S.1. Neuromechanics of Human Locomotor Stability: Theoretical Insights and Clinical Applications

Inter-limb cutaneous feedback in walking balance: Early responses at the ankle to rapid light touch displacement at the fingertip during walking
John Misiaszek¹, Tania Shiva¹
¹University of Alberta

Perturbation Based Gait Training May Improve the Tradeoff of Stability and Maneuverability in Patients with Lower Limb Injury
Riley Sheehan¹, Jason Wilken¹, Jonathan Dingwell²
¹Military Performance Lab, Center for the Intrepid, ²University of Texas at Austin

Post-stroke deficits in a mediolateral gait stabilization strategy (and a possible intervention)
Jesse Dean¹
¹Medical University of South Carolina

The effect of balance perturbations after myelopathy related sensory deficits on cortical oscillations during walking
Joseph Lee¹, Brian Schmit¹
¹Marquette University

Cortical Correlates of Locomotor Adaptation to Perturbations of Symmetry
James Finley¹
¹University of Southern California

System Identification of the Human Locomotion Control System and Energy-optimal Feedback Control
Varun Joshi¹, Barrett Clark¹, Nidhi Seethapathi¹, Yang Wang², Manoj Srinivasan¹
¹The Ohio State University, ²Caterpillar

S.2. Motor Unit Control

Transposed firing activation of motor units during oscillatory contractions
Paola Contessa¹, Joshua Kline¹, Carlo De Luca²
¹Delsys Inc, ²Boston University, Delsys Inc

Biomechanical Benefits of the Onion-Skin Scheme of Motor Unit Firing
Carlo De Luca¹, Paola Contessa²
¹Boston University/Delsys Inc, ²Delsys Inc

Synchronization studies require accurate motor unit firings and robust statistical tests
Joshua Kline¹, Carlo De Luca¹
¹Delsys, Inc
Assessing Motor Unit Pool Control Properties in Aging using Surface Electromyography
Xiaogang Hu¹, William Rymer², Nina Suresh²
¹University of North Carolina-Chapel Hill, ²Rehabilitation Institute of Chicago

Homogeneity of the Relationship between Motor Unit Recruitment Thresholds versus Derecruitment Thresholds across Force Levels and the Lifespan
Matt Stock¹, Jacob Mota²
¹University of Central Florida ²Texas Tech University

Motor unit coherence and synchronization in response to sustained isometric contraction of the first dorsal interosseous muscle
Lara McManus¹, Xiaogang Hu², William Rymer³, Nina Suresh⁴, Madeleine Lowery¹
¹University College Dublin, ²University of North Carolina-Chapel Hill and North Carolina State University , ³Northwestern University, ⁴Rehabilitation Institute of Chicago

O.1. Rehabilitation Technologies I

A new wearable exoskeleton device that controls knee motion in individuals after stroke
Shihomi Kawasaki¹, Koji Ohata¹, Tadao Tsuboyama¹, Yuichi Sawada², Yoshiyuki Higashi³
¹Graduate School of Medicine, Kyoto University, ²Kyoto Institute of Technology

A Novel Device for Functional Strength Training during Gait: Evidence from Healthy and Stroke Subjects
Edward Washabaugh¹, Edward Claflin¹, Richard Gillespie¹, Chandramouli Krishnan¹
¹University of Michigan

Gait Rehabilitation in Paediatric Population through a Novel Robotic Platform: Pilot study
Cristina Baruón¹, Eduardo Rocon¹
¹CSIC

The kinematic change for inverted pendulum during stance phase with assist of hip movement in individuals after stroke.
Koji Ohata¹, Shihomi Kawasaki¹, Yasushi Ikeuchi², Yosuke Nagata², Toru Takenaka²
¹Graduate school of Medicine, Kyoto University, ²Honda R&D Co., Ltd.

Measuring balance control on a treadmill: no need for shear forces
Ingrid Schut¹, Jolanda Roelofs², Jantsje Pasma³, Herman van der Kooij¹, Vivian Weerdesteyn², Alfred Schouten¹
¹Delft University of Technology, ²Radboud university medical center

The Effect that Joint Mobilization has on Propriospinal Reflexes and Pain
James Agostinucci¹, John McLinden¹
¹University of Rhode Island
O.2. Neuromechanics I

*Task dependancy in Sensorimotor Training: Influence of free bipedal and unipedal stance on variance of soleus H-reflex amplitudes*
Gunnar Wahmkow¹, Tilman Engel¹, Steffen Müller¹, Eduardo Martinez-Valdez¹, Kaplick Hannes¹, Frank Mayer¹
¹Potsdam University

*Trunk Muscle Reflexes Are Elicited by Small Continuous Perturbations*
Daniel Ludvig¹, Christian Larivière²
¹University of Montreal, ²Occupational Health and Safety Research Institute Robert-Sauvé (IRSST)

*Heteronymous models are needed to describe shoulder stretch reflexes*
M. Hongchul Sohn¹, Emma Baillargeon¹, David Lipps², Eric Perreault³
¹Northwestern University, ²University of Michigan, ³Northwestern University and Rehabilitation Institute of Chicago

*Nonlinear connectivity in the human stretch reflex revealed by nonlinear phase coherence and multisine perturbations*
Yuan Yang¹, Teodoro Solis-Escalante¹, Jun Yao², Frans van der Helm¹, Julius Dewald³, Alfred Schouten¹
¹Delft University of Technology, ²Northwestern University

*Peri-patellar taps elicit regional stretch reflexes in the human vastus medialis*
Alessio Gallina¹, Jean-Sébastien Blouin¹, Tanya Ivanova¹, S Jayne Garland²
¹University of British Columbia, ²University of Western Ontario

*Evidence of Invariance in the Lower Leg Muscle’s Response due to Stretch Reflex Excitation during Movement.*
Diego Guarin¹, Robert Kearney¹
¹McGill University
O.3. EMG: modeling

*Comparison of EMG Feature Projection Techniques for Force Estimation*
Muhammad Asim Waris¹, Winnie Jensen¹, Kevin Englehart², Ernest Kamavuako¹
¹Aalborg University, ²University of New Brunswick

*Periods of non-stationarity indicate motor unit recruitment in the tibialis anterior muscle of young healthy adults*
Shanette Go¹, William Litchy¹, Carlos Mantilla¹, Gary Sieck¹, Kenton Kaufman¹
¹Mayo Clinic

*Two Degrees of Freedom EMG-Force at the Wrist in Able-Bodied Subjects Using a Minimum Number of Electrodes: Pilot Testing of Limb-Absent Subjects*
Edward Clancy¹, Carlos Martinez-Luna², Marek Wartenberg¹, Todd Farrell²
¹Worcester Polytechnic Institute, ²Liberating Technologies, Inc.

*A comparison of Spike Shape Measures from Surface and Indwelling Electromyography during Elbow Flexion Isometric Ramp Contractions*
Lara Green¹, Anita Christie², J. Greig Inglis¹, David Gabriel¹
¹Brock University, ²University of Oregon

*On the Usability of Rejection Capable Support Vector Machines in an Online Virtual Targeting Task*
Jason Robertson¹, Kevin Englehart¹, Erik Scheme¹
¹University of New Brunswick

*Towards Improving the Training of Pattern Recognition Based Myoelectric Control*
Kadie Wright¹, Kevin Englehart¹, Erik Scheme¹
¹Institute of Biomedical Engineering

O.4. Rehabilitation Technologies II

*Cranial Nerve Non-Invasive Neuromodulation for Symptomatic Treatment of Mild and Moderate Traumatic Brain Injury - Effects on Muscle Coordination Patterns during Walking*
Samuel Acuña¹, Mitchell Tyler¹, Yuri Danilov¹, Darryl Thelen¹
¹University of Wisconsin-Madison

*What does the CNS see during electrically stimulated muscle contractions?*
Patrick Crago¹
¹Case Western Reserve University

*Does the distance between electrodes markedly affect the knee extension torque elicited in tetanic, stimulated contractions?*
Taian Vieira¹, Laura Gastaldi¹, Alberto Botter¹
¹Politecnico di Torino
Sensory and Motor Thresholds for Surface Electrical Stimulation of Median and Ulnar Nerves at Elbow for Sensory Feedback
Marjolein Eiselia Thijssen¹, Petr Sipka¹, Søren Larsen¹, Mai Kristiane Thomsen¹, Eugen Romulus Lontis¹, Winnie Jensen¹
¹Aalborg University

The effect of rehabilitation with the neuromuscular electrical stimulation after femoral neck fracture surgery - Short term intervention reports
Daisuke Bai¹, Mitsunori Tokuda¹, Yuki Fujimori¹, Yuki Kameguchi¹, Munehiro Ogawa², Yasuhiro Tanaka²
¹Heisei Memorial Hospital, ²Nara Medical University

The cortical adaptation monitoring system for leg press machine with FES induced biofeedback
Misato Kasuya¹, Mai Nozakura¹, Soichi Morishita¹, Yinlai Jiang¹, Masao Sugi¹, Hiroshi Yokoi¹
¹The University of Electro-Communications

O.5. Neuromechanics II

Effect of Lower Extremity Efforts on Involuntary Upper Extremity Activity in Chronic Hemiparetic Stroke: Preliminary Findings
Rachel Hawe¹, Jules Dewald¹
¹Northwestern University

Variability in neuromotor control of the musculoskeletal system dynamics: a stochastic modelling approach.
Bart van Veen¹, Saulo Martelli², Claudia Mazzâ¹, Erkki Somersalo³, Daniela Calvetti³, Marco Viceconti¹
¹University of Sheffield, ²Flinders University, ³Case Western Reserve University

From muscle-tendon to whole-body dynamics: towards a multi-scale empirical understanding of human movement biomechanics
Karl Zelik¹
¹Vanderbilt University

The same library of muscle synergies are shared across diverse locomotor tasks
Jessica Allen¹, Andrew Sawers², Lena Ting¹
¹Emory University, ²University of Illinois at Chicago

Decreasing the lumbar flexion moment induces earlier onset of flexion relaxation
Derek Zwambag¹, Diana De Carvalho², Stephen Brown¹
¹University of Guelph, ²Memorial University of Newfoundland

Estimation of Ankle Impedance During Walking on a Slippery Surface
Mariah Whitmore¹, Levi Hargrove¹, Eric Perreault¹
¹Northwestern University
O.6. Motor Units I

**Motor units in the human medial gastrocnemius muscle are not spatially localized or functionally grouped**
Martin Héroux¹, Harrison Brown⁷, John Inglis⁵, Gunther Siegmund⁴, Jean-Sébastien Blouin²
¹Neuroscience Research Australia, ²University of British Columbia, ³MEA Forensic Engineers & Scientists

**Motor Unit Action Potential Clustering**
Michael Asmussen¹, Vinzenz von Tscharner¹, Benno Nigg¹
¹University of Calgary

**EMG envelope and tension oscillations during steady fine motor control**
Claudio Orizio¹, Francesco Negro⁸, Marta Cogliati¹, Anna Castronovo⁸, Dario Farina²
¹University of Brescia, ²University Medical Center Göttingen

**Using the Size Principle to Model Peripheral Muscle Fatigue**
Jim Potvin¹, Andrew Fuglevand²
¹McMaster University, ²University of Arizona

**Motor units activation changes induce by mechanical vibration**
Luigi Fattorini¹, Angelo Tirabasso², Alessandro Lunghi², Raoul DiGiovanni², Floriana Sacco², Enrico Marchetti²
¹Sapienza University of Rome, ²National Institute for Insurance against Accidents at Work

**Features for tracking spatial intra-cortical, electrophysiological changes in a rat model of ischemic stroke**
Rasmus Nielsen¹, Winnie Jensen¹
¹Sensory-Motor Interaction
S.3 Muscle mechanics and neural control determining fine hand-motor tasks

**Mechanical factors limiting finger independence**
Huub Maas¹, Nathalie van Beek¹, Josien van den Noort², Dick Stegeman³
¹Vrije Universiteit Amsterdam, ²VU University medical center, ³Radboud University Medical Centre

**Neuromuscular control of extrinsic flexors and extensors during single finger movements**
Nathalie van Beek¹, Dick Stegeman², Josien van den Noort³, DirkJan Veeger⁴, Huub Maas¹
¹Vrije universiteit Amsterdam, ²Radboud University Medical Centre, ³VU University medical center

**The Effect of the Subsynovial Connective Tissue in the Carpal Tunnel On Finger Motion In Health And Disease**
Peter Amadio¹
¹Mayo Clinic

**Wrist posture and force effects on finger control**
Peter Keir¹, Stephen May¹
¹McMaster University

**Correlated deficits in bi-lateral hand function following unilateral stroke**
Naveed Ejaz¹, Jing Xu², Benjamin Hertler³, Meret Branscheidt⁴, Mario Widmer⁵, Nathan Kim⁶, Michelle Harran⁶, Juan Cortes⁶, Andreia Faria⁶, Pablo Celnik⁶, Tomoko Kitago⁶, Andreas Luft⁷, John Krakauer⁷, Jörn Diedrichsen⁵
¹University College London, ²Johns Hopkins University, ³University of Zürich, ⁴Columbia University, ⁵University of Western Ontario

**Base vectors in complex finger movements**
Sigrid Dupan¹, Naveed Ejaz², Dick Stegeman¹, Joern Diedrichsen²
¹Donders Institute for Brain, Cognition, and Behaviour, ²The Brain and Mind Institute

S.4 Neuromodulatory Strategies for Improving Motor Control after CNS Damage

**Novel neuromodulation strategies for Parkinson’s disease**
Robert Chen¹
¹Toronto Western Hospital, University of Toronto

**Changing a reflex to improve walking: operant conditioning of the soleus h-reflex in people with chronic incomplete spinal cord injury**
Aiko Thompson¹
¹Medical University of South Carolina

**Acute Intermittent Hypoxia Enhances Neuroplasticity In Incomplete Sci**
william rymer¹, Milap Sandhu¹, arun jayaraman¹
¹Rehabilitation Institute of Chicago
Stimulation-induced plasticity in corticospinal transmission to motoneurones
Janet Taylor¹, Siobhan Donges¹, Jessica D’Amico¹
¹Neuroscience Research Australia

Using targeted neuroplasticity for rehabilitation
Jonathan Wolpaw¹
¹Wadsworth Center (NY State Dept. of Health) and SUNY Albany

Plasticity in the Corticospinal Pathway after Human Spinal Cord Injury
Monica Perez¹
¹University of Miami

S.5 International Society of Biometrics Symposium

Surface Electromyography Meets Biomechanics or Bringing sEMG to Daily Life
Catherine Disselhorst-Klug

Intrinsic foot muscle activity in response to different loading conditions
Andrew Cresswell¹, Glen Lichtwark¹, Luke Kelly¹
¹The University of Queensland

The additional value of electromyography in system identification and parameter estimation to assess the contribution of underlying systems in standing balance
Jantsje Pasma¹, Joost van Kordelaar², Digna de Kam³, Vivian Weerdesteyn³, Alfred Schouten¹, Herman van der Kooij²
¹Delft University of Technology, ²University of Twente, ³Radboud University Medical Center

Neck pain: Do head movement qualities change during an intensive treatment period?
Marit Thielemann¹, Nina Vøllestad¹
¹University of Oslo

An electromyographic evaluation of elastic band exercises targeting neck and shoulder pain
Thomas Grøndberg¹, Lars Kristensen¹, Ying Gao², Mike Murray¹, Gisela Sjøgaard¹, Karen Søgaard¹
¹University of Southern Denmark, ²University of Jyväskylä

Forearm muscle activity differs during gripping in people with tennis elbow compared to healthy individuals.
Nagarajan Manickaraj¹, Leanne M Bisset², Justin J Kavanagh²
¹PhD Student, Griffith University, ²Griffith University
S.6 Stepping out of the lab: EMG in daily life

Fully-Integrated Stretchable Epidermal Electronics and Biosensors
Roozbeh Ghaffari¹
¹MC10 Inc.

A Wireless Surface EMG System for Daily Activity Measurement
Yi Su¹, Sudhamayee Routhu¹, Kee Moon¹, Yusuf Ozturk¹
¹San Diego State University

Tattoo-like, long-term electromyography sensors for quantifying muscle fatigue and recovery
Nanshu Lu¹, Luke Nicolini¹, Dragan Djurdjanovic¹
¹University of Texas at Austin

EMG-based Online Intent Recognition for a Powered Lower Limb Prosthesis
John Spanias¹, Eric Perreault¹, Levi Hargrove²
¹Northwestern University, Rehabilitation Institute of Chicago, ²Rehabilitation Institute of Chicago, Northwestern University

NeuroGame Therapy for the Improvement of Ankle Control in Children with Cerebral Palsy
Torey Gilbertson¹, Sarah McCoy¹, Kristie Bjornson², Robert Price¹, Chet Moritz¹
¹University of Washington, ²Seattle Children's Research Institute, University of Washington

Backyard Brains: Using EMGs as an entry into neuroscience education
Gregory Gage¹
¹Backyard Brains
S.7 Synchrony and frequency in neuromuscular control

_Synchrony and frequency in neuromuscular control_
Christopher Laine¹
¹Univ of Southern California

_Motor control of upper airway dilator muscles_
John Trinder¹
¹University of Melbourne

_Investigating neural strategies for muscle coordination_
Christopher Laine¹, Francisco Valero-Cuevas¹
¹University of Southern California

_Investigating the neural substrate of motor coordination using muscle networks_
Tjeerd Boonstra¹
¹University of New South Wales

_Motor unit synchronization revisited: Estimating the proportion of common synaptic inputs to population of motor neurons in humans_
Francesco Negro¹, Utku Şükrü Yavuz¹, Dario Farina¹
¹Universitätsmedizin Göttingen

_Sensitivity of intermuscular coherence to identify common oscillatory synaptic inputs to motor neurons_
Kevin Keenan¹, Francesco Negro², Dario Farina², Roger Enoka³
¹University of Wisconsin-Milwaukee, ²Georg-August University, ³University of Colorado

S.8 Neuromuscular Electrical Stimulation: Time to Turn the Page

_Predictors of response to neuromuscular electrical stimulation training_
Marco Alessandro Minetto¹, Isabelle Vivodtzev³, Giuseppe Massazza¹, Nicola Maffiuletti³
¹University of Turin, ²Univ Grenoble Alpes and Inserm U 1042, ³Schulthess Clinic

_Introduction and Conclusion to the symposium "Neuromuscular Electrical Stimulation: Time to Turn the Page"_
Nicola Maffiuletti³, Marco Minetto²
³Schulthess Clinic, ²University of Turin

_An Algorithm for NMES Therapy after Knee Surgery: A Novel Structured Approach_
Jennifer Stevens-Lapsley¹, Andrew Kittelson¹, Yocheved Laufer², Michal Elboim-Gabyzon³, Nicola Maffiuletti³
¹University of Colorado, Anschutz Medical Campus, ²University of Haifa, ³Schulthess Clinic
**Low-frequency pulsed currents vs. Khz-frequency alternating currents**
Marco vaz¹
¹Federal University of Rio Grande do Sul

**Maximising the central contribution to electrically-evoked contractions**
David Collins¹, Matheus Wiest¹, Austin Bergquist²
¹University of Alberta, ²University of Toronto

**Spatially Distributed Sequential Stimulation: Method to Reduce Muscle Fatigue During Transcutaneous Functional Electrical Stimulation**
Kei Masani¹, Dimitry Sayenko², Robert Nguyen³, Vishvek Babbar⁴, Tomoyo Hirabayashi⁵, Austin Berquist⁴, Milos Popovic⁴
¹Toronto Rehab and University of Toronto, ²University of California, ³ETH Zurich, ⁴University of Toronto and Toronto Rehab, ⁵Toronto Rehab

**O.7. EMG: signal processing**

**Optimum threshold for slope sign changes and zero crossing features.**
Rosa Hugosdottir¹, Julie Gade¹, Kevin Englehart³, Erik Scheme², Ernest Nlandu Kamavuako¹
¹Aalborg University, ²University of New Brunswick

**Variability of Features Extracted from sEMG Signal**
Yiyang Shi¹, Dawn MacIsaac¹, Philip Parker¹
¹University of New Brunswick

**Wavelet-based functional ANOVA to reveal statistically-significant contrasts between EMG waveforms recorded in different experimental conditions**
J. Lucas McKay¹, Torrence Welch¹, Brani Vidakovic¹, Lena Ting¹
¹Emory University and Georgia Tech

**Nonnegative matrix factorization to assess spatiotemporal muscle activation**
Didier Staudenmann¹, Andreas Dafertshofer², Dick Stegeman³, Jaap van Dieen²
¹University of Fribourg, Movement and Sport Science, ²Vrije Universiteit Amsterdam, ³Radboud University Medical Centre

**Analysis of amplitude estimation of non-stationary myoelectric signals**
David Hofmann¹
¹Emory University

**Automated Detection of Fasciculations in Motor Neurone Disease Patients using B mode Ultrasound: A Comparison with Electromyography.**
Kate Bibbings¹, Peter Harding¹, Nick Combes², Ian Loram¹, Emma Hodson-Tole¹
¹Manchester Metropolitan University, ²Preston Royal Hospital
O.8. Motor performance and Ergonomics

The surgeon's workload; traditional laparoscopic (TLS) versus robot-assisted (RAS) surgery
Bente Rona Jensen¹, Morten Dedenroth¹, Dorte Hartwell¹, Berit Mosgaard¹, Annemette Jørgensen², Torur Dalsgaard¹
¹University of Copenhagen, ²Aalborg University Hospital

Characterizing changes in neuromuscular control in response to different locomotor tasks using electromyographic wavelet analysis
Linard Filli¹, Martina Waser¹, Christopher Easthope², Tim Killeen², Christian Meyer¹, Lilla Loerincz¹, Armin Curt², Marc Bolliger², Björn Zoerner¹
¹University Hospital Zurich, ²Balgrist University Hospital

Temporal trunk muscle patterns are altered ipsilateral to back injury side despite perception of recovery
D Adam Quirk¹, Cheryl Hubley-Kozey¹
¹Dalhousie University

Adapting to different running footwear: A neuromuscular approach
Devon Coetzee¹, Nicholas Tam¹, Ross Tucker³, Yumna Albertus¹
¹University of Cape Town, ²University of Free State

Surface electromyographic inter-individual variability and pattern recognition in front crawl swimming
Jonas Martens¹, Daniel Daly¹, Kevin Deschamps¹, Filip Staes¹, Ricardo Fernandes²
¹KU Leuven, ²University of Porto

Posture variation and maximal acceptable work pace during repetitive work
Tessy Luger¹, Svend Erik Mathiassen², Tim Bosch³, Marco Hoozemans¹, Marjolein Douwes³, DirkJan Veeger¹, Michiel de Looze³
¹Vrije Universiteit Amsterdam, ²University of Gävle, ³TNO
Thursday, July 7 11:00 - 12:30am

O.9. EMG: novel applications

*Changes in the surface electromyographic signal during high intensity fatiguing dynamic exercise*
Clare Davidson¹, Giuseppe De Vito¹, Madeleine Lowery¹
¹University College Dublin

*Feasibility of uterine electromyography outside pregnancy*
Chiara Rabotti¹, Federica Sammali¹, Nienke Kuisters², Benedictus Schoot³, Massimo Mischi¹
¹Eindhoven University of Technology, ²Catharina Hospital, ³University Hospital Gent

*Nonlinear Analysis of Electromyography in Parkinson’s Disease During Isometric Leg Extension*
Matthew Flood¹, Bente Jensen², Anne Malling³, Martin Rose³, Madeleine Lowery¹
¹University College Dublin, ²University of Copenhagen, ³University of Copenhagen

*Chronic EMG activity reveals early changes in muscle activation in treadmill running SOD1 mice*
CJ Heckman¹, Matthew Tresch¹, Vicki Tysseling¹
¹Northwestern University Feinberg School of Medicine

*The gluteus medius, gluteus minimus and tensor fascia latae are more active during gait in post-menopausal women with greater trochanteric pain syndrome*
Charlotte Ganderton¹, Tania Pizzari¹, Adam Semciw²
¹La Trobe University, ²University of Queensland

*Quadratus femoris is minimally active in common rehabilitation exercises*
Adam Semciw¹, Jodie McClelland², Damien Moore², Tania Pizzari²
¹The University of Queensland, ²La Trobe University

O.10. Sensorimotor control and learning

*Locomotor Adaptation to Stable and Unstable Environments*
Keith Gordon¹, Mengnan Wu¹, Geoffery Brown¹
¹Northwestern University

*Motor adaptations to pain during a bilateral plantarflexion task: does the cost of using the non-painful limb matter?*
François Hug¹, Paul Hodges², Timothy Carroll², Enrico De Martino², Justine Magnard¹, Kylie Tucker²
¹University of Nantes, ²The University of Queensland

*Size of kinematic error affects retention of locomotor adaptation in children with cerebral palsy*
Mongnian Tang¹, Janis Kim¹, Deborah J Gaebler-Spira¹, Ming Wu¹
¹Rehabilitation Institute of Chicago

*Motor learning with pain results in long-lasting changes in motor strategies*
Sauro Salomoni¹, Welber Marinovic¹, Timothy Carroll¹, Paul Hodges¹
¹The University of Queensland
Factors affecting smoothness of head movements
Marit Thielemann¹, Nina Vøllestad¹
¹University of Oslo

Multichannel SEMG activity and force variability during isometric contractions at low level forces in diabetic individuals
Eneida Y Suda¹, Isabel CN Sacco¹, Thiago T Kawamura¹, Rogerio P Hirata⁹, Afshin Samani², Pascal Madeleine²
¹University of São Paulo, ²Aalborg University

O.11. Novel measurement techniques

High density multi-channel needle electromyography: towards electrical cross-sectional imaging of human skeletal muscle
Bashar Sheikh Hasan¹, Enrique Escobedo-Cousin¹, Hock Soon Low¹, Anthony O'Neill¹, Stuart Baker¹, Roger Whittaker¹
¹Newcastle University

Spatiotemporal muscle activation of a sustained contraction until task failure assessed with nonnegative matrix factorization
Didier Staudenmann¹, Andreas Daffertshofer², Dick Stegeman³, Roger Enoka⁴
¹University of Fribourg, Movement and Sport Science, ²Move Research Institute / Vrije Universiteit Amsterdam, ³Donders Institute / Radboud University Medical Centre, ⁴Department of Integrative Physiology / University of Colorado

Monitoring changes in motor unit behavior following short-term high intensity interval training with high-density surface electromyography motor unit tracking
Eduardo Martinez-Valdes¹, Deborah Falla², Francesco Negro², Frank Mayer¹, Dario Farina²
¹University of Potsdam, Potsdam, Germany, ²University Medical Center Göttingen, Georg-August University, Göttingen, Germany

Neuromuscular control adaptations in strength trained athletes: a high-density EMG study
Alessandro Del Vecchio¹, Federico Quinzi¹, Ilenia Bazzucchi¹, Luigi Di Luigi¹, Francesco Felici¹
¹University of Rome "Foro Italico"

Assessing somatosensory evoked potentials using high density surface electromyography grids
Tessy Luger¹, Andreas Daffertshofer¹
¹Vrije Universiteit Amsterdam

Design of New Multi-channel Electrodes for the Collection of Surface Electromyography Monopolar Signals for the Software Generation Signals for Linear Array and Laplacian Configurations for Digital Signal Processing
Jeff Kilby¹, Krishnamachar Prasad¹, Grant Mawston¹
¹Auckland University of Technology
O.12. Motor Units II

Comparison of Five Methods for Estimating Motor Unit Firing Rates from Firing Times
Lukai Liu¹, Paolo Bonato², Edward Clancy¹
¹Worcester Polytechnic Institute, ²Spaulding Rehabilitation Hospital & Harvard Medical School

The common synaptic input signal underlying the common drive
Kevin McGill¹, Zoia Latev¹, M. Elise Johanson¹
¹VA Palo Alto Health Care System

Assessment of single motor unit activation in central and peripheral neuronal disorders
Kathrin Koch¹, Catherine Disselhorst-Klug¹
¹RWTH Aachen University

Modulation of motor units serving different VM fibers during knee extension
Hélio Cabral¹, Leonardo de Souza¹, Roger Mello², Liliam Oliveira¹, Taian Vieira¹
¹Universidade Federal do Rio de Janeiro, ²Escola Naval/Marinha do Brasil

Estimating Motor Unit Territories Using Statistical Parametric Mapping
Peter Harding¹, Ian Loram¹
¹Manchester Metropolitan University

The Temporal Structure of Intermuscular Motor Unit Synchronization: Application of Wavelet Coherence
Maurice Mohr², Vinzenz von Tscharner³, Benno Nigg¹
¹University of Calgary
Thursday, July 7  3:00 - 4:30pm

S.9 Implementation of Impairment Based Neuro-Rehabilitation Devices and Technologies following Brain Injury

Robotic assessment of the "good arm" following stroke
Sean Dukelow¹, Jennifer Semrau¹, Troy Herter², Stephen Scott³
¹Hotchkiss Brain Institute/University of Calgary, ²University of South Carolina, ³Queen's University

Robotic Measurement and Intervention for Synergy-Related Reaching Dysfunction Following Stroke
Michael Ellis¹, Julius Dewald¹
¹Northwestern University

Using Robotic Systems to Assess Proprioceptive Deficits in Individuals with Hemiparetic Stroke
Netta Gurari¹
¹Northwestern University

The use of haptic robots to study neural mechanisms underlying the expression of sensorimotor impairments in stroke.
Julius Dewald¹, Albert Chen², Jun Yao¹
¹Northwestern University Feinberg School of Medicine, ²Athenahealth

Training modalities in robot-mediated upper limb rehabilitation in stroke
Arno Stienen¹
¹University of Twente

4D EEG: Assessing the role of the sensorimotor cortex in reflex modulation during motor control.
Frans van der Helm¹, Yuan Yang¹, T Solis-Escalante¹, M Vlaar¹, Jun Yao², Jules Dewald², Alfred Schouten¹
¹Delft University of Technology, ²NOorthwestern University

S.10 Neural mechanisms underlying falls and impaired balance: an introspective from animal to patient

Balance reactions following perturbations to touch are more pronounced when standing on an unstable surface
John Misiaszek¹, Jesse Vander Meulen¹
¹University of Alberta

Altered sensorimotor transformations for balance in Parkinson’s disease
J. Lucas McKay¹, Madeleine Hackney², Lena Ting¹
¹Emory University and Georgia Tech, ²Emory University and Atlanta VAMC

New rehabilitation tools and technologies to improve balance and mobility
Joyce Fung¹
Strategies to maintain static and dynamic lateral stability during locomotion in the cat
Boris Prilutsky¹, Hungue Park¹, Ricky Mehta¹, Joshua Jarrell¹, Stephen DeWeerth¹, Bradley Farrell²
¹Georgia Institute of Technology, ²Georgia State University

Are Hypermetric Stretch Reflexes Significant Contributors to Falls in Stroke Survivors?
Claire Honeycutt¹, Mark Grabiner²
¹Arizona State University, ²University of Illinois at Chicago

Basic insights in tripping responses can assist in designing appropriate fall prevention programs.
Jacques Duysens¹, Zrinka Potocanac²
¹Katholieke Universiteit Leuven, ²Jozef Stefan Institute

S.11 EMG Signal Analysis in Clinical Applications

A novel method for analysis of pathological tremor in electroencephalograms
Ales Holobar¹, Juan Gallego², Rok Istenic¹, Eduardo Rocon², Juan Romero³, Julian Benito-Leon⁴, José Pons⁵, Vojko Glaser¹
¹University of Maribor, Faculty of Electrical Engineering and Computer Science, ²Neural and Cognitive Engineering Group, CAR, Spanish National Research Council, ³School of Biomedical Sciences, Universidad Francisco de Vitoria, ⁴Department of Neurology, Un

Contribution of deep and superficial motor units to the surface EMG of the masseter muscle.
Johannes van Dijk¹, Ulrike Eiglsperger¹, Johanna Radeke¹, Hans Schindler², Bernd Lapatki¹
¹University of Ulm, ²University of Heidelberg

Alterations in motor unit firing rate and action potential properties during isometric fatigue in stroke survivors
Lara McManus¹, Xiaogang Hu², William Rymer³, Madeleine Lowery¹, Nina Suresh⁴
¹University College Dublin, ²University of North Carolina-Chapel Hill and North Carolina State University, ³Rehabilitation Institute of Chicago and Northwestern University, ⁴Rehabilitation Institute of Chicago

High Density Surface EMG Examination of Motor Unit Firing Behavior in Amyotrophic Lateral Sclerosis
Faezeh Jahanmiri-Nezhad¹, Ales Holobar², William Rymer³, Ping Zhou⁴
¹University of Northern Iowa, ²University of Maribor, ³Rehabilitation Institute of Chicago, ⁴University of Texas Health Science Center at Houston

A novel device for assessing pelvic floor muscle function in women
Stéphanie Madill¹, Angelica Lang², Gordon Sarty¹
¹University of Saskatchewan
The use of EMG in neuromuscular diagnosis: an overview
Dick Stegeman¹
¹Radboud University Medical Centre

S.12. Spastic muscle and its treatment using botulinum toxin: new viewpoints with major implications
Persistent muscle weakness and contractile material loss in a clinically relevant botulinum toxin type-a (btx-a) injection protocol
Rafael Fortuna¹, Andrew Sawatsky¹, Walter Herzog¹
¹University of Calgary

Experimental and Modeling Assessments Specific to Treatment Aims Indicate New Viewpoints and an Understanding of Mechanisms of Effects of Botulinum Toxin Type A
Can Yucesoy¹, Filiz Ates²
¹Bogazici University, ²Waseda University

Intraoperative Testing of Individual Spastic Knee Flexor Muscles’ Capacity to Affect Impeded Knee Joint Function in Cerebral Palsy Patients
Filiz Ates¹, Yener Temelli², Can Yucesoy³
¹Waseda University, ²Istanbul University, ³Bogazici University

Muscle material properties in children with hemiplegic cerebral palsy
Sabrina Lee¹, Deborah Gaebler-Spira¹, Li-Qun Zhang¹, William Rymer², Katherine Steele³
¹Northwestern University, ²Rehabilitation Institute of Chicago, ³University of Washington

The effect of botulinum toxin injections on gastrocnemius muscle volume in children with spastic cerebral palsy
Adam Shortland¹, Adam Shortland¹, Adam Shortland¹, Adam Shortland¹
¹Guy’s & St Thomas’ Foundation Trust

Structural and Functional Consequences of Neurotoxin injection in a Rat Model System
Richard Lieber¹, Samuel Ward²
¹Rehabilitation Institute of Chicago, ²University of California, San Diego,
S.13 Prosthetics to Orthotics: Transferable Expertise

*Direct mechanical control outperforms EMG control*
Dick Plettenburg¹
¹Delft University of Technology

*The state-of-the-art EMG control in dynamic orthoses*
Derek Kamper¹
¹Illinois Institute of Technology

*Surface EMG control in neurorehabilitation: experiences from EMG-driven modelling and robotic for upper and lower limb post-stroke rehabilitation*
Dario Farina¹, Massimo Sartori¹, Andrea Turolla²
¹University Medical Center Goettingen, ²IRCCS San Camillo Hospital Foundation

*Structured panel discussion on prosthetics to orthotics: transferrable expertise*
Arno Stienen¹
¹University of Twente

*Unassisted FES is all you need to regain hand function*
Thierry Keller¹
¹Tecnalia Research and Innovation

*The case for impedance control in wearable robotics*
Elliott Rouse¹
¹RIC / Northwestern University

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S.14 Clinical applications of muscle synergies

*Function and dysfunction in brain connectivity coordinating muscle synergies in humans*
Jason Kutch¹
¹University of Southern California

*Does modularity in post-stroke motor coordination differ in dynamic and static tasks?*
Jinsook Roh¹, Kevin Wilger¹, William Rymer², Randall Beer³
¹Temple University, ²Northwestern University, ³Rehabilitation Institute of Chicago

*Neuromotor modules as markers of diseased states and progress of motor recovery*
Vincent C. K. Cheung¹, Giacomo Severini², Paolo Bonato³, Andrea Turolla⁴, Roy T. H. Cheung⁵
¹The Chinese University of Hong Kong, ²University College Dublin, ³Harvard Medical School, ⁴IRCCS San Camillo Hospital, ⁵The Hong Kong Polytechnic University
Synergistic changes in muscle coordination post-stroke in a locomotor learning task
Gelsy Torres-Oviedo¹, Pablo Iturralde¹
¹University of Pittsburgh

Do muscle synergies change after treatments in cerebral palsy?
Benjamin Shuman¹, Marije Goudriaan², Kaat Desloovere¹, Michael Schwartz³, Katherine Steele¹
¹University of Washington, ²KU Leuven, ³Gillette Children's Specialty Healthcare

Long-term training modifies the modular structure and organization of walking balance control
Andrew Sawers¹, Jessica Allen², Lena Ting²
¹University of Illinois at Chicago, ²Emory University

O.13. Muscle Physiology

Passive stiffness of lumbar multifidus and erector spinae muscle fibres is decreased in ENT1 deficient mice
Kelsey Gsell¹, Derek Zwambag¹, Cheryle Séguin², Stephen Brown¹
¹University of Guelph, ²Western University

High-resolution in vivo measurement of changes in architecture of the human medial gastrocnemius muscle during passive lengthening
Bart Bolsterlee¹, Arkiev D’Souza¹, Simon Gandevia¹, Robert Herbert¹
¹Neuroscience Research Australia (NeuRA)

Three Different Cell Types Produce Collagen During Skeletal Muscle Fibrosis
Mark Chapman¹
¹University of California, San Diego

Inhomogeneity of emg-and ultrasound-detected onset of voluntary muscle activation explains their inconsistent relationship
Angela Dieterich¹, Alberto Botter², Taian Vieira³, Anneli Peolsson³, Frank Petzke¹, Paul Davey⁴, Deborah Falla¹
¹University Medical Center Goettingen, ²Politecnico di Torino, ³Linköping University, ⁴Curtin University

Feasibility of quantitative uterine motion analysis by ultrasound speckle tracking outside pregnancy
Federica Sammali¹, Nienke Kuijsters², Chiara Rabotti¹, Benedictus Schoot³, Massimo Mischì³
¹Eindhoven University of Technology, ²Catharina Hospital, ³University Hospital Ghent

Functional Relevance of Epimuscular Interactions at Forearm: In vivo Assessments with Ultrasound Elastography
Filiz Ates¹, Yasuo Kawakami¹
¹Waseda University
A startling acoustic stimulus influences initial and late phases of postural responses differently in people after stroke
Jolanda Roelofs¹, Milou Coppens¹, Nicole Donkers¹, Jorik Nonnekes¹, Vivian Weerdesteyn¹, Alexander Geurts¹
¹Radboud university medical center

Evaluations of wrist spasticity post stroke
Sang Hoon Kang¹, Song Joo Lee², Li-Qun Zhang³
¹Northwestern University; Rehab. Inst. of Chicago; UNIST, ²Northwestern University; Rehab. Inst. of Chicago; KIST, ³Northwestern University; Rehab. Inst. of Chicago; Northshore University HealthSystem

Coordination of deep hip muscle activity is altered in symptomatic femoroacetabular impingement
Laura Diamond¹, Wolbert Van den Hoorn², Kim Bennell¹, Tim Wrigley¹, Rana Hinman¹, John O'Donnell³, Paul Hodges²
¹The University of Melbourne, ²The University of Queensland, ³St Vincent's Hospital

Trunk neuromuscular patterns in recovered low back injury individuals differs between those who do and do not re-injure at one-year follow up
Cheryl Hubley-Kozey¹, D Adam Quirk¹, Daniel Trudel²
¹Dalhousie University, ²Canadian Armed Forces

Extrinsic finger muscle stiffness contributes substantially to increased passive stiffness of the wrist and finger joints in chronic hemiparetic stroke individuals: A Pilot Study
Benjamin Binder-Markey¹, Julius Dewald¹, Wendy Murray¹
¹Northwestern University

Humeral rotational capabilities of stroke survivors and pattern recognition of intent during shoulder tasks
Joseph Kopke¹, Levi Hargrove³, Michael Ellis¹
¹Northwestern University, ²Northwestern University; Rehabilitation Institute of Chicago
S.15 Multichannel EMG: decomposition and other applications

**Convolutive source deflation significantly improves convergence of blind motor unit identification from surface electromyograms**
Uros Manacinski¹, Ales Holobar¹
¹University of Maribor, Faculty of Electrical Engineering and Computer Science

**High-density surface electromyograms: do they sample representative muscle active?**
Taian Vieira¹
¹Politecnico di Torino

**Topographical characteristics of motor units of the complete facial musculature determined by means of high-density surface EMG.**
Bernd Lapatki¹, Alisa Barth¹, Johannes Neubert¹, Johanna Radeke¹, Dick Stegeman², Ales Holobar³, Johannes van Dijk¹
¹University of Ulm, ²Radboud University Medical Centre, ³University of Maribor

**Longitudinal tracking of individual motor units using high-density surface electromyography**
Francesco Negro¹, Eduardo Martínez-Valdes², Christopher Thompson³, Michael Johnson⁴, Deborah Falla¹, Charles Heckman⁴, Dario Farina¹
¹universitätsmedizin göttingen, ²University of Potsdam, ³Temple University, ⁴Northwestern University

**Differences in motor unit discharge characteristics among proximal and distal muscles of the upper limb in individuals with chronic hemiparetic stroke**
Laura Miller McPherson¹, Francesco Negro², Chris Thompson³, CJ Heckman⁴, Dario Farina¹, Jules Dewald⁴
¹Florida International University, ²University of Gottingen, ³Temple University, ⁴Northwestern University

**How synaptic organization shapes the motoneuron to EMG transform**
CJ Heckman¹, Randy Powers²
¹Northwestern University, ²University of Washington

S.16 The Mobilize Center: Accelerating Movement Science with Big Data

**The Mobilize Center: Accelerating Movement Science with Big Data**
Jennifer L. Hicks¹, Joy P. Ku¹, Scott L. Delp¹,²
¹Departments of Bioengineering¹ and Mechanical Engineering², Stanford University

**Stepping forward? Patient-specific measures of altered control to improve treatment outcomes in cerebral palsy**
Katherine Steele¹, Michael Schwartz²
¹University of Washington, ²Gillette Children's Specialty Healthcare
Detecting foot strike from kinematics, a case study in the debate between hypothesis-first and data-first methods
Sean Osis¹, Reed Ferber¹
¹University of Calgary

Data and data management for finite element analysis in joint biomechanics
Ahmet Erdemir¹
¹Cleveland Clinic

Moving Forward: From Physical Activity Monitoring to Physical Performance Monitoring
Matthew Smuck¹
¹Stanford University

Characterizing Clinically Meaningful Phenotypes of Osteoarthritis Progression: Eight-Year Data from the Osteoarthritis Initiative
Eni Halilaj¹, Jason Fries¹, Jennifer Hicks¹, Scott Delp¹
¹Stanford University

S.17 Practical Application of Electrophysiology and Kinesiology

Application of multi-channel surface EMG technique to researches of aging and lifestyle-related diseases
KOHEI WATANABE¹
¹Chukyo University

Rehabilitation robot using muscle activity and neural decoding
Toshihiro Kawase¹, Duk Shin¹, Hiroyuki Kambara¹, Natsue Yoshimura¹, Yasuharu Koike¹
¹Tokyo Institute of Technology

Ubiquitous approach for health and sport
Masaki Yoshida¹, Zunyi Tang¹, Masaki Sekine³, Toshiyo Tamura¹
¹Osaka Electro-Communication University

A Remote and Non-Contact Monitoring System of Physiological Indices to Cope with Visually Induced Motion Sickness
Makoto Yoshizawa¹, Norihiro Sugita¹, Makoto Abe³, Akira Tanaka³, Noriyasu Homma¹, Tomoyuki Yambe¹
¹Tohoku University, ²Shinshu University, ³Fukushima University

Brain-muscle-machine interface: controlling a prosthetic hand
Ryu Kato¹
¹Yokohama National University
S.18 Intermittent control

Intermittent Control provides a deterministic explanation of linear and remnant components of human stance control without injection of random noise.
Cornelis van de Kamp¹, Henrik Gollee², Peter J Gawthrop³, Ian D Loram⁴
¹Delft University of Technology, ²University of Glasgow, ³University of Melbourne, ⁴Manchester Metropolitan University

Intermittent control: a general paradigm for understanding sensorimotor control
Ian Loram¹, Peter Gawthrop², Henrik Gollee³
¹Manchester Metropolitan University, ²The University of Melbourne, ³University of Glasgow,

A machine learning model of intermittent control
Ryan Cunningham¹, Ian Loram³
¹Manchester Metropolitan University

Remnant response in visual-manual tasks and intermittent control
Henrik Gollee¹, Ian Loram², Peter Gawthrop³
¹University of Glasgow, ²Manchester Metropolitan University, ³University of Melbourne

Sensorimotor dynamics in the brain during intermittent control of goal-directed movements
Scott Beardsley¹, Robert Scheidt¹
¹Marquette University

A dual Kalman filter approach to adaptation in intermittent control
Jose Alvarez Martin¹, Henrik Gollee¹, Ian Loram², Peter Gawthrop³
¹University of Glasgow, ²Manchester Metropolitan University, ³University of Melbourne

Intermittency using boundary control
James Patton¹, Amit Shah¹
¹University of Illinois at Chicago (UIC), and the Rehabilitation Institute of Chicago (RIC)