensory feedback, within the leg. We found that perturbing local circuits had subtle (but important) effects on leg kinematics without altering the overall pattern of movement. In contrast, perturbing descending input results in major changes in leg kinematics. We concluded that the entire feed-forward circuit, including the brain and the thoracic ganglia, is essential for the control of the kinematics of a single leg. Next, to investigate the role of descending neurons, we first activated and inactivated single descending neurons. We found that descending neurons exerted their effect at the level of single-legs by changing the probability of engaging a given motor primitive or changing the phase, amplitude or frequency of the same. Finally, we performed recordings from descending neurons (DNs). The activity in these DNs is strongly correlated to the characteristics of movement in a subset of movement-types. Overall, our data suggests that control over multi-jointed limbs can be decomposed into two parts: single limb control which is dominated by feedforward control and sculpted by sensory feedback and inter-leg coordination that is largely feedback.

Dorsal premotor cortex recruits primary motor cortex to compensate for altered dynamics

Matthew Perich[1], Juan Gallego[1], Lee Miller[1]

[1]Northwestern University

The motor system has an impressive ability to learn new skills, a process which has been studied behaviorally by perturbing reaches with a "curl field" (CF), a velocity-dependent force applied orthogonally to the hand. Past studies showed that neurons in primary motor cortex (M1) alter their discharge during CF adaptation, though we have found that these changes occur while the cells actually maintain a fixed relationship with the altered movement dynamics. Consequently, adaptation must be driven by altered recruitment of M1 neurons by upstream areas. Dorsal premotor cortex (PMd) is thought to compute motor plans based on context and sensory inputs and ultimately sends those plans to M1 for execution. We hypothesize that PMd computes new motor plans to alter the recruitment of M1 neurons during CF learning. Intriguing new models of cortical processing suggest that some PMd activity corresponds to commands sent to M1, while some reflects only local computations. Mathematically, these can be formalized as "output-potent" and "output-null" spaces. The potent space represents PMd activity that correlates with M1 and embodies any causal effect of PMd on M1. Since PMd activity in the null space has no direct effect on M1, it can include motor planning computations that are not explicitly sent to M1. If we are correct that PMd recruits new patterns of M1 activity to learn the CF then its null space activity should change progressively with behavioral adaptation. At the same time, the mapping through which PMd transmits these plans to M1 (the potent space) may not necessarily change. We recorded from populations of M1 and PMd neurons with chronically implanted electrode arrays as two monkeys made reaching movements with the CF. We projected PMd activity into the potent and null spaces of M1 using Principle Components Analysis. We trained Poisson Generalized Linear Models (GLMs) to predict the spiking of single M1 neurons from activity in both the potent (PMdP-M1) and null (PMdN-M1) spaces. We also predicted spiking exclusively within each area (M1-M1, PMd-PMd). We trained the GLMs using data after CF behavioral performance had stabilized and evaluated prediction accuracy using pseudo-R-squared (pR2), a standard GLM quality of fit metric. We then asked if the GLMs could continue to predict neural activity during learning. Decreased pR2 indicates the model no longer accurately represents the relationship between a neuron and the population. Across all predicted cells, we found no change in pR2 for M1-M1 or PMd-PMd during learning ($p>0.8$; ANOVA over trials). While PMdP-M1 was similarly unchanged ($p>0.9$), pR2 for null space models (PMdN-M1) decreased ($p<0.01$) with a time course matching that of behavioral adaptation. These results show that M1 recruitment is a result of new motor plans formed within PMd, and illustrate a mechanism for the motor system to learn using population-level computations without changing the relationships within M1 or PMd.

Characterizing percepts evoked via intracortical microstimulation delivered to human somatosensory cortex

Sharlene Flesher[1], Jeffrey Weiss[1], Elizabeth Tyler-Kabara, Sliman Bensmaia[2], Michael Boninger[1], Jennifer Collinger[1], Robert Gaunt[1]

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

Brain-computer interfaces (BCI) have enabled users to achieve high degree-of-freedom control of a prosthesis even though limb state feedback has been limited to information available through vision. In tasks such as object manipulation however, providing tactile sensory feedback could be an important step to improving control as vision provides less salient cues. Intracortical microstimulation (ICMS) of the primary somatosensory cortex (S1) could evoke these tactile percepts. Indeed, we show that ICMS in area 1 of S1 can convey spatially selective tactile percepts that are graded over a range of perceived intensities and may therefore be sufficient for providing cutaneous force feedback. In this study, a twenty-eight year old participant with a chronic C5 motor and C6 sensory spinal cord injury was implanted with two intracortical microelectrode arrays in primary motor cortex and two arrays in S1. The S1 electrode arrays were targeted to the hand region of area 1 in the left hemisphere based on presurgical imaging. The goal was to elicit cutaneous percepts that project to the fingers of the right hand. Over an 18-month period, electrodes were stimulated at supraliminal intensities so that the participant could describe the locations and qualities of the percepts. The projected fields of the electrodes were located in digits 2-5 and were generally at the base of each of those fingers. Sensations were reported from 62 of 64 electrodes, and no painful sensations or paresthesias were reported. We then evaluated the effect of changing pulse amplitude and frequency. We found that perceived intensity was linearly related to pulse amplitude for all tested electrodes. Projected field size, however, had non-linear relationships with both pulse amplitude and frequency, the nature of which varied by electrode. We further characterized the relationship between stimulation parameters and evoked sensations by stimulating in short bursts (200 ms) in an attempt to evoke more naturalistic sensations. On some tested electrodes, short stimulus trains evoked sensations of being tapped several times in rapid succession. When static pulse trains were delivered to the same electrodes, the non-modulated pulse trains were reported to feel very dissimilar to the modulated pulse trains. Other tested electrodes were reported to feel the same as non-modulated pulse trains but in short bursts rather than long, continuous sensations. The finding that perceived intensity but not projected field size monotonically increases with pulse amplitude suggests that ICMS feedback can relay a range of intensities without sacrificing the spatial selectivity that makes it such an attractive source for providing tactile feedback. A more thorough exploration of parameter space and characterization of evoked sensations is needed to restore naturalistic feedback. This restoration of feedback could improve the BCI user’s control and experience with the prosthetic device.

Coding of hand postures and movements in somatosensory cortex

Sliman Bensmaia[1], James Goodman[1], Gregg Tabot[1], Aneesha Suresh[1], Nicholas Hatsopoulos[1]

[1]University of Chicago

Despite the remarkable complexity of the hands, we are able to use them effortlessly to grasp and manipulate objects. To achieve dexterous object manipulation requires not only a sophisticated motor system to move the hand but also a sensory system to provide feedback on the consequences of those movements. Although proprioceptive representations of the proximal forelimbs in somatosensory cortex have received some experimental attention, little is known about the corresponding representations of the hands. Proprioceptive representations of the hand likely differ from their proximal limb counterparts because the proximal limb and the hand play different roles: The proximal limb places the hand somewhere in three dimensional space whereas the hand is specialized to interact with objects, which requires that it assume precise time-varying configurations. To investigate hand proprioception in cortex, we simultaneously recorded time-varying joint kinematics of the hand - measured using a camera-based motion tracking system - and neural activity from primary somatosensory cortex (S1) of rhesus macaques - using chronically implanted electrode arrays - as the animals performed a wide range of natural grasping movements. We also recorded from primary motor cortex (M1) to compare sensory and motor representations of the hand. We found that individual S1 neurons encode the posture and movement of the hand distributed over multiple joints spanning the entire hand. We then assessed whether these multi-joint receptive fields follow canonical postural synergies (identified through principal component analysis of the kinematics) and found no relationship between proprioceptive fields and kinematic synergies. Finally, we observed that representations of the hand in S1 are very similar to those in M1. The proprioceptive response properties of cortical neurons are consistent with the hypothesis that sensorimotor cortices represent whole-hand configurations and movements rather than individual joints or digits. Furthermore, the resulting manifold on which hand representations lie is more complex than that implied by a common interpretation of the postural synergies hypothesis.

Subcortical LFPs as an assistive control signal for Brain Machine Interfaces

Huiling Tan[1], Petra Fischer[1], Syed Shah[1], Peter Brown[1]

[1]University of Oxford

Brain machine interfaces (BMIs) have great potential in restoring movement/function through decoding brain signals and using the decoded information to drive external devices. However, most existing BMI systems are limited by relying on neuronal spikes and decoding is limited to kinematics only. No human BMI user has yet achieved force control of a robotic hand. We aim to investigate whether subcortical local field potentials can provide an assistive control signal for gripping force for BMIs, to allow for long-term stability and more natural prosthetic control. The basal ganglia, especially the subthalamic nucleus (STN) and globus pallidus interna (GPi), are known to be involved in the planning, execution and controlling of gripping force. Previous work from our group has shown that frequency specific activities in the local field potentials (LFPs) recorded from these structures scale with both the amplitude and speed of gripping force. In particular, we found that a first order dynamic linear model with STN LFP activities in the gamma (55-90 Hz) and beta (13-30 Hz) bands as inputs can be used to decode the temporal profile of gripping force on individual trial basis. In a more recent study, we recorded LFPs in Parkinson's disease patients and investigated if similar changes can be observed during imagined gripping at different 'forces'. We found that STN LFP activity was modulated by the intended force in imaginary gripping, suggesting that the STN LFP carries information about intended force generation even in the absence of actual muscle activity or movement-related peripheral proprioceptive feedback. The results suggest that similar spectral reactivity might be retained within the STN in patients who cannot move and thus receive no movement-related sensory feedback. Meanwhile, we have tested a Wiener-Cascade (WC) model based decoder incorporating both time-domain and frequency-domain features from LFPs recorded from the STN in human subjects. This demonstrates that gripping force can be decoded on a continuous basis at short latency. This series of studies provides proof of concept for using deep brain local field potentials for more refined BMI control. They also lay the foundation for future studies in which we plan to use the proposed methods to decode force in real-time based on LFP signals recorded from the STN in patients. This is likely to have significant implications for developing BCI systems allowing more fine-tuning of outputs, with extra assistive information from deep brain structures.

Neural limits in tracking high bandwidth movements

Shreya Saxena[1], Sridevi Sarma[2], Munther Dahleh[1]

[1]Massachusetts Institute of Technology, [2]Johns Hopkins University

The generation of high bandwidth movements during sensorimotor control is fundamentally limited by the number of neurons devoted to the task, their ability to transfer information about the intended movements, and the dynamics of muscles involved. Yet, these factors and corresponding tradeoffs have not been quantified rigorously. In this study, we use feedback control principles to identify limitations in the ability of the sensorimotor control system to track intended fast movements. We begin with a simple closed-loop model in which N integrate-and-fire neurons actuate a combination of agonist and antagonistic muscles under visual and proprioceptive feedback. The input to the motor system is assumed to be a sinusoidal signal which conceptually characterizes the motor intent stimulus likely generated in parietal regions during back-and-forth movements. The frequency of this sinusoidal signal captures the speed of the intended movement. The intended movement signal is fed into N neurons which innervate a muscle model, the output of which is considered to be the trajectory generated by the muscle. We identify undesirable phenomena at the output if the sinusoidal is above a certain frequency, i.e., subharmonic oscillations appearing in the output for sinusoidal inputs. This translates to the output 'skipping' cycles during the back-and-forth movement. Using tools in signal processing and nonlinear control theory, we analyze the fundamental limits of this feedback loop. We first identify an effective pair of integrate-and-fire neurons that capture the effect of the N neurons. For this pair of neurons, we then derive explicit conditions on the neurons' ability to transfer information about the input, as well as the neuron and muscle dynamics under which the undesirable phenomena may exist. The maximum attainable frequency depends on the muscle and feedback dynamics, as well as N and the neuronal dynamics. We build upon new theory developed using feedback control principles and an appropriately simplified model of the sensorimotor control system to identify how number of neurons, neural dynamics, delays, muscles and feedback may interact during the generation of fast movements. Therefore if one component is compromised, we can take advantage of the other components to restore motor performance with an assistive neuroprosthetic device. This work has applications for helping stroke patients with corticospinal tract injuries who can no longer move quickly, as well as in the performance of Brain Machine Interfaces for prosthetic devices.

Session 15, Tutorial

Friday, May 5   14:45 - 16:45

What can mobile brain imaging with electroencephalography tell us about the neural control of movement?

Daniel Ferris[1], Johanna Wagner[3], Klaus Gramann[4]

[1]University of Michigan, [3]University of California, San Diego, [4]Berlin Institute of Technology

Recent advances in EEG hardware and signal processing now allow researchers to study electrocortical dynamics during human walking and running. In addition to investigating the neural control of locomotion, there are many natural motor behaviors that occur during locomotion requiring subjects to be mobile during experiments. These include cognitive-motor dual tasks like texting on a smartphone while walking, adapting gait to avoid obstacles, and maintaining dynamic balance to perturbations. Other cognitive-motor tasks are inherently embedded within locomotion such as navigation. The last six years have seen a rapid increase in the number of published research studies using EEG to study these types of locomotor tasks. The approach is likely to spread amongst the research community as relevant hardware and software improves. However, there are distinct technical challenges to recording reliable EEG during walking and running that make it difficult for a novice laboratory to adopt the technique. This panel will present valuable information about the technical approaches to using scalp EEG to study brain dynamics during human walking and running, and discuss new solutions to overcome remaining challenges. The panel will also discuss how EEG has provided unique insight into the neural control of dynamic balance for both self-induced and external perturbations and how humans prepare and control corrective motor adjustments during walking. The addition of virtual reality to mobile EEG experiments has been valuable in providing novel sensory experiences to the subjects, and allows researchers to investigate specific cause-effect relationships for electrocortical activity and human movement. Lastly, the panel will include discussions of how combined whole body motion capture and mobile brain imaging provides new appreciation of how the brain manages to control the body and navigate in new environments. Audience members will leave the panel discussion with important information about how they can add mobile EEG to their laboratory repertoire in future research studies on the neural control of movement.

Session 16, Keynote on next page

Session 16, KEYNOTE

Friday, May 5 16:45 - 18:00

Primate specific features of corticospinal control

Roger Lemon, University College London

Although the corticospinal tract is a feature of all mammalian brains, there are major species differences in the organisation of the corticospinal (CS) projection, and these are reflected in the different functions mediated by the CS tract.

I will discuss various interrelated CS features, all of which impact on its function. First, the **size distribution** of CS fibres. The non-human primate exhibits a similar CS fibre size spectrum to that of the human: there is a small but significant population of large, fast-conducting (> 50m/s) fibres. These fast fibres are not found in the rodent CS. Fast-conducting fibres might reflect activity levels in CS fibres, but are more likely important in reducing conduction delays in large-bodied primates. For technical reasons, most of our neurophysiological knowledge of the primate CS system is confined to this fast-conducting population. In the macaque this amounts to only 3% of the total number of fibres in the pyramidal tract, but this still represents some 18,000 fibres. A definitive role or roles for the much more numerous population of very thin fibres (axon diameter 1 μm or less) has yet to be found.

Second, the **duration of CS action potentials**. When recording from identified CS neurons in macaque motor cortex, activity is dominated by action potentials from large CS neurons. Most of these neurons (~80 %) have very brief spikes (<400 μs), with some as short as 150-200 μs. Brief spikes are also found in other M1 pyramidal neurons with projections to different subcortical targets. This is in contrast to the rodent motor cortex, where pyramidal neurons have much broader spikes (typically around 900 μs).

Third, I will consider **membrane expression of the Kv3.1a K+ channel protein**. Kv3.1a is rarely found in rat pyramidal neurons, while in the macaque most of these neurons show very clear expression. Since Kv3.1a channels likely contribute to the rapid repolarisation of the action potential, this is consistent with brief spike durations in monkey pyramidal neurons.

The final feature I shall discuss is the presence of CS fibres with **direct cortico-motoneuronal (CM) connections**. These are found in all dexterous primates, and are particularly well developed in humans. They are not present in rodents and carnivores. The monkey CM system is particularly active during dexterous movements, including tool use, while damage to the CS system has devastating immediate effects on skilled hand use. Although we do not know the exact proportion of the CS system that gives rise to CM connections, recent quantitative anatomical studies suggest that CM projections to motoneuron pools are numerous and amount to around one-third of the projections to the spinal intermediate zone. Clinically this system may be important in stroke and spinal injury, while in amyotrophic lateral sclerosis (ALS), the pattern of muscle weakness and wasting closely follows the distribution of CM projections, confirming that ALS is a primate specific disease that may spread through CM connections.

I will discuss how models of motor control might take into account these important features of the CS system.

Notes

NCM Scholarship Winners 2017

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.

Ashesh Dhawale
Harvard University

I did my PhD with Upinder Bhalla at NCBS in Bangalore, India, studying sensory coding in the olfactory bulb and associative learning in the hippocampus. I'm now a postdoc with Bence Olveczky, investigating the role of the basal ganglia in motor sequence learning, and the neural basis of motor exploration.

Sharlene Flesher
University of Pittsburgh

Sharlene Flesher is a PhD candidate in the Department of Bioengineering at the University of Pittsburgh. Sharlene received her BS in Computer Engineering from St. Mary's University in San Antonio in 2011. Her research interests are in improving brain-computer interfaces to restore arm function by providing somatosensory feedback.

Juan Gallego
Northwestern University

Juan A. Gallego is a Marie Currie postdoctoral Fellow at Northwestern University, where he studies how populations of neurons in motor cortex cause behavior, and develops neuroprostheses to restore movement. He is also interested in the neural mechanisms of tremor and in the use of engineering techniques to drive neural plasticity and induce motor recovery.

Robert Hardwick
Johns Hopkins University

Robert Hardwick is a postdoctoral research fellow at Johns Hopkins University. His research focuses on understanding how different parts of the brain contribute to motor learning, on enhancing motor function using non-invasive brain stimulation, and on addressing the deficits in movement control that result from aging and stroke.

Li-Ann Leow
University of Queensland

Li-Ann Leow, postdoctoral research fellow at the University of Queensland, has previously shown how classical markers of retention (savings, anterograde interference) are affected by dopaminergic deficits, and how savings require a memory of errors, not a memory of successful actions. Here, Li-Ann will highlight how task success influence adaptation behaviour.

Diana Mitchell
McGill University

I recently completed my Ph.D. in Kathleen Cullen's laboratory at McGill University. My research focused on how neurons in vestibulo-ocular and vestibulo-spinal reflex circuits respond to vestibular prosthetic stimulation. These results, linking plasticity at different neural sites with changes in motor performance, will further the development of treatment options for vestibular patients.

Emily Oby
University of Pittsburgh

I earned my PhD in the lab of Lee Miller (Northwestern University) where I used brain-computer interfaces to answer basic science questions about the neural control of movement. As a post-doc in the lab of Aaron Batista (University of Pittsburgh), I use a similar approach to study motor learning.

Matthew Perich
Northwestern University

Matt Perich is a PhD candidate in the lab of Dr. Lee Miller at Northwestern University. He is interested in motor control and mechanisms of neural computation, especially for neuroprosthetic applications. Currently, he studies how populations of neurons in the motor cortices coordinate to drive behavior during motor learning.

Shreya Saxena
Massachusetts Institute of Technology

Shreya Saxena received her B.S. degree in Mechanical Engineering from EPFL, Switzerland in 2009; and her M.Sc. in Biomedical Engineering from Johns Hopkins University in 2011. She is currently a Ph.D. candidate in Electrical Engineering at Massachusetts Institute of Technology. Her research interests include neural signal processing and sensorimotor control.

Menno Veldman
University of Groningen

Menno Veldman is PhD candidate at the University of Groningen interested in the neural mechanisms underlying motor learning, and examines these using electrophysiological techniques. As a human movement scientist, the translation of fundamental knowledge concerning motor learning to the rehabilitation of patients suffering from neurological disorders is his ultimate goal.

Johanna Wagner
University of California San Diego

Johanna Wagner is a postdoc at the Psychology Department at the University of California San Diego, USA. After studying Psychology (M.Sc.), she received her Ph.D in Computer Science from Graz University of Technology, Austria. She is working on the electrocortical dynamics of gait and motor stopping.

Poster Author Index | By Author Name

All posters will be located in the Fitzwilliam Suites and Landsdowne Room

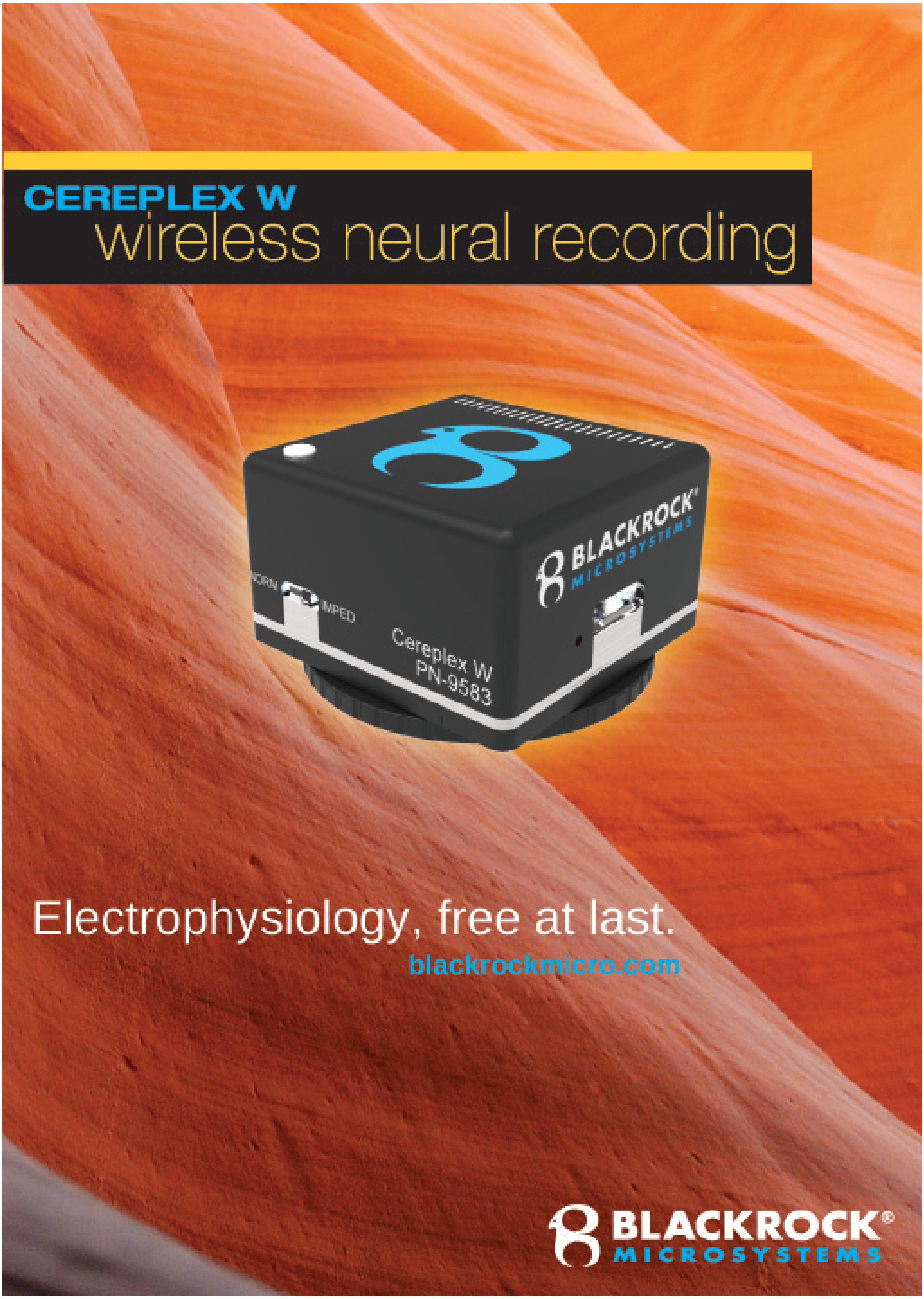
Session 1:	Tuesday May 2:	08:00 – 17:00
	Wednesday May 3:	08:00 – 17:00
Session 2:	Thursday May 4:	08:00 – 14:15
	Friday May 5:	08:00 – 14:45

The poster board numbers work in the following way:
Session – Theme – Board Number (Eg. 2-A-43)

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

Author	Poster No.
‘t Hart, B	2-F-88, 2-F-86
Abbott, L	2-B-8
Abdulkarim, Z	1-D-53
Abe, T	1-F-91
Afschrift, M	1-C-42
Agudelo-Toro, A	1-B-39, 1-G-135
Aguiar, S	2-B-9
Ahmad, S	2-G-126
Ahmed, A	1-G-126
Al-Loos, R	1-B-16
Alayrangues, J	1-F-105, 2-F-90
Albaghdadi, M	1-F-95
Albert, S	2-G-127
Alessandro, C	2-D-69
Alessandro, F	1-F-86
Alter, K	2-D-68
Amano, S	1-E-72
Ames, K	2-B-7
Andersen, K	2-C-41
Anderson, J	2-E-73
Andersson, B	2-G-135
Andrew, D	1-F-99, 1-F-110
Angelaki, D	1-B-19
Ansaldo, A	2-B-31
Antoine, M	2-C-44
Applegate, M	2-B-33
Arikan, B	2-D-70
Arpinar-Avsar, P	2-C-42
Arslan, Y	2-C-42
Astill, S	1-B-36
Asturias, A	2-F-124
Aucie, Y	1-F-120
Averbeck, B	1-E-83
Avraham, C	1-B-11
Avraham, G	1-B-11
Baarbé, J	2-F-111
Babikian, S	1-B-12
Baker, C	2-F-121
Baker, R	2-C-50
Baker, S	1-B-21, 2-B-9
Bakker, R	2-D-5
Bakkum, A	1-F-109
Ballard, D	2-C-46
Balsters, J	1-B-30, 1-B-37
Barany, D	2-B-23
Barbiero, M	1-F-111
Barnes, G	2-B-19
Barnes, J	1-D-70
Barnhoorn, J	1-B-6, 1-B-7, 1-B-9
Barroso, F	2-D-69
Bastian, A	2-C-39, 2-C-40
Baugh, L	2-B-14
Bede, P	1-E-81
Bekius, A	2-C-45
Bells, S	1-A-1
Bendall, R	1-F-121
Benoit, C	2-E-74
Bensmaia, S	2-G-133
Bernier, P	2-D-60
Berniker, M	1-G-127, 2-F-115
Berret, B	1-B-19, 1-C-49, 2-G-128
Bestmann, S	1-G-129
Billino, J	2-F-100
Birch, D	1-E-84
Bittner, S	2-B-8
Blazevich, A	2-F-116
Block, H	2-F-85
Bloomberg, J	1-F-125, 2-F-94, 2-F-105
Blouin, J	2-D-56
Blum, K	1-B-13
Boisgontier, M	1-C-43
Bonato, P	2-F-119
Borish, C	1-E-72
Bosch, T	2-B-14
Bostan, A	1-D-54
Bostan, S	2-A-1
Botzheim, L	1-G-134
Bourdin, C	2-F-91
Bouyer, L	1-B-31
Boyer, E	2-F-117
Bozzacchi, C	1-B-14
Brandes, J	1-D-59
Bravi, R	1-G-128
Breault, M	2-B-142
Brenner, C	2-B-14
Brenner, E	1-C-52, 2-B-89, 2-F-122
Brette, R	1-C-47, 2-F-104
Brien, D	1-A-1
Broderick, M	1-E-81
Brown, P	2-B-25
Bruening, G	1-G-126
Brun, C	1-D-55, 1-F-93, 2-F-92
Brunfeldt, A	2-F-102
Burgess, N	2-B-19
Bush, D	2-B-19
Bächinger, M	1-B-30
Bévilacqua, F	2-F-117
Camponogara, I	1-D-56
Cardinali, L	1-F-90
Carlsen, A	1-B-29
Carroll, T	1-F-112, 1-F-116
Carter, M	2-B-10
Casadio, M	1-D-69
Cashaback, J	2-F-93
Cassady, K	2-F-94
Castagnola, E	2-B-31
Castanier, C	2-G-128
Cattaert, D	2-D-66, 2-F-95, 2-G-134
Ceccarelli, F	2-B-29
Celik, H	2-C-42
Cesonis, J	2-G-129
Cesqui, B	1-B-15, 2-B-29
Chakrabarty, S	1-B-36
Chalavi, S	1-C-43
Chambers, C	2-G-130
Chan, J	1-F-96
Chase, S	1-F-106
Chavet, P	2-C-44
Chen, X	1-G-129
Cheung, B	2-G-131
Cheung, R	1-E-75, 2-G-131
Cheung, V	1-E-75, 2-F-119, 2-G-131

Poster Author Index | By Author Name


CEREPLEX W
wireless neural recording
NORM
IMPED
Cereplex W
PN-9583
BLACKROCK
MICROSYSTEMS
Electrophysiology, free at last.
blackrockmicro.com
BLACKROCK®
MICROSYSTEMS

Poster Sessions | Authors, Titles and Affiliations

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.

Poster Session 1

Tuesday May 2 & Wednesday May 3 8:00 – 17:00

Poster Session 2

Thursday May 4 & Friday May 5
Thursday 8:00 – 14:15
Friday 8:00 – 14:45

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 & Gait
D – Integrative Control of Movement
E – Disorders of Motor Control
F – Adaptation & Plasticity in Motor Control
G – Theoretical & Computational Motor Control

Poster Session 1

Tuesday May 2 & Wednesday May 3

Posters are listed by theme.

A - Control of Eye & Head Movement

1-A-1 The role of cortical oscillations in preparation and execution of anti- and pro-saccades

Sonya Bells[1], Silvia Isabella[1], Donald Mabbott[1], Donald Brien[2], Douglas Munoz[2], Douglas Cheyne[1]

[1]The Hospital for Sick Children Research Institute, [2]Centre for Neuroscience Studies Queen University

1-A-2 Timing of cortical activation related to an attention-mediated delayed saccade task

Wendy Huddleston[1], Nicole Recka[1], Nicholas Wohkittel[1]

[1]University of Wisconsin - Milwaukee

1-A-3 Gaze-dependent updating of somatosensory reach targets after eye movements in depth

Stefanie Mueller[1], Katja Fiehler[1]

[1]Giessen University

1-A-4 Vestibular prosthesis responses are consistent with canal - otolith convergence.

James Phillips[1], Leo Ling[1], Christopher Phillips[1], Amy Nowack[1], Kaibao Nie[1], Jay Rubinstein[1]

[1]University of Washington

1-A-5 Superior Colliculus Encodes Instantaneous Saccade Velocity

Ivan Smalianchuk[1], Uday Jagadisan[1], Neeraj Gandhi[1]

[1]University of Pittsburgh

B – Fundamentals of Motor Control

POSTER CLUSTER (1-B-6 to 1-B-10)

1-B-6 Non-invasive brain stimulation improves motor learning in healthy older adults

Jonathan Barnhoorn[1], Edwin van Asseldonk[1], Brian Greeley[2], Willem Verwey[1]

[1]University of Twente, [2]University of Michigan

1-B-7 Multi-session transcranial direct current simulation during motor sequence learning in young and older adults

Brian Greeley[1], Jonathan Barnhoorn[2], Willem Verwey[2], Rachael Seidler[1]

[1]University of Michigan, [2]University of Twente

1-B-8 Does a bout of acute exercise facilitate fine motor learning in older adults?

Lena Hübner[1], Ben Godde[2], Claudia Voelcker-Rehage[1]

[1]Chemnitz University of Technology, [2]Jacobs University Bremen

1-B-9 Overview of the 'motor learning in older adults' (reLoad) project

Willem Verwey[1], Jonathan Barnhoorn[1], Edwin van Asseldonk[1], Stefan Panzer[2], Janine Vieweg[2], Claudia Voelcker-Rehage[3], Lena Huebner[3], Brian Greeley , Rachael Seidler

[1]University of Twente, [2]Universitaet des Saarlandes, [3]Technische Universitaet Chemnitz, University of Michigan

1-B-10 Movement slowing: "The Discovery of Slowness"

Janine Vieweg[1], Stefan Panzer[1]

[1]Saarland University

1-B-11 The effect of adaptation to a hemispace-specific visuomotor delay on the symmetry of drawing

Chen Avraham[1], Guy Avraham[1], Ilana Nisky[1]

[1]Ben-Gurion University of the Negev

1-B-12 Cortical activity predicts good variation in human motor output: experiment and mathematical model

Sarine Babikian[1], Eva Kanso[1], Jason Kutch[1]

[1]University of Southern California

1-B-13 Estimated muscle fiber forces predict history-dependent muscle spindle spike rates

Kyle Blum[1], Paul Nardelli[2], Timothy Cope[2], Lena Ting[1]

[1]Georgia Tech/ Emory University, [2]Georgia Tech

1-B-14 The brain in prediction: how decision making processes affect the elaboration of visual stimuli

Chiara Bozzacchi[1], Sirarpi Vardanian[2], Valeria Gazzola[1], Christian Keysers[1]

[1]Netherlands Institute for Neuroscience, [2]University of Ghent

1-B-15 Grasping in one-handed catching in relation to performance

Benedetta Cesqui[1], Marta Russo[2], Francesco Lacquaniti[2], Andrea d'Avella[1]

[1]Fondazione Santa Lucia, [2]University of Rome Tor Vergata

1-B-16 MEG measures reveal developmental changes in primary motor cortex during early childhood

Douglas Cheyne[1], Cecilia Jobst[1], Rita Al-Loos[1], Wei He[2], Huizen Tang[3], Blake Johnson[2]

[1]Hospital for Sick Children Research Institute, [2]Macquarie University, [3]Albert Einstein College of Medicine

1-B-17 Evi1 is a highly conserved marker of motor neurons that innervate axial muscle

Kristen D'Elia[1], Jeremy Dasen[1], David Schoppik[1]

[1]NYU Langone Medical Center

1-B-18 Moving together synchronously in rhythmic motion is only possible at certain frequencies

Jason Friedman[1], Lior Noy[2]

[1]Tel Aviv University, [2]Weizmann Institute of Science

1-B-19 Direction-dependent arm kinematics reveal optimal integration of gravity cues

Jeremie Gaveau[1], Bastien Berret[2], Dora Angelaki[3], Charalambos Papaxanthis

[1]INSERM 1093, Univ. Bourgogne Franche Comté, [2]CIAMS, Université Paris-Sud, Université Paris Saclay, CIAMS, Université d'Orléans, France, [3]Baylor College of Medicine, INSERM U1093, Univ. Bourgogne Franche Comté

1-B-20 Does credit assignment of error affect learning of a novel balance-beam walking motor task?

Laksh Gill[1], Kara Patterson[1], Luc Tremblay[1], Rosalie Wang[1], Avril Mansfield [1]

[1]University of Toronto

1-B-21 Facilitation of short latency responses in human arm muscles by stimuli targeting the reticular formation

Isabel Glover[1], Hrishikesh Kumar[2], Monica Perez[3], Stuart Baker[1]

[1]Newcastle University, [2]Institute of Neurosciences, [3]The Miami Project to Cure Paralysis

1-B-22 Visuomotor properties of the reticulospinal contribution during human visually-guided reach movements

Chao Gu[1], Andrew Pruszynski[1], Paul Gribble[1], Brian Corneil[1]

[1]University of Western Ontario

1-B-23 Where one hand meets the other: effector-invariant movement encoding in the human motor system

Shlomi Haar[1], Ilan Dinstein[1], Opher Donchin[1]

[1]Ben Gurion University

1-B-24 The role of the reaction time in action selection under conflict

Adrian Haith[1], Robert Hardwick[1], Montrell Vass[1]

[1]Johns Hopkins University School of Medicine

1-B-25 Asymmetric transfer between passive and visual lead-in movements during motor learning

Ian Howard[1], Sae Franklin[2], David Franklin[1]

[1]University of Plymouth, [2]TUM

1-B-26 Diverging dynamical regimes in primate motor/premotor cortex reflect cue timing during grasping movement preparation

Jacqueline Hynes[1], Carlos Vagras-Irwin[1], Lachlan Franquemont[1], John Donoghue[1]

[1]Brown Univeristy

1-B-27 Topography of human motor speech area using externally recorded 12-20Hz beta peaks to identify articulatory movements, phonemes, words and phrases.

Phillip Kennedy[1], Tatiana Limtom[1], Chad Gambrell[1], Alex Kirillov[2]

[1]Neural Signals Inc., [2]Nex Technologies Inc.

1-B-28 Effect of gravity on the control of arm movements

Dinant Kistemaker[1], Martijn van der Sar[1], Rick Staa[1], Rob van Beers[1]

[1]VU University Amsterdam

1-B-29 Evidence from transcranial magnetic stimulation suggests similar neural contributions to response preparation for flexion and extension movements

Alexandra Leguerrier[1], Dana Maslovat[2], Anthony Carlsen[1]

[1]University of Ottawa, [2]University of British Columbia

1-B-30 Central contributions to motor slowing observed during maximal finger tapping

Rea Lehner[1], Marc Bächinger[1], Felix Thomas[1], Céline Ghidoni[1], Samira Hanimann[1], Joshua Balsters[1], Nicole Wenderoth[1]

[1]ETH Zurich

1-B-31 Modulation of corticospinal excitability for elbow flexor and extensor muscles during motor preparation

Cécilia Neige[1], Hugo Massé-Alarie[1], Martin Gagné[1],
Laurent Bouyer[1], Catherine Mercier[1]

[1]Center for Interdisciplinary Research in Rehabilitation and Social Integration

1-B-32 Approaches to identification and analysis of control patterns in motorcycle emergency braking response

Marilee Nugent[1], Pedro Huertas-Leyva[1], Simon Roslie[1],
Giovanni Savino[1]

[1]University of Florence

1-B-33 Signatures of the fast and slow learning processes in the motor commands that move the eyes during a saccade

Simon Orozco[1], Reza Shadmehr[1]

[1]Johns Hopkins University

1-B-34 Recruitment of the articulatory motor cortex in speech perception in older adults

Muriel Panouillères[1], Riikka Mottonen[1]

[1]University of Oxford

1-B-35 Bad habits in motor skill learning: how initial instructions influence performance in long-term motor sequence learning

Nicola Popp[1], Neda Kordjazi[1], Atsushi Yokoi[2], Paul Gribble[1],
Jörn Diedrichsen[1]

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

1-B-36 Shared neural input between muscles activated during shoulder abduction and adduction

Thomas Richards[1], Piyanee Sriya[1], Sarah Astill[1], Samit Chakrabarty[1]

[1]University of Leeds

1-B-37 Changing oscillatory brain state using TMS-based neurofeedback

Kathy Ruddy[1], Joshua Balsters[1], Quanying Liu[2], Dante Mantini[2],
Pegah Kassraian-Fard[1], Nicole Wenderoth[1]

[1]ETH Zürich, [2]KU Leuven

1-B-38 High-density surface EMG recording of the SLR

Sonal Sengupta[1], Luc Selen[1], Pieter Medendorp[1], Chao Gu[2],
Brian Corneil[2], Peter Praamstra[1]

[1]Radboud University Nijmegen, [2]University of Western Ontario

1-B-39 Representation of individual finger movements on the macaque grasping circuit

Wei-An Sheng[1], Andres Agudelo-Toro[1], Hansjörg Scherberger[1]

[1]Deutsches Primatenzentrum

1-B-40 Characterization of arm movement speed related brain areas using fMRI and a custom build MR-compatible arm tracking system

Seyyed Iman Shirinbayan[1], Alexander Dreyer[1], Jochem Rieger[1]

[1]University of Oldenburg

1-B-41 Dynamics of the Reward Prediction Signal in the primary sensorimotor cortex.

Venkata S. Aditya Tarigoppula[1], John Hessburg[1], John Choi[2],
David McNiel[1], Brandi Marsh[3], Joseph Francis

[1]SUNY Downstate Medical Center, [2]New York University,
[3]Northwell Health, Cullen College of Engineering, University of Houston

C – Posture & Gait

1-C-42 Increased sensory noise explains age-related changes in non-stepping postural responses to perturbations of standing

Maarten Afschrift[1], Ilse Jonkers[1], Friedl De Groote[1]

[1]Ku Leuven

1-C-43 Brainstem and basal ganglia structure predicts postural control and balance loss in young and older adults

Matthieu Boisgontier[1], Boris Cheval[2], Sima Chalavi[1],
Peter van Ruitenbeek[1], Inge Leunissen[1], Oron Levin[1],
Alice Nieuwboer[1], Stephan Swinnen[1]

[1]KU Leuven, [2]Geneva University

1-C-44 Cortical underpinnings of increased gait variability in aging: an EEG-based mobile brain-body imaging study

Pierfilippo De Sanctis[1], Sophie Molholm[1], Brenda Malcolm[1],
John Foxe[1]

[1]Albert Einstein College of Medicine

1-C-46 How does mixed reality affect quiet stance?

Gaiqing Kong[1], Kunlin Wei[2], Konrad Kording[3]

[1]Northwestern University,Rehabilitation Institute of Chicago, Peking University, [2]Peking University, [3]Northwestern University, Rehabilitation Institute of Chicago

1-C-47 A model of postural learning in the neural control of standing balance

Charlotte Le Mouel[1], Romain Brette[1]

[1]Institut de la Vision, Paris

1-C-48 Base of support manipulation in standing affects intra-cortical facilitation

Tulika Nandi[1], Beth Fisher[1], Tibor Hortobágyi[2], George Salem[1]

[1]University of Southern California, [2]University Medical Center Groningen

1-C-49 Does a bilateral synergy hypothesis allow a better simplification of control in human locomotion?

Caroline Teulier[1], Elodie Hinnekens[1], Bastien Berret[1]

[1]University of Paris Sud

1-C-50 Abnormal arm swing disrupts lower limb EMG during walking in healthy young adults

Erin Vasudevan[1], Christine Wang[1]

[1]SUNY Stony Brook University

1-C-51 Neural correlates of hindlimb obstacle memory revealed via chronic microelectrode array recordings in area 5 of walking cats

Carmen Wong[1], Stephen Lomber[1]

[1]The University of Western Ontario

1-C-52 Postural responses to target jump and background motion in fast-pointing task

Yajie Zhang[1], Eli Brenner[1], Jacques Duysens[2], Sabine Verschueren[2], Jeroen Smeets[1]

[1]MOVE Research Institute Amsterdam, Vrije Universiteit Amsterdam, [2]KU Leuven

D – Integrative Control of Movement

1-D-53 Recalibration of hand position sense during unconscious active and passive movements

Zakaryah Abdulkarim[1], Henrik Ehrsson[1]

[1]Karolinska Instiutet

1-D-54 Basal Ganglia Circuits with the Frontal Cortex: Closed and Open Loops

Andreea Bostan[1], Richard Dum[1], Peter Strick[1]

[1]University of Pittsburgh

1-D-55 Use of passive displacement and proprioceptive feedback from one arm (but not its mirror reflection) modulates involuntary motor behaviour of the other arm

Clémentine Brun[1], Michel Guerraz[2]

[1]CIRRIS, [2]Laboratory of psychology and neurocognition

1-D-56 Grasping movements directed towards visual, haptic and visuo-haptic objects

Ivan Camponogara[1], Robert Volcic[1]

[1]New York University Abu Dhabi

1-D-57 Neuromagnetic Oscillations reflecting sensory and motor contributions to visual motor transformation

Paul Ferrari[1], Erin Cressman[2], Jaejin Lee[3], Jody Jensen[3], Douglas Cheyne , Douglas Crawford

[1]Dell Children's Hospital / University of Texas at Austin, [2]University of Ottawa, [3]University of Texas at Austin, The Hospital for Sick Children, York University

1-D-58 The contribution of proprioceptive feedback and limb dynamics in the formation of motor primitives.

Russell Hardesty[1], Erienne Olesh[1], Brad Pollard[1], Valeriya Gritsenko[1]

[1]West Virginia University

1-D-59 Bimanual coordination relies on visual information about direction, but not about posture and muscles

Tobias Heed[1], Farhad Rezvani[2], Janina Brandes[2]

[1]Bielefeld University, [2]University of Hamburg

1-D-60 Sensory information on the finger tips modulates the feedback response of the upper limb during manipulation of a slipping object

Carlos Hernandez-Castillo[1], Rodrigo Maeda[1], Andrew Pruszynski[1], Jorn Diedrichsen [1]

[1]Western University

1-D-61 Feedback responses to muscle vibration depend on task and reach direction

Johannes Keyser[1], Rob E. F. S. Ramakers[1], W. Pieter Medendorp[1], Luc P. J. Selen[1]

[1]Radboud University Nijmegen

1-D-62 Upper Limb Motor Performance is not Predicted by Proprioceptive Acuity in Younger or Older Adults

Nick Kitchen[1], Chris Miall[1]

[1]University of Birmingham

1-D-63 Exploring the role of value-driven attentional capture in a rapid reaching task

Kevin LeBlanc[1], Sarah Kraeutner[1], Heather Neyedli [1]

[1]Dalhousie University

1-D-64 The effect of gaze behavior and prior knowledge on the use of allocentric information in memory-guided reaching movements

Zijian Lu[1], Mathias Klinghammer[1], Katja Fiehler[1]

[1]Giessen University

1-D-65 Salient distractors attract visual attention but attenuate action-related interference: Corroborating evidence from EEG and fMRI

Dan McCarthy[1], Christine Gamble[1], Jeff Moher[2], Joo-Hyun Song[1]

[1]Brown University, [2]Williams College

1-D-66 Sensing the world through a hand-held tool

Luke Miller[1], Luca Montroni[1], Romeo Salemme[1], Vincent Hayward[2], Alessandro Farnè[1]

[1]INSERM U1028, CRNL, [2]Université Pierre et Marie Curie

1-D-67 This feels wrong!: Movement trajectories differentiate the evolving neural competition during action selection between optimal and non-optimal decisions in the presence of spatial vs. value information

Heather Neyedli[1], Sarah Kraeutner[1]

[1]Dalhousie Univeresity

1-D-68 Effects of AMPA antagonist perampanel on movement-related oscillations

Holly Rossiter[1], Beth Routley[1], Khalid Hamandi[1], Krish Singh[1], Suresh Muthukumaraswamy[2]

[1]Cardiff University, [2]Auckland University

1-D-69 Learning to use vibrotactile sensory feedback enhances goal-directed reach performance and generalizes across workspaces

Nicoletta Risi[1], Leigh Mrotek[2], Valay Shah[3], Maura Casadio[1], Robert Scheidt[3]

[1]University of Genova, [2]University of Wisconsin Oshkosh, [3]Marquette University

1-D-70 Seamless prismatic-circular precision grasp reorganization in a naturalistic shape perturbation paradigm

Luis Schettino[1], Jennifer Barnes[1], Laura McKeown[1], Marissa Laws[1], Noah Steinberg[1], Eugene Tunik[2]

[1]Lafayette College, [2]Northeastern University

1-D-71 Spatial proximity determines the strength of multi-finger interactions

Jeffrey Yau[1], Md. Shoaibur Rahman[1], Akshat Patel[2]

[1]Baylor College of Medicine, [2]Rice University

E – Disorders of Motor Control

1-E-72 Estimation of intended force for myocontrol in children with cerebral palsy

Cassie Borish[1], Shinichi Amano[1], Terence Sanger[1]

[1]University of Southern California

1-E-73 Intermuscular coherence of surface electromyography in Parkinson's Disease during isometric leg extension

Matthew Flood[1], Bente Jensen[2], Anne Malling[2], Madeleine Lowery[1]

[1]University College Dublin, [2]University of Southern Denmark

1-E-74 Effect Nintendo Wii exercise program on static and functional balance in children with Down syndrome

Andrea Leiton-Muñoz[1], Valeska Gatica-Rojas[1]

[1]Universidad de Talca

1-E-75 Muscle coordination in a spinal muscular atrophy patient: a case study of abnormal locomotor modules

Sophia C. W. Ha[1], Xiaochang Zheng[1], Xianda Wei[2], Desheng Liang[2], Linqing Wu[2], Roy T. H. Cheung[3], Vincent C. K. Cheung[1]

[1]The Chinese University of Hong Kong, [2]Prenatal Diagnosis Center of Xiangya Hospital, [3]The Hong Kong Polytechnic University

1-E-76 Anticipation of torques when interacting with objects following stroke

Joachim Hermsdörfer[1], Constantin von Deimling[1], Peter Föhr[1], Thomas Schneider[1]

[1]Technical University of Munich

1-E-77 Improvement of neural motor control in stroke hemiplegia by EEG-based brain-computer interface training

Junichi Ushiba[1], Shoko Kasuga[1], Takashi Ono[1], Tetsuo Ota[2], Akio Kimura[3], Toshiyuki Fujiwara , Meigen Liu[3]

[1]Keio University, [2]Asahikawa Medical University Hospital, [3]Keio University School of Medicine, Juntendo University Graduate School of Medicine

1-E-78 Effect of laryngeal vibro-tactile stimulation on voice quality and sensorimotor cortical activation in spasmodic dysphonia

Juergen Konczak[1], Arash Mahnan[1], I-ling Yeh[1], Peter Watson[1], Sanaz Khosravani[1]

[1]University of Minnesota

1-E-79 Inference of differences in neural control strategies from attractor reconstruction of dynamic fingertip forces

Lorenzo Peppoloni[1], Emily Lawrence[2], Emanuele Ruffaldi[1], Francisco Valero-Cuevas[3]

[1]Scuola Superiore Sant'Anna, [2]The Mayo Clinic, [3]University of Southern California

1-E-80 Spinal locomotor output of patients affected by Hereditary Spastic Paraparesis

Giovanni Martino[1], Yuri Ivanenko[2], Mariano Serrao[3], Francesco Lacquaniti[1]

[1]University of Rome Tor Vergata, [2]IRCCS Fondazione Santa Lucia, [3]University of Rome "La Sapienza"

1-E-81 EEG measures of altered cortico-cortical connectivity correlate with structural MRI changes in amyotrophic lateral sclerosis

Bahman Nasseroleslami[1], Stefan Dukic[1], Amina Coffey[1], Roisin Mc MacKin[1], Michael Broderick[1], Kieran Mohr[2], Brighid Gavin[1], Christina Schuster[1], Mark Heverin[1], Alice Vajda[1], Parameswaran Iyre[1], Peter Bede[1], Edmund Lalor[1], Orla Hardiman[1]

[1]Trinity College Dublin, The University of Dublin, [2]University College Dublin

1-E-82 Entrainment for attentional selection in Parkinson's disease

Erik te Woerd[1], Robert Oostenveld[1], Floris de Lange[1], Peter Praamstra[1]

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

1-E-83 Reduced fronto-striatal resting state connectivity and striatal volume in Parkinson's disease patients with impulse control disorders

Marit Ruitenberg[1], Bruno Averbeck[2], Tina Wu[1], Kelvin Chou[1], Rachael Seidler[1]

[1]University of Michigan, [2]National Institutes of Health and Mental Health

1-E-84 Bursting neurons in the deep dorsal horn may initiate long latency responses in vitro following spinal cord injury

Vicki Tysseling[1], Theeradej Thaweerattanasinp[1], Derin Birch[1], Alyssa Puritz[1], Mingchen Jiang[1], Matt Tresch[1], CJ Heckman[1]

[1]Northwestern University

1-E-85 Decreased head movement variability after unilateral vestibular lesion: A locomotion study on vestibular schwannoma patients

Omid Zobeiri[1], Susan King[2], Richard Lewis[2], Kathleen Cullen[3]

[1]McGill University, [2]Harvard Univesity, [3]Johns Hopkins University

F – Adaptation & Plasticity in Motor Control

POSTER CLUSTER (1-F-86 to 1-F-90)

1-F-86 Short-term anaesthetic to a single digit causes changes in lateral-inhibition across the hand map: Evidence from somatosensory evoked potentials

Harriet Dempsey-Jones[1], Miller Luke[2], Farne Alessandro[2], Makin Tamar[3]

[1]Oxford University/ University College London, [2]INSERM, [3]Oxford University/UCL

1-F-87 Dextrous use of the toes shapes to(e)pography in foot artists

Harriet Dempsey-Jones[1], Daan Wesselink[2], Tobias Heed[3], Makin Tamar[2]

[1]Oxford University/ University College London, [2]Oxford University/UCL, [3]Bielefeld University

1-F-88 Consistent motor control of a missing hand: links with chronic phantom pain

Sanne Kikkert[1], Melvin Mezue[1], David Henderson-Slater[2], Heidi Johansen-Berg[1], Irene Tracey[1], Tamar Makin[3]

[1]University of Oxford, [2]Nuffield Orthopaedic Centre, [3]University College London

1-F-89 Malleability of the cortical hand map following single digit nerve block

Zeena-Britt Sanders[1], Daan Wesselink[2], Harriet Dempsey-Jones[3], Sanne Kikkert[1], Andreas Themistocleous[1], Jörn Diedrichsen , Tamar Makin

[1]Oxford University , [2]Oxford University & Unversity College London, [3]Oxford University & University College London, University of Western Ontario, University College London & Oxford University

1-F-90 Persistent organisation of digit representations in primary somatosensory cortex is immutable to changed experience

Daan Wesselink[1], Fiona M Van den Heiligenberg[1], Naveed Ejaz[2], Harriet Dempsey-Jones[1], Lucilla Cardinali[2], Aurelie Tarall[3], Jörn Diedrichsen[2], Tamar Makin

[1]University of Oxford, [2]University of Western Ontario, [3]Opcare, University College London

POSTER CLUSTER (1-F-91 & 1-F-92)

1-F-91 Motor adaptation in mice is driven by task-relevant error-based signals, and dependent on intact cerebellar outputs

Alexander Mathis[1], Taiga Abe[1], Mackenzie Weygandt Mathis[1], Naoshige Uchida[1]

[1]Harvard University

1-F-92 Somatosensory cortex plays an essential role in forelimb motor adaptation in mice

Mackenzie Weygandt Mathis[1], Alexander Mathis[1], Naoshige Uchida[1]

[1]Harvard University

1-F-93 Assessement of kinesthesia in individuals with chronic upper limb pain using robotics and virtual reality

Clémentine Brun[1], Nicolas Giorgi[1], Martin Gagné[1], Candida McCabe[2], Catherine Mercier[1]

[1]Center for Interdisciplinary Research in Rehabilitation and Social Integration, [2]Royal National Hospital for Rheumatic Diseases

1-F-94 The relationship between reinforcement and explicit strategies during visuomotor adaptation.

Olivier Codol[1], Peter Holland[1], Joseph Galea[1]

[1]University of Birmingham

1-F-95 Extracting the explicit contributions to visuomotor adaptation through gaze patterns

Anouk de Brouwer[1], Mohammed Albaghdadi[1], J Flanagan[1], Jason Gallivan[1]

[1]Queen's University

1-F-96 Developmental differences in children's explicit and implicit motor learning

Kanfeng Kanfeng Deng[1], John S.Y. Chan[1], Danxia Liang[1], Jin Yan[1]

[1]Shenzhen University

1-F-97 Timescales of motor memory formation in dual adaptation

Marion Forano[1], David Franklin[1]

[1]Technical University of Munich

1-F-98 Saccadic adaptation and cerebellar structure may define a subphenotype of Autism Spectrum Disorder

Edward Freedman[1], Ana Francisco[1], Eric Nicholas[2], Luke Shaw[2], Lars Ross[1], Sophie Molholm[1], John Foxe[2]

[1]Einstein College of Medicine, [2]University of Rochester

1-F-99 Increased accuracy and differential changes in early somatosensory evoked potentials in response to novel motor training for the non-dominant hand relative to the dominant hand

Ryan Gilley[1], Bernadette Murphy[1], Danielle Andrew[1], Paul Yielder[1]

[1]University of Ontario Institute of Technology

1-F-100 Formation and adaptation of a de novo controller

Alkis Hadjiosif[1], Adrian Haith[1]

[1]Johns Hopkins University

1-F-101 Electrocortical activity distinguishes between indoor and outdoor walking

Grant Hanada[1], Marija Kalabic[1], Dan Ferris[1]

[1]University of Michigan

1-F-102 Closed-loop functional electrical stimulation for upper limb rehabilitation following stroke and SCI

Ed Hodkin[1], Isabel Glover[1], Hrishikesh Kumar[2], Monica Perez[3], Helen Rodgers[1], Andrew Jackson[1]

[1]Newcastle University, [2]Institute of Neuroscience Kolkata, [3]University of Miami

1-F-103 Compatibility effect changes according to short-term visuomotor adaptation

Yoshihiro Itaguchi[1], Chiharu Yamada[2], Kazuyoshi Fukuzawa[2]

[1]Keio University, [2]Waseda University

1-F-104 Conserved neural coordination in sleep, movement and learning

Andrew Jackson[1], Felipe de Carvalho[1], Jennifer Tulip[1], Thomas Hall[1]

[1]Newcastle University

1-F-105 Distinct modulations of beta-band activity by implicit and explicit adaption processes in a reaching task.

Amirhossein Jahani[1], Julie Alayrangues[1], Flavie Torrecillos[2], Nicole Malfait[1]

[1]Institut de Neurosciences de le Timone, [2]Oxford University

1-F-106 Dissociating the influence of postural and visual shifts on the transfer of motor adaptation to novel workspace locations

Wilsaan Joiner[1], Katrina Colucci-Chang[1], Weiwei Zhou[1], Steven Chase[2]

[1]George Mason University, [2]Carnegie Mellon University

1-F-107 Target size modulates motor adaptation from sensory prediction errors

Hyosub Kim[1], Darius Parvin[1], Richard Ivry[1]

[1]University of California, Berkeley

1-F-108 Computational motor control approaches to multi-faceted locomotion rehabilitation after complete SCI

David Logan[1], Tim Kiemel[2], Anthony Himes[1], John Lee[1], Simon Giszter[1]

[1]Drexel University College of Medicine, [2]University of Maryland

1-F-109 Aging slows rate of adaptation but does not affect retention in visuomotor learning

Daniel Marigold[1], Shaila Gunn[1], Amanda Bakkum[1]

[1]Simon Fraser University

1-F-110 Comparing neurophysiological and behavioural outcomes between distal and proximal upper limb muscles in response to novel motor skill acquisition

Sinead O'Brien[1], Paul Yielder[1], Danielle Andrew[2], Bernadette Murphy[1]

[1]University of Ontario Institute of Technology, [2]University of Waterloo

1-F-111 Transfer of motor adaptation between visual and auditory feedback conditions

Jean-Jacques Orban de Xivry[1], Marie Barbiero[2], Olivier White[2]

[1]KU Leuven, [2]Université de Bourgogne Franche-Comté (UBFC)

1-F-113 Physiological indicators of virtual-reality-induced stress during balance beam walking

Steven Peterson[1], Daniel Ferris[1]

[1]University of Michigan

1-F-114 The relative weight of 'slow' versus 'fast' systems during adaptation reflects excitation-inhibition balance in M1

Pierre Petitet[1], Jill O'Reilly[2], Ana Margarida Silva Gonçalvez[2], Uzay Emir[2], Heidi Johansen-Berg[2], Jacinta O'Shea[2]

[1] University of Oxford, [2]University of Oxford

1-F-115 Does the loss of proprioception result in advantages or deficits when wearing prisms? Implications for movement planning and adaptation

Alix Renault[1], Chris Miall, Jonathan Cole, Jean-Louis Vercher[1], Fabrice Sarlegna[1]

[1]ISM - UMR CNRS 7287

1-F-116 Reduced neural responses to sensory prediction errors are associated with impaired adaptation to novel sensorimotor conditions in older adults.

Eva-Maria Reuter[1], Gregory E Pearcey[2], Tess Stevenson[1], Timothy Carroll[1]

[1]The University of Queensland, [2]University of Victoria

1-F-117 Optogenetic mediated neuromodulation of motor cortex enhances voluntary control of trunk muscles nominally below the T9/T10 injury in adult complete transected rats with BDNF-induced stepping and robot-assisted rehabilitation

Kendall Schmidt[1], Simon Giszter[1]

[1]Drexel University

1-F-118 No effect of right prefrontal or cerebellar transcranial direct current stimulation on explicit and implicit learning of a 75° visuomotor rotation.

Raphael Schween[1], Carolin Hahling[1], Christian Leukel[2], Albert Gollhofer[2], Mathias Hegele[1], Janine Reis[3]

[1]Justus-Liebig-University, [2]Albert-Ludwigs-University, [3]Freiburg University Clinic

1-F-119 Can the practice schedule produce the formation of one general or multiple specific internal models of a task?

Christian Stockinger[1], Ernst-Joachim Hossner[2], Thorsten Stein[3]

[1]Technical University of Munich, [2]University of Bern, [3]Karlsruhe Institute of Technology

1-F-120 A Novel Approach to Study Locomotor Learning During Over ground Walking

Gelsy Torres-Oviedo[1], Yashar Aucie[1], Xunjie Zhang[2], James Sargent[3]

[1]University of Pittsburgh, [2]Carnegie Mellon Universtity , [3]Carnegie Mellon University

1-F-121 Executive Function During Target Stepping in Young Healthy Adults.

Susanne van der Veen[1], Robbert Bendall[1], Kristen Hollands[1]

[1]University of Salford

1-F-122 Predicting upcoming sensorimotor events: cluster analysis for EEG data

Maria Luiza Rangel[1], Lidiane Souza[1], José Magalhães Oliveira[2], Michelle Miranda[3], Antonio Galves[1], Claudia D. Vargas[1]

[1]Institute of Biophysics of the Federal University of Rio de Janeiro, [2]Federal University of Rio de Janeiro, [3]University of São Paulo

1-F-123 Multiple processes can lead to savings

Cong Yin[1], Kunlin Wei[1]

[1]Peking University

1-F-124 Pupil dilation during the adaptation to the novel dynamic environment

Atsushi Yokoi[1], Jeff Weiler[2], Andrew Pruszynski [2], Jörn Diedrichsen[2]

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

1-F-125 Brain activations for vestibular stimulation and dual tasking change with spaceflight

Peng Yuan[1], Vincent Koppelmans[1], Patricia Reuter-Lorenz[1], Yiri De Dios[2], Nichole Gadd[2], Scott Wood[3], Roy Riascos , Igor Kofman[2], Jacob Bloomberg[3], Ajitkumar Mulavara[2], Rachael Seidler[1]

[1]University of Michigan, [2]KBRwyle, [3]NASA Johnson Space Center, The University of Texas Health Science Center

1-F-142 Motor adaptation during a sound-oriented task: modulation of movement trajectory by sonification.

Eric Boyer[1], Frédéric Bévilacqua[1], Sylvain Hanneton[2], Agnes Roby-Brami[1]

[1]University Pierre et Marie Curie, [2]ISIR

G – Theoretical & Computational Motor Control

1-G-126 An objective measure of effort via metabolic cost accounts for preferred movement speed

Alaa Ahmed[1], Gary Bruening[1], Reza Shadmehr[2], Megan O'Brien[1]

[1]University of Colorado Boulder, [2]Johns Hopkins University

1-G-127 A normative approach to examining motor control networks

Max Berniker[1]

[1]University of Illinois at Chicago

1-G-128 Tampering with temporal coordination: effects of a sensory device on asymmetries in timing precision between dominant and non-dominant effectors

Riccardo Bravi[1], Erez James Cohen[1], Alessio Martinelli[1], Anna Gottard[1], Diego Minciacchi[1]

[1]University of Florence

1-G-129 Differential effects of age on reward- and punishment-based motor decision-making (motor gambles)

Xiuli Chen[1], Sven Bestmann[2], Joseph Galea[1]

[1]University of Birmingham, [2]University College London

1-G-130 Statistics of natural hand use only partially explains structure of stimulation-evoked muscle activity

Sigrid Dupan[1], Naveed Ejaz[2], Dick Stegeman[3], Simon Overduin , Joern Diedrichsen[2]

[1]Donders Institute for Brain, Cognition, and Behaviour, Radboud University, [2]Brain and Mind Institute, Western University, [3]Donders Institute for Brain, Cognition, and Behaviour, Radboud University Nijmegen Medical Centre, University of California, Berke

1-G-131 Hand choice and the role of posterior parietal cortex

Aoife Fitzpatrick[1], Kenneth Valyear[1]

[1]Bangor University

1-G-132 Learning visuomotor maps through reconfiguration of motor primitives

Takuji Hayashi, Ken Takiyama[1], Daichi Nozaki[2]

[1]Tokyo University of Agriculture and Technology, [2]The University of Tokyo

1-G-133 An intermittent control based model predicts the biphasic nature of EMG activity during hand reaching

Raz Leib[1], Amir Karniel[1], Andrea d'Avella[2], Ilana Nisky[1]

[1]Ben-Gurion University, [2]University of Messina

1-G-134 Muscle synergies during arm cycling by dominant and non-dominant arms

Szabolcs Malik[1], Mariann Mravcsik[2], Lilla Botzheim[2], Jozsef Laczko[3]

[1]Wigner Research Centre for Physics, [2]University of Pecs, [3]University of Pecs & Wigner Research Centre for Physics

1-G-135 A modular neural network model of the primate grasping circuit

Jonathan Michaels[1], Stefan Schaffelhofer, Andres Agudelo-Toro[1], Hansjörg Scherberger[1]

[1]German Primate Center

1-G-136 Modeling sensory preferences in speech motor planning

Jean-François Patri[1], Pascal Perrier[2], Julien Diard[1]

[1]CNRS, [2]Grenoble INP

1-G-137 Surface EMG model of the first dorsal interosseous muscle based on diffusion tensor imaging

Diego Pereira Botelho[1], Niall Colgan[2], Andrew Fagan[3], Kathleen Curran[1], Madeleine Lowery[1]

[1]University College Dublin, [2]National University of Ireland, [3]St. James's Hospital, Trinity College Dublin

1-G-138 The target as an obstacle: grasping an object at different heights.

Jeroen Smeets[1], Rebekka Verheij[1]

[1]VU University Amsterdam

1-G-139 A relational approach to identifying functionally linked neuronal sub-networks

Carlos Vargas-Irwin[1], Jonas Zimmermann[1], Jacqueline Hynes[1], John Donoghue[1]

[1]Brown University

1-G-140 The height of a maximal jump is limited by motor noise

Madhusudhan Venkadesan[1], Alexander Lee[1]

[1]Yale University

1-G-141 Interaction between effort and reward in the oculomotor system

Tehrim Yoon[1], Reza Shadmehr[1]

[1]Johns Hopkins University

Notes

Poster Session 2

Thursday May 4 & Friday May 5

Posters are listed by theme.

A - Control of eye & head movement

2-A-1 MEG analysis of microsaccade-locked visually evoked responses

Stefan Radu Bostan[1], Cecilia Jobst[1], Douglas Cheyne[1]

[1]Hospital for Sick Children Research Institute

2-A-2 Modeling Eye Movement Deficits in Clinical Populations

Brian Coe[1], Thomas Trappenberg[2], Douglas Munoz[1]

[1]Queen's University, [2]Dalhousie University

2-A-3 Integration of past and current visual information during eye movements in Amblyopia

Nicolas Deravet[1], Demet Yuksel[2], Jean-Jacques Orban de Xivry[3], Philippe Lefevre[1]

[1]Universite catholique de Louvain (UCL), [2]Cliniques Universitaires Saint-Luc, [3]Katholieke Universiteit Leuven

2-A-4 The variability of saccade trajectories explained by the superposition of planning noise, premotor noise, and motor noise

Thomas Eggert[1], Andreas Straube[1], Farrel Robinson[2]

[1]Ludwig-Maximilians Universität, [2]University of Washington

2-A-5 Low intensity focused ultrasound on frontal eye field modulates human saccade behavior

Sang-Hoon Yeo[1], Kijoo Park[2], Hyungmin Kim[2]

[1]University of Cambridge, [2]Korea Institute of Science and Technology

2-A-6 Neck muscle fatigue affects performance of a tracking task performed using shoulder rotation

Mahboobeh Zabihhosseinian[1], Bernadette Murphy[1], Michael WR Holmes[2]

[1]University of Ontario Institute of Technology, [2]Brock University

B – Fundamentals of Motor Control

POSTER CLUSTER (2-B-7 & 2-B8)

2-B-7 Motor cortex activity during contralateral versus ipsilateral movements: preserved global response structure despite local reorganization of responses.

K. Cora Ames[1], Mark Churchland[1]

[1]Columbia University

2-B-8 Motor cortical activity reflects a detangled version of muscle activity

Abigail Russo[1], Sean Bittner[1], Jeffrey Seely[1], Sean Perkins[1], Brian London, Antonio Lara, Andrew Miri[1], Adam Kohn[2], Thomas Jessell[1], Laurence Abbott[1], John Cunningham[1], Mark Churchland[1]

[1]Columbia University, [2]Albert Einstein College of Medicine

2-B-9 A new method for assessing human upper limb Ib function?

Stefane Aguiar[1], Supriyo Choudhury[2], Hrishikesh Kumar[2], Monica Perez[3], Stuart Baker[1]

[1]Newcastle University, [2]Institute of Neurosciences Kolkata, [3]University of Miami

2-B-10 Gaze behaviour reveals the specification of competing reach movements

Michael Carter[1], Anouk de Brouwer[1], Lauren Smail[1], Jason Gallivan[1], J. Randall Flanagan[1]

[1]Queen's University

2-B-11 Differences in the internal representation of the two arms could explain hand dominance.

David Córdova Bulens[1], Frédéric Crevecoeur[1], Jean-Louis Thonnard[1], Philippe Lefèvre[1]

[1]Université catholique de Louvain

2-B-12 Online learning and update of internal models during reaching in a force field

Frederic Crevecoeur[1], Jean-Louis Thonnard[1], Philippe Lefevre[1]

[1]Université catholique de Louvain

2-B-13 Adding artificial skin stretch to kinesthetic force in tool-mediated interaction with elastic objects augments perception of stiffness and grip-force control

Mor Farajian[1], Raz Leib[1], Amit Milstein[1], Ilana Nisky[1]

[1]Ben-Gurion University of the Negev

2-B-14 It's not mu, it's me: sensorimotor rhythm desynchronization during action observation is not synonymous with skilled motor performance

Kelene Fercho[1], Taylor Bosch[1], Sara Niederbaumer[1], Cami Brenner[1], Lee Baugh[1]

[1]University of South Dakota

2-B-15 The role of explicit strategies during reinforcement (binary)-based motor learning

Peter Holland[1], Olivier Codol[1], Joseph Galea[1]

[1]University of Birmingham

2-B-16 Importance of ipsilateral motor cortex in motor learning: cortical oscillations in MEG using bimanual implicit learning

Silvia Isabella[1], Charline Urbain[2], J. Allan Cheyne[3], Douglas Cheyne[1]

[1]University of Toronto and Hospital for Sick Children, [2]Laboratoire de cartographie fonctionnelle du cerveau, [3]University of Waterloo

2-B-17 Emerging states in the population activity of M1 neurons decompose movement into distinct behavioral segments

Naama Kadmon Harpaz[1], David Ungarish[1], Nicholas Hatsopoulos[2], Tamar Flash[1]

[1]Weizmann Institute of Science, [2]University of Chicago

2-B-18 The effect of a full season of aerial firefighting on human performance

Michael Kennefick[1], Jane Nettleton[1], Chris McNeil[1]

[1]University of British Columbia

2-B-19 Dynamic representation of spatio-temporal sequence features by spectral profiles (MEG)

Katja Kornysheva[1], Dan Bush[1], Sofie Meyer[1], Anna Sadnicka[1], Neil Burgess[1], Gareth Barnes[1]

[1]University College London

2-B-20 Electroencephalographic correlates of motor errors

Olave Krigolson[1], Francisco Colino[1]

[1]University of Victoria

2-B-21 Influences of sex, number of responses, and movement direction on lateral visual cue reaction time

Emily Lawrence[1]

[1]Sports Academy

2-B-22 Relative elbow angle influences perceived effort in a contralateral, upper extremity effort-matching task

Lindsey Logan[1], Jennifer Semrau[1], Tyler Cluff[1], Stephen Scott[2], Sean Dukelow[1]

[1]University of Calgary, [2]Queen's University

2-B-23 Distinguishable cerebellar, parietal, and motor representational patterns for anticipatory control of object manipulation.

Michelle Marneweck[1], Deborah Barany[2], Trevor Lee-Miller[3], Lukas Volz[1], Matthew Cieslak[1], Andrew Gordon[3], Marco Santello[4], Scott Grafton[1]

[1]University of California, Santa Barbara, [2]Emory University, [3]Teachers College, Columbia University, [4]Arizona State University

2-B-24 Changes in beta-band motor unit coherence with force level

Lara McManus[1], Madeleine Lowery[1]

[1]University College Dublin

2-B-25 Different components of beta oscillations related to movement preparation and movement execution revealed by beta frequency rTMS

Huiling Tan[1], Liora Michlin[1], Juan Rodriguez[2], Peter Brown[1]

[1]University of Oxford, [2]Instituto de Biomedicina de Sevilla

2-B-26 Single dorsal premotor neurons encode multiple related target- and hand-based parameters during reach planning.

Thomas Pearce[1], Robert Turner[1], Daniel Moran[2]

[1]University of Pittsburgh, [2]Washington University in St. Louis

2-B-27 The presence of a peer affects eye movements: pro-saccades and anti-saccades.

Denis Pelisson[1], Johan Ferrand-Verdejo[1], Leslie Tricoche[1], Brieuc Martin-Montchalin[1], Elisabetta Monfardini[1], Martine Meunier[1]

[1]CRNL: INSERM, CNRS and Univ. of Lyon

2-B-28 Cognitive-motor integration assessment detects impairment in varsity athletes cleared for return to play

Alanna Pierias[1], Johanna Hurtubise[1], Cindy Hughes[1], Alison Macpherson[1], Lauren Sergio[1]

[1]York University

2-B-29 Intercepting approaching balls with and without gravity: evidence for a combination of predictive and prospective control

Marta Russo[1], Benedetta Cesqui[1], Barbara La Scaleia[2], Francesca Ceccarelli[1], Alessandro Moscatelli[1], Myrka Zago[2], Francesco Lacquaniti[1], Andrea d'Avella[3]

[1]Tor Vergata - University of Rome, [2]IRCCS Santa Lucia Foundation, [3]University of Messina

2-B-30 Inhibition in the Primate Supplementary Motor Area.

Demetris Soteropoulos[1]

[1]Newcastle University

2-B-31 Static lower limb position influences the motor representation of distal but not proximal upper limb muscles

Mitsuaki Takemi[1], Banty Tia[2], Akito Kosugi[3], Takafumi Nakamura[3], Elisa Castagnola[2], Alberto Ansaldo[2], Davide Ricci[2], Luciano Fadiga[2], Atsushi Iriki[4], Junichi Ushiba[3]

[1]The University of Tokyo, [2]Istituto Italiano di Tecnologia, [3]Keio University, [4]RIKEN Brain Science Institute

2-B-32 Influence of robots with constraint on degree of freedom in motor learning

Kazutaka Takemoto[1], Yoshihiro Itaguchi[1], Seiichiro Katsura[1]

[1]Keio University

2-B-33 Effects of avatar perspective on joint excursions in full body reaching tasks

James Thomas[1], Samuel Leitkam[1], Megan Applegate[1]

[1]Ohio University

2-B-34 Age- and expertise-related differences in force control manifest in variability

Solveig Vieluf[1], Claudia Voelcker-Rehage[1], Christian Goelz[1], Karin Mora[2], Claus Reinsberger[1]

[1]Institute of sports medicine / University of Paderborn, [2]Department of Mathematics / University of Paderborn

2-B-35 The role of motor cortex in voluntary antagonist muscle co-contraction in mouse

Claire Warriner[1], Thomas Jessell[1], Andrew Miri[1]

[1]Columbia University

2-B-36 Short- and long-latency responses at the elbow integrate information about wrist movement to return the hand to a specific location

Jeff Weiler[1], Paul Gribble[1], Andrew Pruszynski[1]

[1]University of Western Ontario

2-B-37 Use-dependent biases in selection of reaction time

Aaron Wong[1], Jeff Goldsmith[2], Alexander Forrence[1], Adrian Haith[1], John Krakauer[1]

[1]Johns Hopkins University School of Medicine, [2]Columbia University Mailman School of Public Health

2-B-38 Structuring of muscle coordination by distinct neural populations in human motor cortex

Moheb Yani[1], Joyce Wondolowski[1], Sandrah Eckel[1], Kornelia Kulig[1], Beth Fisher[1], James Gordon[1], Jason Kutch[1]

[1]University of Southern California

2-B-142 Nonmotor regions and their role in encoding modulations during movement

Macauley Breault[1], Pierre Sacre[1], Matthew Kerr[2], Matthew Johnson[3], Juan Bulacio[4], Jorge Gonzalez-Martinez[4], Sridevi Sarma[1], John Gale[5]

[1]Johns Hopkins University, [2]University of Cambridge, [3]University of Minnesota, [4]Cleveland Clinic, [5]Emory University

C – Posture & Gait

POSTER CLUSTER (2-C-39 & 2-C-40)

2-C-39 Multiday timescale of saving novel walking patterns

Kevin Day[1], Kristan Leech[1], Amy Bastian[1]

[1]Johns Hopkins University

2-C-40 Motor and perceptual learning during multiday walking training

Kristan Leech[1], Kevin Day[1], Amy Bastian[1]

[1]Johns Hopkins University

2-C-41 Rock-paper-scissors - Multivariate pattern representations of hand gestures in the human brain

Kasper Andersen[1], Kristoffer Madsen[1], Hartwig Siebner[1]

[1]Centre for Functional and Diagnostic Imaging and Research, Copenhagen University Hospital Hvidovre

2-C-42 Rambling and trembling in the analysis of postural adjustments prior to the self-selected and reaction time tasks

Hüseyin Celik[1], Yunus Ziya Arslan[2], Pinar Arpinar-Avsar[1]

[1]Hacettepe University Faculty of Sports Sciences, [2]Istanbul University

2-C-43 Development of maneuverability via coordinated use of an acquired effector

David Ehrlich[1], David Schoppik[1]

[1]NYU School of Medicine

2-C-44 Postural changes shape the sensory transmission to the cortex during quiet standing

Marie Fabre[1], Marine Antoine[2], Pascale Chavet[1], Normand Teasdale[2], Laurence Mouchnino[1], Martin Simoneau[2]

[1]Aix-Marseille University CNRS, [2]Université Laval, Québec

2-C-45 Neural contributions to arm swing transitions during walking at different speeds

Jennifer Kerkman[1], Annike Bekius[1], Andreas Daffertshofer[1], Nadia Dominici[1]

[1]Vrije Universiteit Amsterdam

2-C-46 Goal-directed movement during virtual tracing tasks

Lijia Liu[1], Dana Ballard[1], Oran Zohar[1]

[1]University of Texas at Austin

2-C-47 Monaural Electrical Vestibular Stimulation as a Method of Assessing Vestibular Function in Patients with Vestibular Schwannoma

Stuart Mackenzie[1], Richard Irving[1], Peter Monksfield[1], Raghu Kumar[1], Attila Dezso[1], Raymond Reynolds[1]

[1]University of Birmingham

2-C-48 Methods for measuring corticospinal motor excitability of vastus lateralis and gluteus maximus

Yo Shih[1], Beth Fisher[1], Christopher Powers[1]

[1]University of Southern California

2-C-49 Desynchronization of the theta, alpha, and gamma rhythms in the supplementary motor area differentiates the preparation of compensatory balance responses with distinct postural demands

Teodoro Solis-Escalante[1], Joris van der Cruijsen[1], Digna de Kam[2], Joost van Kordelaar[3], Vivian Weerdesteyn[2], Alfred Schouten[1]

[1]TU Delft, [2]Radboud University Medical Center, [3]University of Twente

2-C-50 How to measure foot-placement accuracy during target stepping tasks: centre of pressure or centre of foot?

Susanne van der Veen[1], Richard Baker[1], Kristen Hollands[1]

[1]University of Salford

D – Integrative Control of Movement

POSTER CLUSTER (2-D-51 to 2-B-54)

2-D-51 Investigating the reliability of a double-coil TMS method to assess corticospinal excitability bilaterally

Julien Grandjean[1], Gerard Derosiere[1], Pierre Vassiliadis[1], Louise Quemener[1], Ysaline de Wilde[1], Julie Duque[1]

[1]Université catholique de Louvain

2-D-52 Challenging the function of motor inhibition: does it really contribute to action selection?

Caroline Quoilin[1], Fanny Fievez[1], Julie Duque[1]

[1]Université catholique de Louvain

2-D-53 Testing the influence of various parameters on preparatory motor inhibition: a possible explanation for discrepancies between previous studies?

Emmanuelle Wilhelm[1], Julien Grandjean[1], Julie Duque [1]

[1]Institute of Neuroscience, Université catholique de Louvain, Brussels

2-B-54 Cortical correlates of selective attention and action selection during decision-making under conflict

Gerard Derosiere[1], Pierre-Alexandre Klein[1], Nozaradan Sylvie[1], André Mouraux[1], Alexandre Zénon[1], Julie Duque[1]

[1]Institute of Neuroscience, catholic University of Louvain

2-D-55 Reference frames in the decisions of hand choice

Romy Bakker[1], Luc Selen[1], Pieter Medendorp[1]

[1]Donders Institute, Radboud University Nijmegen

2-D-56 Two neural circuits to point home position after body displacement

Jean Blouin[1], Anahid Saradjian, Jean-Philippe Pialasse, Gerome Manson, Laurence Mouchnino[1], Martin Simoneau[2]

[1]CNRS/Aix-Marseille University, [2]Laval University

2-D-57 Multisensory integration over separate yet kinematically related objects

Nienke Debats[1], Marc Ernst[2], Herbert Heuer[1]

[1]Bielefeld University, [2]Ulm University

2-D-58 Attentional focus manipulation alters variability response to increased mechanical demand in hopping

Abbigail Fietzer[1], Kornelia Kulig[1]

[1]University of Southern California

2-D-59 Reach-relevant somatosensory signals modulate tactile suppression

Hanna Gertz[1], Dimitris Voudouris[1], Katja Fiehler[1]

[1]Giessen University

2-D-60 Theta and beta power respectively reflect negative and positive feedback processing in a reaching task

Raphaël Hamel[1], Félix-Antoine Savoie[1], Angélina Lacroix[1], Maxime Trempe[2], Pierre-Michel Bernier[1]

[1]Université de Sherbrooke, [2]Bishop's University

2-D-61 Modulation of Motor Cortex During Intracortical Microstimulation in Somatosensory Cortex

Christopher Hughes[1], Sharlene Flesher[1], John Downey[1], Jeff Weiss[1], Jennifer Collinger[1], Robert Gaunt[1]

[1]University Of Pittsburgh

2-D-62 How unexpected sensory information affects the kinematics of a reaching hand

Georgiana Juravle[1]

[1]French National Institute of Health and Medical Research, INSERM U1028

2-D-63 From hand to hand: A novel pattern of remote plasticity following training-independent tactile learning

Silvia Macchione[1], Dollyane Muret[2], Hubert R. Dinse[2], Karen T. Reilly[1], Alessandro Farnè[1]

[1]Lyon Neuroscience Research Center - Inserm U1028 - CNRS UMR5292, [2]Neural Plasticity Laboratory, Institute for Neuroinformatics, Ruhr-University

2-D-64 What makes a reach movement effortful? Physical effort discounting supports common minimization principles in decision making and motor control

Pierre Morel[1], Philipp Ulbrich[1], Alexander Gail[1]

[1]German Primate Center

2-D-65 Simultaneous control of cortical and spinal pattern generators in a polyrhythmic, segmentally specific trunk motor skill.

Marilee Nugent[1], Theodore Milner[1]

[1]McGill University

2-D-66 Grip force control of stationary objects with constant load: the influence of gravity and load direction

Florent Paclet[1], Frédéric Danion[2], Etienne Guillaud[1], Floren Colloud[3], Franck Quaine[4], Daniel Cattaert[1], Aymar De Rugy[1]

[1]INCIA - CNRS UMR5287, [2]INT - CNRS UMR7289, [3]Institut PPRIME UPR3346, [4]GIPSA-lab

2-D-67 Conflicting neural evidence and delayed attentional shifts underlie changes of mind in decision-making

Joo-Hyun Song[1], Jeff Moher[1], J. Daniel McCarthy[1], Maro G Machizawa[1], Peisi Yan[1], Xi Luo[1]

[1]Brown University

2-D-68 Intrinsic and extrinsic contributions to submovement kinematics

Damar Susilaradeya[1], Thomas Hall[1], Ferran Galán[1], Kai Alter[1], Andrew Jackson[1]

[1]Newcastle University

2-D-69 Does the nervous system regulate internal joint state?

Matthew Tresch[1], Cristiano Alessandro[1], Filipe Barroso[1], Thomas Sandercock[1]

[1]Northwestern University

2-D-70 Disentangling efference copy mechanisms from general sensory matching processes

Bianca van Kemenade[1], Belkis Ezgi Arikan[1], Kornelius Podranski[1], Olaf Steinsträter[1], Tilo Kircher[1], Benjamin Straube[1]

[1]Philipps-University Marburg

2-D-71 Time dependent modulation of tactile perception

Dimitris Voudouris[1], Katja Fiehler[1]

[1]Giessen University

2-D-72 Kinematic and visual similarity affect slips of the pen

Chiharu Yamada[1], Yoshihiro Itaguchi[2], Kazuyoshi Fukuzawa[1]

[1]Waseda University, [2]Keio University

E – Disorders of Motor Control

2-E-73 Binocular abnormalities during saccadic eye movements in mTBI

John Anderson[1]

[1]Minneapolis VA Health Care System - University of Minnesota

2-E-74 Degeneration of Locus Coeruleus in Parkinson’s disease covaries with subjective fatigue score

Charles-Etienne Benoit[1], Oleg Solopchuk[1], Etienne Olivier[1], Alexandre Zenon[1]

[1]Catholic University of Louvain

2-E-75 Changes in the supplementary motor cortex projection to gigantocellular reticular nucleus of the medulla after peri-rolandic injury are correlated with recovery of upper limb function

Warren Darling[1], Jizhi Ge[2], Kimb Stilwell-Morecraft[1], Marc Pizzimenti[1], Diane Rotella[1], Robert Morecraft[1], Warren Darling[1]

[1]University of Iowa, [2]University of South Dakota

2-E-76 Visuomotor training in early-stage dementia patients can aid cognition and functional abilities: a preliminary report

Casper de Boer[1], Lauren Sergio[1]

[1]York University Toronto

2-E-77 Predicting Chronic Proprioceptive Impariments Post-Stroke

Sonja Findlater[1], Jennifer Semrau[1], Jeffrey Kenzie[1], Amy Yu[1], Troy Herter[2], Stephen Scott[3], Sean Dukelow[1]

[1]University of Calgary, [2]University of South Carolina, [3]Queen’s University

2-E-78 The effect of obesity on motor control

David Gaul[1], Johann Issartel[1]

[1]Dublin City University

2-E-79 Relationship between center of pressure and medio-lateral directions in the functional reach test: clinical projection in spinal cord injury

Juan Claudio López-Monardez[1], Valeska Gatica-Rojas[2]

[1]Universidad Santo Tomás, [2]Universidad de Talca

2-E-80 Predictability of postural control patterns in early Parkinson’s disease is associated with cognitive function: findings from non-linear analysis

Annette Pantall[1], Silvia Del Din[1], Lynn Rochester[1]

[1]Newcastle University

2-E-81 Characterizing kinesthesia with and without the use of vision after stroke

Jennifer Semrau[1], Troy Herter[2], Stephen Scott[3], Sean Dukelow[1]

[1]University of Calgary, [2]University of South Carolina, [3]Queen’s University

2-E-82 Comparisons of two types of rehabilitation robot on upper extremity function: A randomized,single blinded on-going trial

Joon-Ho Shin[1], Gyulee Park[1]

[1]National Rehabilitation Center of Korea

2-E-83 Modeling sensitivity of reaching behavior to sensorimotor deficits

Cole Simpson[1], Sean Sketch[1], Frédéric Crevecoeur[2], Allison Okamura[1]

[1]Stanford University, [2]Université catholique de Louvain

2-E-84 Hour by hour analysis of infant leg movement durations across a day

Ivan Trujillo-Priego[1], Beth Smith[1]

[1]University of Southern California

F – Adaptation & Plasticity in Motor Control

POSTER CLUSTER (2-F-85 to 2-B-89)

2-F-85 Spatial calibration of multisensory information for hand movement: Visuo-proprioceptive realignment in hand perception and motor corticospinal excitability

Hannah Block[1], Anna Lynch[1], Jasmine Mirdamadi[1]

[1]Indiana University Bloomington

2-F-86 Proprioceptive recalibration and updating predicted sensory consequences are not affected by explicit instruction

Denise Henriques[1], Chad Vachon[1], Shanaathanan Modchalingam[1], Bernard ‘t Hart[1]

[1]York University

2-F-87 Somatosensory perceptual training enhances motor learning by observing

Heather McGregor[1], Paul Gribble[1]

[1]The University of Western Ontario

2-F-88 A multi-rate model does not explain proprioceptive recalibration

Bernard ‘t Hart[1], Jennifer Ruttle[1], Denise Henriques[1]

[1]York University

2-B-89 Sensory matching errors

Irene Kuling[1], Eli Brenner[1], Jeroen Smeets[1]

[1]Vrije Universiteit, Amsterdam

2-F-90 Foreperiod and post-movement beta-band activities are differently modulated by movement errors depending on the interlimb coordination

Julie Alayrangues[1], Flavie Torrecillos[2], Amirhossein Jahani[1], Nicole Malfait[1]

[1]Institut de Neurosciences de la Timone, [2]University of Oxford

2-F-91 Does force-field adaptation recalibrate the representation of peripersonal space?

Christophe Bourdin[1], Nicolas Leclere[1], Yann Coello[2], Fabrice Sarlegna[1]

[1]Aix Marseille University, [2]University of Lille

2-F-92 Sensory disturbances, but not motor disturbances, induced by sensorimotor conflicts are increased in the presence of acute pain

Clémentine Brun[1], Martin Gagné[1], Candy McCabe[2], Catherine Mercier[1]

[1]Center for Interdisciplinary Research in Rehabilitation and Social Integration, [2]Royal National Hospital for Rheumatic Diseases

2-F-93 Reinforcement gradient ascent during sensorimotor learning

Joshua Cashaback[1], Christopher Lao[1], Heather McGregor[1], Dimitri Palidis[1], Susan Coltman[1], Paul Gribble[1]

[1]Western University

2-F-94 Neural predictors of visuomotor adaptation rate and multi-day savings

Kaitlin Cassady[1], Marit Ruitenberg[1], Vincent Koppelmans[1], Patricia Reuter-Lorenz[1], Yiri De Dios[2], Nichole Gadd[2], Scott Wood[3], Roy Riascos[4], Igor Kofman[2], Jacob Bloomberg[3], Ajitkumar Mulavara[2], Rachael Seidler[1]

[1]University of Michigan - Ann Arbor, [2]KBRwyle, [3]NASA Johnson Space Center, [4]University of Texas Health Science Center

2-F-95 Model and experiments to optimize co-adaptation in a simplified myoelectric control system

Mathilde Couraud[1], Daniel Cattaert[1], Florent Paclet[1], Pierre-Yves Oudeyer[2], Aymar De Rugy[1]

[1]INCIA - CNRS UMR 5287, [2]INRIA Bordeaux Sud-Ouest

2-F-96 The effect of tonic pain and motor learning on corticospinal excitability

Erin Dancey[1], Bernadette Murphy[1], Paul Yielder[1]

[1]University of Ontario Institute of Technology

2-F-97 Adaptation of motor planning activity in monkey motor, premotor and parietal cortices during BCI control of 3D reaches

Enrico Ferrea[1], Pierre Morel[1], Alexander Gail[1]

[1]German Primate Center

2-F-98 Adaptation to artificial spasticity induced by a neuromuscular simulator

Christopher Hasson[1], Sarah Goodman[1]

[1]Northeastern University

2-F-99 Separate motor memories are engaged when controlling different points on the same tool

James Heald[1], James Ingram[1], Randy Flanagan[2], Daniel Wolpert[3]

[1]University of Cambridge, [2]Queen?s University, [3]The University of Cambridge

2-F-100 The effects of punishment and reward on motor learning in the young and elderly

Mathias Hegele[1], Sabine Margolf-Hackl[1], Jing Huang[1], Jutta Billino[1]

[1]University of Giessen

2-F-101 Organization of the cerebellum by prediction errors reveals bidirectional changes during saccade adaptation

David Herzfeld[1], Yoshiko Kojima[2], Robijanto Soetedjo[2], Reza Shadmehr[1]

[1]Johns Hopkins University School of Medicine, [2]University of Washington, National Primate Center

2-F-102 Interference during bimanual movements scales with force feedback

Florian Kagerer[1], Alexander Brunfeldt[1], Phillip Desrochers[1]

[1]Michigan State University

2-F-103 Relationship between Interhemispheric Inhibition and Bimanual Coordination in Musicians

Yi-Ling Kuo[1], Beth Fisher[1]

[1]University of Southern California

2-F-104 Mobility as the purpose of postural control

Charlotte Le Mouel[1], Romain Brette[1]

[1]Institut de la Vision, Paris

2-F-105 Spaceflight effect on white matter structural integrity

Jessica Lee[1], Vincent Koppelmans[1], Ajitkumar Mulavara[2], Ofer Pasternak[3], Jacob Bloomberg[4], Rachael Seidler[1]

[1]University of Michigan, [2]Universities Space Research Association, [3]Brigham and Women’s Hospital, Harvard Medical School, [4]Johnson Space Center

2-F-106 Have we been looking at motor variability in old age all wrong? An example of when motor errors improve performance of older adults

Shelly Levy-Tzedek[1]

[1]Ben Gurion University

2-F-107 Learning and transfer of novel intersegmental limb dynamics between feedforward and feedback control

Rodrigo Maeda[1], Tyler Cluff[2], Paul Gribble[1], Andrew Pruszynski[1]

[1]Western University, [2]University of Calgary

2-F-108 Developmental steps in teenager motor control of tools: Learning and plasticity

Marie Martel[1], Livio Finos[2], Alessandro Farnè[3], Alice Roy[3]

[1]Bielefeld University, [2]University of Padova, [3]University of Lyon

2-F-109 How dependent are the update of control and prediction during adaptation to visuomotor rotation?

James Mathew[1], Frederic Danion[1]

[1]CNRS & Aix-Marseille University

2-F-110 Does prior delay exposure facilitate speech sensorimotor learning with delayed auditory feedback?

Ludo Max[1], Takashi Mitsuya[1], Douglas Shiller[2]

[1]University of Washington, [2]Université de Montréal

2-F-111 Spinal manipulation for mild recurrent neck pain influences upper limb biomechanics: A four-week randomized controlled trial

Julianne Baarbé[1], Bernadette Murphy[2], Heidi Haavik[3], Michael Holmes[4]

[1]University of Toronto, [2]University of Ontario Institute of Technology, [3]New Zealand College of Chiropractic, [4]Brock University

2-F-112 Dynamic changes in brain network organization during visuomotor adaptation learning

Joseph Nashed[1], Dominic Standage[1], J. Randall Flanagan[1], Jason Gallivan[1]

[1]Queen’s University

2-F-113 Time scales and specificity of acquisition, retention and generalization of a novel motor skill over months and years

Se-Woong Park[1], Dagmar Sternad[1]

[1]Northeastern University

2-F-114 Task dependent modulation of implicit visuomotor adaptation

Darius Parvin[1], John Morehead[2], Alissa Stover[1], Rich Ivry[1]

[1]UC Berkeley, [2]Harvard

2-F-115 The influence of end-effector visual feedback on the planning of reaches

Steven Penny[1], Natarajan Vaidyanathan[1], Max Berniker[1]

[1]University of Illinois at Chicago

2-F-116 Changes in corticospinal excitability do not contribute to stretch-induced muscle force loss

Timothy Pulverenti[1], Gabriel Trajano[2], Benjamin Kirk[1], Anthony Blazevich[1]

[1]Edith Cowan University, [2]Queensland University of Technology

2-F-118 Cerebellar Purkinje cells track the learning of a visuomotor association through a trial-by-trial change in activity

Naveen Sendhilnathan[1], Mulugeta Semework[2], Michael Goldberg[2], Anna Ipata[1]

[1]Columbia University Department of Neuroscience, [2]Columbia University

2-F-119 Neuromuscular correlates of locomotor adaptation to robot-induced perturbations unravel a mixture of flexible high-level adaptation strategies.

Giacomo Severini[1], Alexander Koenig[2], Vincent Cheung[3], Paolo Bonato[2]

[1]University College Dublin, [2]Harvard Medical School, [3]Chinese University of Hong Kong

2-F-120 Motor memory decay is specific to the motor plan, even if not executed

Hannah Sheahan[1], James Ingram[1], Goda Zalalyte[1], Randall Flanagan[2], Daniel Wolpert[1]

[1]Cambridge University, [2]Queen’s University

2-F-121 Reward and punishment differentially recruit hippocampus and cerebellum to stabilize skill memories

Adam Steel[1], Edward Silson[2], Charlotte Stagg[3], Chris Baker[2]

[1]University of Oxford/National Institutes of Health, [2]National Institutes of Health, [3]University of Oxford

2-F-122 Downscaling of error feedback improves retention of motor adaptation

Robert van Beers[1], Eli Brenner[1], Jeroen Smeets[1], Katinka van der Kooij[1]

[1]VU University Amsterdam

2-F-123 New perspective on the impact of aging on motor adaptation

Koenraad Vandevoorde[1], Jean-Jacques Orban de Xivry[1]

[1]KU Leuven

2-F-124 Monetary incentives differentially modulate fast and slow motor learning

Lukas Volz[1], Wendy Meiring[1], Alex Asturias[1], Matthew Cieslak[1], Taraz Lee[2], Scott Grafton[1]

[1]University of California, Santa Barbara, [2]University of Michigan

2-F-125 Stroke patients can learn a new cooperative bimanual task. Does tDCS improve this learning?

Maral Yeganeh Doost[1], Jean-Jacques Orban de Xivry [2], Benoît Herman[3], Patrice Laloux[1], Jean-Marc Raymackers[4], Yves Vandermeeren[1]

[1]Université catholique de Louvain (UCL), CHU UCL Namur, [2]Katholiek Universiteit Leuven (KUL), [3]UcL (Université catholique de Louvain), [4]Clinique St-Pierre

G – Theoretical & Computational Motor Control

2-G-126 A cortical circuit for fast sensorimotor learning and recognition

Subutai Ahmad[1], Jeff Hawkins[1], Yuwei Cui[1]

[1]Numenta, Inc.

2-G-127 Estimating fast and slow adaptive processes during sensorimotor learning

Scott Albert[1], Reza Shadmehr[1]

[1]Johns Hopkins School of Medicine

2-G-128 Cost of time in self-paced arm movement: identification methodology and focus on inter-individual differences

Bastien Berret[1], Carole Castanier[1], Thomas Deroche[1], Frédéric Jean[2]

[1]Univ. Paris-Sud, Université Paris-Saclay, [2]ENSTA ParisTech, Université Paris-Saclay

2-G-129 Visuomotor feedback gains: optimal temporal evolution or fixed relation to movement velocity?

Justinas Cesonis[1], David Franklin[1]

[1]Technical University of Munich

2-G-130 Learning to approximate Bayesian behavior

Claire Chambers[1], Konrad Kording[1]

[1]Northwestern University

2-G-131 Muscle synergies for performance optimization: Insights from novice and experienced runners

Ben Man Fei Cheung[1], Vincent Chi Kwan Cheung[1], Roy Tsz Hei Cheung[2]

[1]The Chinese University of Hong Kong, [2]The Hong Kong Polytechnic University

2-G-132 Trajectory generation using a spiking neuron implementation of dynamic movement primitives

Travis DeWolf[1], Chris Eliasmith[1]

[1]University of Waterloo

2-G-133 No evidence for hand synergies in sensorimotor cortices of macaques

James Goodman[1], Gregg Tabot[1], Aneesha Suresh[1], Nicho Hatsopoulos[1], Sliman Bensmaia[1]

[1]University of Chicago

2-G-134 Capabilities of a spinal like regulator (SLR) network to control elbow movement with gravity and perturbation

Matthieu Guémann[1], Florent Paclet[1], Damien Ricard, Eric Lapeyre, Daniel Cattaert[1], Aymar de Rugy[1]

[1]INCIA CNRS

2-G-135 Imagining a movement involves the prediction of its sensory consequences

Konstantina Kilteni[1], Benjamin Andersson[1], H. Henrik Ehrsson[1]

[1]Karolinska Institutet

2-G-136 Between zero and one: evidence for an analog computation in the re-planning of movements

Samuel McDougle[1], Jordan Taylor[1]

[1]Princeton University

2-G-137 Cognitive and kinematic factors influencing motor chunking

Daniel McNamee[1], Máté Lengyel[1], Daniel Wolpert[1]

[1]University of Cambridge

2-G-138 Bayesian timing as dynamic computations in recurrent neuronal populations

Devika Narain[1], Mehrdad Jazayeri[1]

[1]MIT

2-G-139 Visual and somatosensory contributions to the feedback control of movement: Evidence from a clinical model of sensory neuronopathy

Fabrice Sarlegna[1], R Miall[2], J Cole[3], Jean-Louis Vercher, David Franklin [4], Marion Forano[4]

[1]CNRS & Aix-Marseille University, [2]University of Birmingham, [3]Poole Hospital & University of Bournemouth, [4]Technical University of Munich

2-G-140 Predictability, effort and (anti-)resonance in complex object control

Pauline Maurice[1], Fei Ye[1], Neville Hogan[2], Dagmar Sternad[1]

[1]Northeastern University, [2]Massachusetts Institute of Technology

2-G-141 Nonlinear coupling between cortical oscillations and muscle activity during steady-state force generation

Yuan Yang[1], Frans van der Helm[1], Teodoro Solis-Escalante[1], Mark van de Ruit[1], Jun Yao[2], Julius Dewald[2], Alfred Schouten[1]

[1]Delft University of Technology, [2]Northwestern University

NCM Sponsors and Exhibitors

BKIN Technologies Ltd*

www.bkintechnologies.com

BKIN is the leading developer of robotic technologies for understanding brain function and dysfunction. KINARM Labs are flexible robotic platforms that address sensory and motor control researchers' needs for measurement and action of the upper limb. Users span the basic and clinical research continuum. We continuously strive to incorporate requests to meet your research needs. The new KINARM Exoskeleton, providing 3X improved stiffness over the KINARM Classic and full access to the head to enable use of TMS, tDCS, etc., is now in full production.

@BKINTech @KINARMLab

Visit our exhibition **Booth 4**

*Sponsor of both the Annual Meeting and the Satellite Meeting

Blackrock Microsystems

www.blackrockmicro.com

Blackrock Microsystems is a privately held company that provides enabling tools for the neuroscience, neural engineering and neuroprosthetics research and clinical community worldwide. The Blackrock team backs up your project from start to finish so you ultimately can publish faster. All our solutions provide high-quality, reliable data because they are precisely tailored to your project needs and fully integrated. Blackrock systems are known for their user-friendliness and intuitive, plug-and-play experience. Such ease of use and reliability have come about in part because we offer the largest portfolio of FDA and CE approved products, which are by definition more documented, proven, reliable and safe.

https://twitter.com/BlackrockMicro

www.facebook.com/BlackrockMicro

Visit our exhibition **Booth 3**

Delsys, Inc.

www.delsys.com/

Delsys is a world leader in the design, manufacture, and marketing of a broad portfolio of high-performance electromyography instruments and biomechanical sensors used in virtually all types of movement measurement studies in research and education. Our breakthrough surface EMG decomposition technology offers scientists new insight into the neural control of muscles. Thousands of researchers and educators in 85 countries use Delsys products to understand and solve real-world problems associated with movement disorders.

https://twitter.com/delsysinc/

www.facebook.com/Delsys-Inc-5851

Visit our exhibition **Booth 5**

NDI

www.ndigital.com

NDI is a global leading innovator and manufacturer of advanced 3D measurement technology systems, with over 45,000 installations worldwide. For over 30 years, our optical measurement and electromagnetic tracking solutions have been trusted by the world’s foremost organizations and institutes in medicine, industry, simulation, and academia. From image-guided surgery to aeronautics; from quality assurance to biomechanics research, NDI solutions are used whenever best-in-class measurement accuracy and reliability are required.

Visit our exhibition **Booth 2**

Neuralynx Europe

www.NLXneuro.com

Neuralynx provides the complete solution for human single unit recording with one integrated data acquisition system. The Neuralynx Atlas Neurophysiology system is the only FDA cleared DC Single Unit Recording System for human use. The ATLAS system manages clinical and research signals from both macro and microelectrodes through a network infrastructure designed for distributed processing and analysis. One amplifier records multi-scale signals across differing impedances through microwire pre-amplifiers and buffered headboxes. We’ve worked with over 700 labs and hospitals globally for over 20 years. This partnership allows us to continue to innovate in advanced recording applications in epilepsy, DBS & cognitive electrophysiology research environments.

Visit our exhibition **Booth 6**

Plexon, Inc.

www.plexon.com

Plexon is a pioneer and leading innovator of custom, high performance data acquisition, behavior and analysis solutions specifically designed for scientific research. We collaborate with and supply thousands of customers including the most prestigious neuroscience laboratories around the globe driving new frontiers in areas including basic science, brain-machine interfaces (BMI), neurodegenerative diseases, addictive behaviors and neuroprosthetics. Plexon offers integrated solutions for in vivo neurophysiology, optogenetics and behavioral research -- backed by its industry-leading commitment to quality and customer support.

Ripple

www.rippleneuro.com

Ripple provides high performance electrophysiology data acquisition systems for in vivo neuro-muscular recording and stimulation. Our systems are compact, portable, and heavily optimized for real-time, closed-loop control applications with up to 512 channels of EMG, EEG, and microelectrode data. Our software is cross platform, and can be run on Windows, Mac OS X, and Linux.

Visit the resource table for more information

Sutter Instrument

www.sutter.com

Quality. Precision. Reliability. For over 40 years, Sutter Instrument has set the highest standards for performance and innovation. New products include the Lambda 421 Optical Beam Combiner that combines separate light sources with different spectra into a single common output beam, the TRIO 3-axis micromanipulator, and BOB, an open-design upright microscope ideal for slice electrophysiology, wide field functional imaging, 2-photon retinal imaging and photo stimulation. The Double IPA (Integrated Patch Amplifier) is an all-in-one low-noise dual patch clamp amplifier with onboard D/A conversion and data acquisition system, and the powerful SutterPatch software package built on the foundations of Igor 7.

XXII Congress of The International Society of Electrophysiological Kinesiology

June 30 - July 2, 2018

www.isek.org/congress-2018/

Fifty years after the inaugural meeting of the International Society of Electrophysiology and Kinesiology, and building on the success of the XXI Congress in Chicago, ISEK 2018 will bring together multidisciplinary delegates from basic scientists to practising clinicians specialising in human movement and the neuromuscular system. The programme will include key-note lectures from distinguished international speakers and a range workshops, in addition to plenary sessions spanning diverse topics including sensorimotor control, motor performance, movement disorders, rehabilitation, neuro-mechanics, neural engineering, modelling and data analysis. The congress will be held at University College Dublin within easy access of the rich cultural and historical heritage of Dublin city.

https://twitter.com/2018Isek

www.facebook.com/ISEK2018/

Visit our exhibition **Booth 7**

Tucker-Davis Technologies

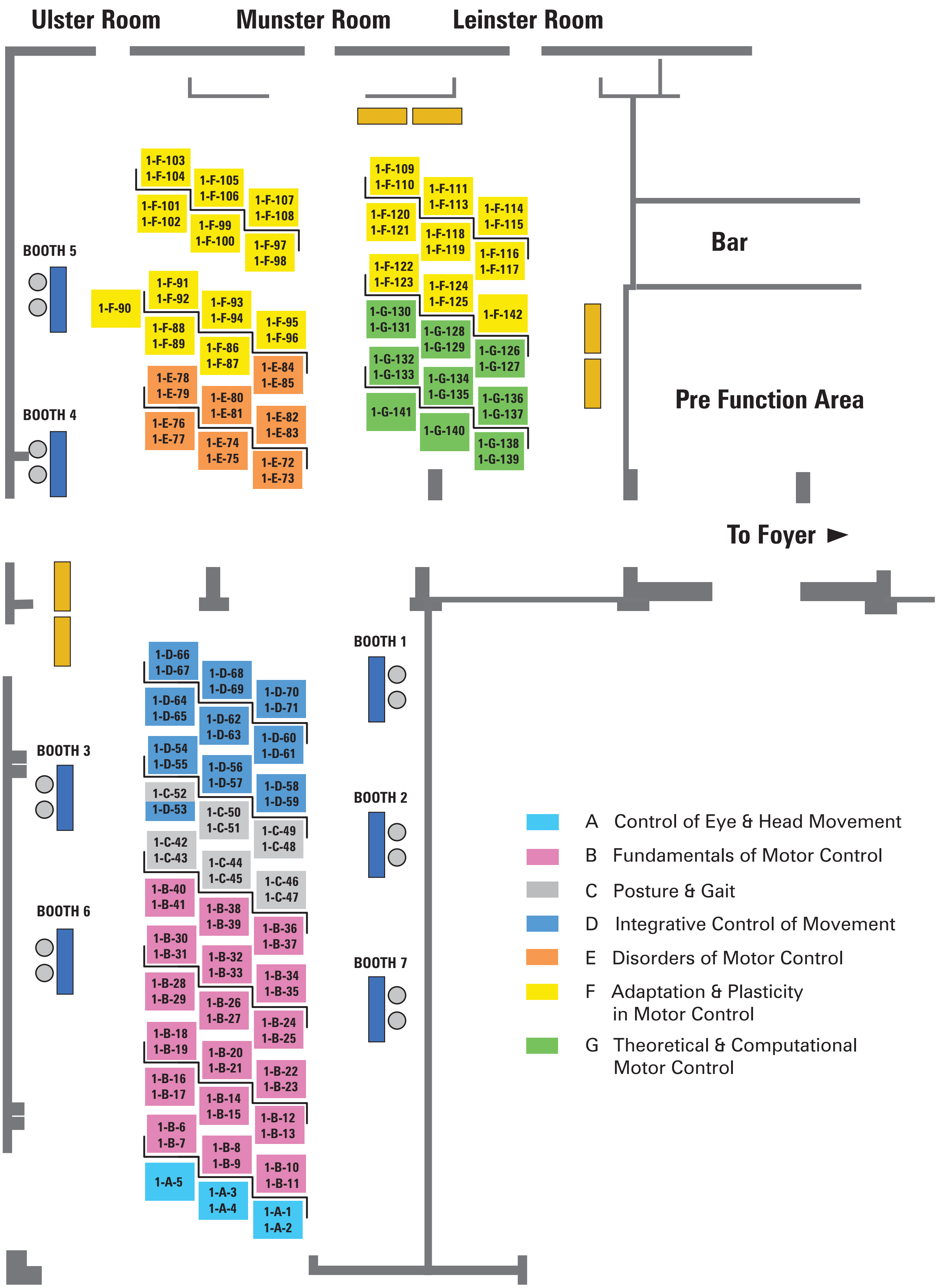
www.tdt.com

Tucker-Davis Technologies (TDT) provides products for basic and applied research in the neurophysiology, hearing, and speech sciences as well as for general data acquisition applications. We offer a complete line of modular DSP-based data acquisition and stimulus generation systems. At TDT, we work closely to achieve our common goal: to supply you with the highest quality, most up-to-date technology available at an affordable price. We believe we can best meet this goal when all areas of our business work together in a cooperative and collaborative environment.

Visit our exhibition **Booth 1**

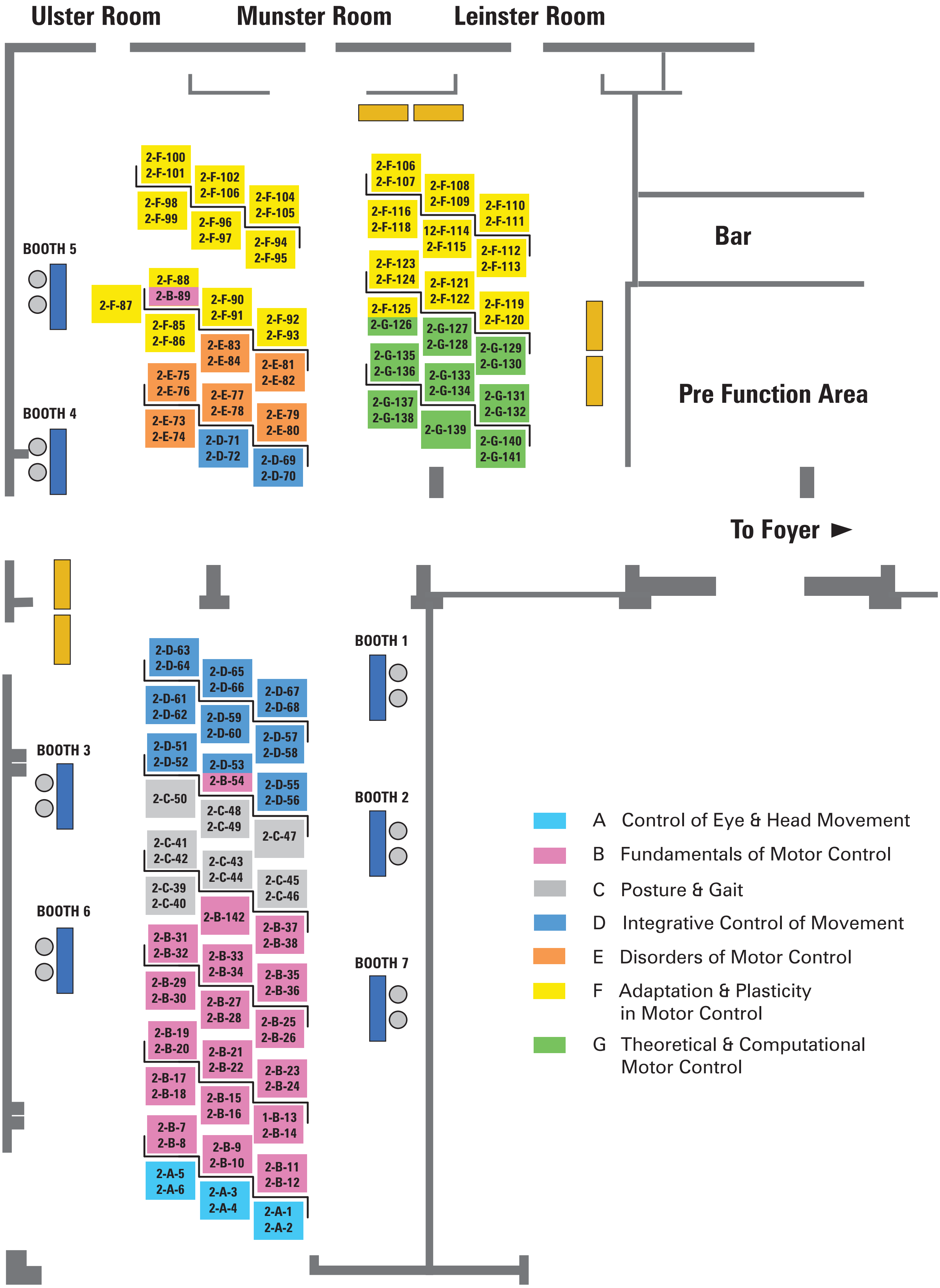
Poster Session 1 Floor Plan

Tuesday May 2 & Wednesday May 3 8:00 – 17:00



Poster Session 2 Floor Plan

Thursday May 4 & Friday May 5 8:00 – 14:15



- 🟦 A Control of Eye & Head Movement
- 🟪 B Fundamentals of Motor Control
- ⬜ C Posture & Gait
- 🟦 D Integrative Control of Movement
- 🟧 E Disorders of Motor Control
- 🟨 F Adaptation & Plasticity in Motor Control
- 🟩 G Theoretical & Computational Motor Control

Society for the
Neural Control of Movement
NCM

The 27th Annual NCM Meeting thanks our sponsors, supporters and donors

b·kin
TECHNOLOGIES
Insight in motion

BLACKROCK®
MICROSYSTEMS

DELSYS®
WEARABLE SENSORS
FOR MOVEMENT SCIENCES

isek
International Society
of Electrophysiology
and Kinesiology

Fāilte Ireland
National Tourism Development Authority

NDI
Northern Digital Inc.

NeuraLynx

PLEXON®

ripple®

SUTTER INSTRUMENT

TDT
TUCKER-DAVIS TECHNOLOGIES