

ICNR 2020



WearRAcon



ICNR2020, WEROB2020 and WearRacon Europe
FULL PROGRAM



Shirley Ryan
Abilitylab



ABOUT ICNR

Restoring human sensory, motor and cognitive functions has been a fascinating research area during the last century. Interfacing the human nervous system with electronic and mechatronic systems to restore or compensate the neural function of patients is facing its crucial passage between research and actual clinical reality.

The 2020 International Conference on Neurorehabilitation brings together researchers and students from the fields of Clinical Rehabilitation, Applied Neurophysiology and Biomedical and Neural Engineering to promote, feed and encourage this therapeutic global shift. Moreover, the conference is held in parallel with the International Symposium on Wearable Robotics (WeRob2020), which brings together researchers and innovators from all around the world to discuss novel approaches, challenges and potential solutions in technologies for wearable robots, especially in the clinical field.

ABOUT WeRob

Researchers and innovators from all around the world will discuss novel approaches, challenges and potential solutions in technologies for wearable robots. The symposium will enclose presentations and discussions in various fields such as: supporting solutions for healthy ageing, advanced therapeutic treatments of neurological diseases, space applications or assistive technologies in the industry. Demonstrations and exhibitions of reference technologies in the field will also take place.

International speakers from academia, government, industry, medical centres and end users are encouraged to participate in this biannual event. WeRob provides an international forum for researchers and practitioners to report the latest innovations, discuss state-of-the-art techniques, and exchange ideas and advances in all aspects of wearable robotics.

Moreover, this event will be held in parallel with the 2020 International Conference on Neurorehabilitation (ICNR2020), which will bring together researchers and students from the fields of Clinical Rehabilitation, Applied Neurophysiology, and Biomedical Engineering to promote, feed and encourage this therapeutic global shift.

LETTER FROM THE CONFERENCE CHAIRS

Dear Colleagues,

It is a great pleasure to welcome you to the International Conference on NeuroRehabilitation (ICNR2020), the International Symposium on Wearable Robotics (WeRob2020) and WearRAcon Europe, to be virtually held from October 14-16, 2020.

ICNR2020 will cover a wide range of topics in the field of Neurorehabilitation, such as neuromodulation, reflex operant conditioning, brain-machine interfaces in motor rehabilitation, motor and sensory facilitation, neurophysiological mechanisms, brain stimulation, neural signal processing, neuromuscular systems, motor neuroprosthetics, robotics, prosthetics, orthotics, neural interfaces, assistive technologies, neuro-musculoskeletal modelling, biomechanics and movement analysis, clinical needs, assessment and management of spasticity, assessment of the pathological brain, translational aspects, etc.

WeRob2020 and WearRacon Europe program includes oral and poster presentations and discussions in various fields such as: supporting solutions for healthy ageing, advanced therapeutic treatments of neurological diseases, space applications or assistive technologies in the industry. Demonstrations and exhibitions of reference technologies in the field will also take place, with a special focus on research prototypes.

The scientific program will start on October 13th. From October 13th to 16th, the conferences will feature oral and poster sessions, and demonstrations in over 20 sessions. Furthermore, 13 plenary lectures will be given: 2 lectures on October 13th, 3 lectures on October 14th, 3 lectures on October 15th and 2 lectures on October 16th. We hope that you will be able of attending many of these exciting presentations and have stimulating discussions with your colleagues.

We would like to thank all the members of the steering committee, the organizing committee and the scientific, clinical and industrial program committees. We are especially grateful to all authors, reviewers and sponsors for their effort and valuable support to make ICNR2020, WeRob2020 and WearRacon Europe a reality.

Finally, note that ICNR2020, WeRob2020 and WearRacon Europe Proceedings will be published by Springer. Digital copies will be published after the conference.

Once again, welcome!

ICNR2020 Chairs

Prof. José L. Pons
Dr. Diego Torricelli

WeRob2020 Chairs

Prof. José L. Pons
Dr. Juan Moreno
Dr. Jawad Masood
Dr. Christophe Maufroy and Dr. Urs Schneider

PROGRAM AT A GLANCE

	October 13			October 14			October 15			October 16		
	Auditorium A	Auditorium B	Private Room (password: walcon472b)	Auditorium A	Auditorium B	Private Room (password: walcon472b)	Auditorium A	Auditorium B	Private Room (password: walcon472b)	Auditorium A	Auditorium B	Private Room (password: walcon472b)
09:00 - 10:00	ROGER GASSERT (Auditorium A)			SANDRO MUSSA-IVALDI (Auditorium A)			NATALIE Mrachacz-Kersting (Auditorium A)			ALES HOLOBAR (Auditorium A)		
10:00 - 11:30	WS1: Brain Computer Interfaces for rehabilitation of stroke patients, for assessment of locked-in and patients with disorder of consciousness	WS2: Open challenges in embedded real-time control of assistive technologies for neurorehabilitation	WeR2: Balance recovery support using wearable robotic devices	SS1: How Challenge patients during Robot Assisted Gait Training: from technical aspects to clinical evidence	SS15: Protocols and Software for the standardization of sEMG processing and analysis for muscle synergy extraction.	WeR3: Active Life with Prosthesis	SS4: User Experience in Robot-aided Rehabilitation and Assistance	WeR5: The testing of industrial exoskeletons	WeR7: Neuromechanical Modelling and Control for Wearable Robots: Enhancing Movement after Neuromuscular Injuries	SS9: "One size does not fit all": new approaches for a patient-tailored rehabilitation process	SS11: Neural correlates of cognitive-motor robotic neurorehabilitation	WeR16: Small-Medium Enterprises in the Wearable Robotics field: tools and opportunities to create a successful company
11:30 - 13:00			WeR12: Exoskeletons in Industry 4.0: open challenges and perspectives	SS17: Neuromechanical Biomarkers in Robot-Assisted Motor Rehabilitation	SS5: Boosting neurorehabilitation in a sustainable way	WeR4: Legislation, safety and performance: regulatory aspects in wearable robots	SS8: Development of novel neural interfaces to improve neurorehabilitation	WeR8: Toward Efficient Human-Exoskeleton Symbiosis	WeR9: Soft wearable robots for health and industry	SS10: Joint stiffness: the sleeping giant of neuromechanics	SS12: Advances and Challenges on Artificial Sensory Feedback Techniques in Manipulation and Locomotion	WeR11: Digitalization and Artificial Intelligence applied to Wearable Technologies and Ergonomics
13:00 - 14:00	INAUGURAL SESSION (Auditorium A)			ISRAEL BENAVIDES (Auditorium A)			NADIA DOMINICI (Auditorium A)					
14:00 - 15:00	TIME FOR LUNCH											
15:00 - 16:00	SUNIL K. AGRAWALI (Auditorium A)			JONATHAN WOLPAW (Auditorium A)			VIVIAN K. MUSHAHWAR (Auditorium A)			JOHN KRAKAUER (Auditorium A)		
16:00 - 17:30	WeR1: What should we expect from passive exoskeletons?	WeR6: Evidenced-based Indications/Contraindications for and Potential Benefits of Exoskeletal-Assisted Walking in Persons with Spinal Cord Injury	SS2: Commanding Lower-Limb Exoskeletons by means of Brain-Machine Interfaces: Achievements and Challenges	SS6: Simulation and Prediction of Human Motion	WeR14: Application Industrial Exoskeletons	Poster session (ICNR) EXPOHALL	SS18: AITADIS session (spanish)	Poster session (WeRob) EXPO ROOM	SS14: Novel Developments of Non-Invasive Brain and Peripheral Stimulation in Neurorehabilitation	SS16: Technologies for daily robotic assistance & rehabilitation	WeR10: Musculoskeletal modelling to evaluate and optimize performance of wearable robotic devices	
17:30 - 19:00		WeR13: Exoskeletons for military applications	SS13: Human-machine interface for real-time wearable robots control		WeR15: Benchmarking Wearable Robots				SS3: .Towards patient-specific Robotic and Neuroprosthetic technologies and therapies for walking rehabilitation and assistance			
19:00 - 20:00				JAMES PATTON (Auditorium A)			ARUN JAYARAMAN (Auditorium A)			MATTHEW MARINO (Auditorium A)		

GENERAL CONFERENCE INFORMATION

Conference venue:



The conference will use a virtual platform (called Virbela) to host the meeting. This platform requires the installation of a dedicated software in your computer and a basic training.

Please check the documents:

- System Requirements (Virbela).pdf
- Downloading and Installing Virbela. pdf
- Basic Guide (Virbela).pdf
- Audio and Microphone Settings (Virbela).pdf

At the website icnr2020.org OR werob2020.org

Poster Information

Posters will be displayed in the Exhibition Area from October 13 to 16. The Poster Session will take place on October 15 from 4pm to 7pm (CEST time). During this session the authors will be present in the Expo Hall and will answer the questions of the audience about the posters. You are encouraged to promote the discussion.

Staff

Feel free to ask anyone of our staff for assistance. For immediate assistance please visit us at the Information Desk. You can also write us an email to info@icnr2020.org OR info@werob2020.org

ICNR2020 PRE-CONFERENCE WORKSHOPS – OCT 13

For updated information about the workshops, including the final program, please visit regularly the website.

WS1. Brain Computer Interfaces for rehabilitation of stroke patients, for assessment of locked-in and patients with disorder of consciousness

Organizer: Alexander Lechner, GTEC.

Abstract:

Lately, BCI systems become increasingly used in the context of stroke rehabilitation. Many BCI systems are based on motor imagery activity recorded from the sensorimotor cortex, which is translated into continuous control signals for rehabilitation devices.

The workshop will review current stroke rehabilitation using BCI technology and will provide insight into technology, experimental setups, results and outcomes of patient studies.

Some patients diagnosed as vegetative are reclassified as (at least) minimally conscious when assessed by expert teams. A further subset of potentially communicative non-responsive patients might be undetectable through standard clinical testing. Other patients might have transient periods of relative wakefulness, but remain unaware of their surroundings. The workshop will provide an overview of BCI technology to identify non-responsive patients that might be able to communicate and use the technology as an assessment tool.

In live demonstrations, we will show systems, which are already in use in rehabilitation units and hospitals. Participants will get the opportunity to try these systems.

WS2. Open challenges in embedded real-time control of assistive technologies for neurorehabilitation

Organizers: Dr. Francesca Marini (MathWorks), Dr. Leonardo Cappello (Scuola Superiore Sant'Anna), Dr. Diego Torricelli (Cajal Institute, CSIC) and Prof. Lorenzo Masia (Heidelberg University).

Abstract:

Current research in the field of human-centered technologies has mainly focused on pushing forward the boundaries of the mechatronics and robotics. Yet, the role of real-time control architectures still represents an emerging area of investigation. Optimizing the control robustness is, in fact, a milestone that allows us to properly design robotic systems, which must closely interact with human beings.

The unmatched performance of the human sensorimotor system imposes multiple challenges for the design of robotic interfaces which should work in the field of neurorehabilitation, and assistive devices such as exoskeletons, prostheses, and telerobots. Bidirectional kinematic and

dynamic communication between the robotic and human actors can be tackled by a control design which must be able to i) collect and interpret the user's intention (e.g., EEG-EMG decoding), ii) convert it to control signals for the assistive device (e.g., AI-based predictive models), and iii) feedback to the user relevant sensory information (e.g., augmented feedback) to allow her/him to take the next action and, ultimately, (re-)learn the motor task.

All these stages further require optimal real-time control in order to be robust to latencies and disturbances originating from several sources. A challenge that still remains open, hampering human-machine interfaces to reach full effectiveness in neurorehabilitation.

To tackle this, a variety of control strategies and architectures have been developed in an ongoing global research effort in real-time embedded control systems, to devise the most seamless integration of robotic devices with human users, and boost their widespread adoption.

We believe that it is possible to foster the development of future solutions only by shedding light on these common problems from different perspectives. We, therefore, propose a workshop where successful techniques and development platforms are presented and jointly discussed, with the goal of sharing the most relevant information to finally overcome the existing challenges.

PROGRAM – OCT 13-26

Tuesday, 13

Tuesday 13				
Auditorium A		Auditorium B		Private Room (password: walcon472b)
09:00 - 10:00	PLENARY TALK: ROGER GASSERT (Auditorium A)			
10:00 - 11:30	WS1. Brain Computer Interfaces for rehabilitation of stroke patients, for assessment of locked-in and patients with disorder of consciousness	WS2. Open challenges in embedded real-time control of assistive technologies for neurorehabilitation	WeR2. Balance recovery support using wearable robotic devices	
11:30 - 13:00			WeR12. Exoskeletons in Industry 4.0: open challenges and perspectives	
13:00 - 15:00	INAUGURAL SESSION (Auditorium A)			
14:00-15:00	TIME FOR LUNCH			
15:00 - 16:00	PLENARY TALK: SUNIL K. AGRAWAL (Auditorium A)			
16:00 - 17:30		WeR1. What should we expect from passive exoskeletons?	WeR6. Evidenced-based Indications/Contraindications for and Potential Benefits of Exoskeletal-Assisted Walking in Persons with Spinal Cord Injury	
17:30 - 19:00			WeR13. Exoskeletons for military applications	

WeR2	Balance recovery support using wearable robotic devices		Day	Time
	Organizers: Edwin van Asseldonk and Cristina Bayón (University of Twente)		Tu13	10.00-11.30
Paper ID	Title	Authors		
7	Ankle-exoskeleton control for assisting in balance recovery after unexpected disturbances during walking	Cristina Bayón, Wolfgang F. Rampeltshammer, Arvid Q.L. Keemink, Herman van der Kooij and Edwin H.F. van Asseldonk		
32	Coupling an Active Pelvis Orthosis with different prosthetic knees while transfemoral amputees manage a slippage: a pilot study	Vito Monaco, Federica Aprigliano, Gabriele Arnetoli, Stefano Doronzio, Antonella Giffone, Nicola Vitiello and Silvestro Micera		
72	Self-Induced Gyroscopic Torques in Lower Extremities During Gait : A Pilot Study	Saher Jabeen, Bram Sterke, Heike Vallery and <u>Daniel Lemus</u>		
88	Comparison of Balance Recovery among Current Control Strategies for Robotic Leg Prostheses	Nitish Thatte and <u>Hartmut Geyer</u>		
109	Reflex-model with additional COM feedback describes the ankle strategy in perturbed walking	<u>Maarten Afschrift</u> and Friedl De Groote		

WeR12	Exoskeletons in Industry 4.0: open challenges and perspectives		Day	Time
	Simona Crea, PhD (The BioRobotics Institute, Scuola Superiore Sant'Anna) and Marco Gazzoni, PhD (Politecnico di Torino).		Tu13	11.30-13.00
Paper ID	Title	Authors		
15	Testing preliminary study in a realistic simulated use-case	<u>Iliaria Pacifico</u> , Federica Aprigliano, Andrea Parri, Giusi Cannillo, Iliaria Melandri, Francesco Violante, Franco Molteni, Francesco Giovacchini, Nicola Vitiello and Simona Crea		
34	A topology-optimization-based design methodology for wearable robots: implementation and application	<u>Lorenzo Bartalucci</u> , Matteo Bianchi, Enrico Meli, Alessandro Ridolfi, Andrea Rindi and Nicola Secciani		
40	Lifting and Carrying: do we need back-support exoskeleton versatility?	<u>Tommaso Poliero</u> , Maria Lazzaroni, Stefano Toxiri, Christian Di Natali, Darwin G. Caldwell and Jesús Ortiz		
94	Quantifying the impact of a lower limb exoskeleton on whole-body manipulation tasks. Methodological approach and first results	<u>Yaiza Benito Molpeceres</u> , Guillermo Asín-Prieto, Juan Carlos García Orden and Diego Torricelli		

96	Assessment of exoskeleton related changes in kinematics and muscle activity	Fabio Vieira dos Anjos, Taian Martins Vieira, Giacinto Luigi Cerone, Talita Peixoto Pinto and <u>Marco Gazzoni</u>
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WeR1	What should we expect from passive exoskeletons?	Day	Time
		Organisers: Maziar Ahamd Sharbafi and Andre Seyfarth (TU Darmstadt) and Greg Sawicki (Georgia Tech)	Tu13
Paper ID	Title	Authors	
28	Design and Evaluation of a Knee Passive Exoskeleton for Vertical Jumping	Coral Ben-David, <u>Raziel Riemer</u> and Barak Ostrach	
36	The Hidden Potential of Energetically Passive Exoskeletons	<u>Amanda Sutrisno</u> and David Braun	
57	Effect of a Back-Assist Exosuit on Logistics Worker Perceptions, Acceptance, and Muscle Activity	Matthew Yandell, Anna Wolfe, <u>Matthew Marino</u> , Mark Harris and Karl Zelik	
92	A robotic tether can assist more efficiently than a passive tether, but the optimal timing is counterintuitive.	Prokopios Antonellis, <u>Arash Mohammadzadeh Gonabadi</u> and Philippe Malcolm	
100	The key elements in the design of passive assistive devices	<u>Maziar Sharbafi</u>	
105	Novel designs for passive elastic lower limb exoskeletons	<u>Daniel Ferris</u> and W. Sebastian Barrutia	
112	Passive Compliance in Legged Systems and Assistive Devices	<u>Andre Seyfarth</u>	
116	Spring Like Passive Elastic Exoskeletons May Improve Stability and Safety of Locomotion in Uneven Terrain	<u>Laksh Kumar Punith</u> , James Williamson, Taylor J M Dick and Gregory S Sawicki	

WeR6	Evidenced-based Indications/Contraindications for and Potential Benefits of Exoskeletal-Assisted Walking in Persons with Spinal Cord Injury	Day	Time
		Organizers: Ann M. Spungen, EdD, Peter Gorman, MD MS, and Gail Forrest, PhD	Tu13
Paper ID	Title	Authors	
2	Alteration of push-off mechanics during walking with different prototype designs of a soft exoskeleton in people with incomplete spinal cord injury – a case series	<u>Eveline Graf</u> , Bauer, Pauli and Wirz	
52	The Effect of Exoskeletal-Assisted Walking on Bowel and Bladder Function: Results from a Randomized Trial	<u>Peter Gorman</u> , Gail Forrest, Pierre Asselin, William Scott, Stephen Kornfield, Eunkyong Hong and Ann Spungen	
80	Comparison of ReWalk® and Ekso® powered exoskeletons for stepping and speed during training sessions	<u>Pierre Asselin</u> , Gail Forrest, Stephen Kornfeld, Eunkyong Hong, Peter Gorman and Ann Spungen	
95	Indications and contraindications for exoskeletal-assisted walking in persons with spinal cord injury	<u>Ann Spungen</u> , Peter Gorman, Gail Forrest, Pierre Asselin, Stephen Kornfeld, Eunkyong Hong and William Bauman	
104	Exoskeleton Controller and Design Considerations: Effect on Training Response for Persons with Spinal Cord Injury	<u>Gail F. Forrest</u> , Peter H. Gorman, Arvind Ramanujam, Pierre K. Asselin, Steven Knezevic, Sandra Wojciehowski and Ann M Spungen	

WeR13	Exoskeletons for military applications	Day	Time
		Organizers: Christophe Maufroy, PhD (Fraunhofer IPA, DE) and Dr. Mona Hichert (Fraunhofer FKIE, DE).	Tu13
Paper ID	Title	Authors	
27	Exoskeletons for military logistics and maintenance	Mona Hichert, <u>Markus Güttes</u> , Ines Bäuerle, Nils Ziegenspeck, Nico Bölke and Jonas Schiebl	
50	Aerial Porter Exoskeleton (APEX) for Lifting and Pushing	W. Brandon Martin, Alexander Boehler, Kevin Hollander, Darren Kinney, Joseph Hitt, Jay Kudva and <u>Thomas Sugar</u>	
65	Exoskeletons for unarmed military use: Requirements and approaches to support human movements. Using the example of protection against unknown CBRN dangers	Jonas Klabunde, <u>Christine Linnenberg</u> , Robert Weidner and Karola Hagner	
86	Analysis of a Passive Ankle Exoskeleton for the Reduction of the Metabolic Costs During Walking – A Preliminary Study	<u>Luís Filipe Pratas Quinto</u> , Pedro Pinheiro, Sérgio Gonçalves, Ivo Roupá and Miguel Silva	
87	A Multivariate Analysis for Force Element Selection in Passive Ankle Exoskeletons	<u>Nuno Ribeiro</u> , Luís Quinto, Sérgio Gonçalves, Ivo Roupá, Paula Simões and Miguel Silva	

Wednesday, 14

Wednesday 14			
Auditorium A	Auditorium B		Private Room (password: walcon472b)
09:00 - 10:00 PLENARY TALK: SANDRO MUSSA-IVALDI (Auditorium A)			
10:00 - 11:30	SS1. How Challenge patients during Robot Assisted Gait Training: from technical aspects to clinical evidence	SS15. Protocols and Software for the standardization of sEMG processing and analysis for muscle synergy extraction.	WeR3. Active Life with Prosthesis
11:30 - 13:00	SS17. Neuromechanical Biomarkers in Robot-Assisted Motor Rehabilitation	SS5. Boosting neurorehabilitation in a sustainable way	WeR4. Legislation, safety and performance: regulatory aspects in wearable robots
13:00 - 14:00 PLENARY TALK: ISRAEL BENAVIDES (Auditorium A)			
14:00 - 15:00 TIME FOR LUNCH			
15:00 - 16:00 PLENARY TALK: JONATHAN WOLPAW (Auditorium A)			
16:00 - 17:30	SS2. Commanding Lower-Limb Exoskeletons by means of Brain-Machine Interfaces: Achievements and Challenges	SS6. Simulation and Prediction of Human Motion	WeR14. Application Industrial Exoskeletons
17:30 - 19:00	SS13. Human-machine interface for real-time wearable robots control		WeR15. Benchmarking Wearable Robots
19:00 - 20:00 PLENARY TALK: JAMES PATTON (Auditorium A)			

SS1	How Challenge patients during Robot Assisted Gait Training: from technical aspects to clinical evidence	Day	Time
	Organisers: Jan Veneman, PhD, Daniele Munari, PhD	We14	10.00-11.30
Paper ID	Title	Authors	
10	How to challenge patients during gait training: The effect of immersive virtual reality on the gait pattern in people post-stroke	Emma De Keersmaecker, David Rodriguez-Cianca, Ben Serrien, Bart Jansen, Carlos David Rodriguez-Guerrero, Eric Kerckhofs and Eva Swinnen	
11	Automatic versus Manual Tuning of Robot-Assisted Gait Training	Cristina Bayón , Simone S. Fricke, Herman van der Kooij and Edwin H.F. van Asseldonk	
41	Influence of innovative rehabilitation technology on intensity of training: preliminary results	Anke I.R. Kottink , Gerdienke B. Prange-Lasonder, Lars Dijk, Chris T.M. Baten, Judith F.M. Fleuren and Jaap H. Buurke	
99	Wearable vibrotactile biofeedback to improve human-exoskeleton compliance during assisted gait training	Cristiana Pinheiro , Joana Figueiredo and Cristina Manuela Peixoto Santos	
174	Challenges in adaptive robot-assisted gait training: the balancing act of minimizing assistance while preserving safety	Alejandro Melendez-Calderon and Serena Maggioni	

SS15	Protocols and Software for the standardization of sEMG processing and analysis for muscle synergy extraction	Day	Time
	Organizer: Alvaro Costa-García. Intelligent Behaviour Control Unit (RIKEN), CBS-TOYOTA Collaboration Center.	We14	10.00-11.30
Paper ID	Title	Authors	
17	Feasibility assessment of muscle force estimation using the Myo armband during arm curl training	Maialen Zelaia Amilibia , Gabriel Hadjadj, Camilo Cortés, Ana de Los Reyes Guzmán, Angel Gil Agudo and Álvaro Bertelsen Simonetti	
25	Influence of Harmonics Filtering for Weak EMG Analysis	Rukiye Aydın , Fady Alnajjar, Moeka Sonoo, Alvaro Costa Garcia, Kumada Takatsune and Shingo Shimoda	
59	Online continuous detection of time-varying muscle synergies	Simone Ranaldj , Claudio Castellini, Andrea D'Avella and Silvia Conforto	

90	Approximate Credibility Intervals for Independent Component Analysis	<u>Olivier Thill</u> and Luca City
158	Muscle Tension Analysis in Stroke Patient Sit-to-Stand Motion by Joint Torque-Based Normalization	<u>Ruoxi Wang</u> , Qi An, Ningjia Yang, Hiroki Kogami, Kazunori Yoshida, Hiroyuki Hamada, Shingo Shimoda, Hiroshi Yamasaki, Moeka Sonoo, Fady Alnajjar, Noriaki Hattori, Kouji Takahashi, Takanori Fujii, Hironori Otomune, Ichiro Miyai, Atsushi Yamashita and Hajime Asama

SS17	Neuromechanical Biomarkers in Robot-Assisted Motor Rehabilitation	Day	Time
	Organizers: Andres Ubada (University of Alicante, Spain) and Diego Torricelli (CSIC, Spain).	We14	11.30-13:00
Paper ID	Title	Authors	
13	Empirical evidence connecting the neural mechanism behind motor coordination and force generation on healthy humans	<u>Alvaro Costa Garcia</u> , Andres Ubada, Eduardo Iañez and Shingo Shimoda	
26	Synergistic parameters of motor adaptation in variable resistance cycling activities	Afra M. Pertusa, Ivan Vujaklija, Rosa M. Sánchez-Pérez, Eduardo Iañez, <u>Álvaro Costa</u> and <u>Andrés Úbeda</u>	
124	Muscle synergies as a tool to unveil specific features in the muscle patterns after cerebellar damage	<u>Denise J. Berger</u> , Marcella Masciullo, Marco Molinari, Francesco Lacquaniti and Andrea d'Avella	
155	On repeatability of MU fatiguing in low-level sustained isometric contractions of Tibialis Anterior muscle	<u>Giovanni Corvini</u> , Aleš Holobar and Juan C. Moreno	
164	Kinematic Features Analysis from Active and Active-assistive Upper Arm Robotic Rehabilitation	Donghwan Hwang, Joon-Ho Shin and Suncheol Kwon	

SS5	Boosting neurorehabilitation in a sustainable way	Day	Time
	Organizers: Antonio Oliviero and Sven Bestmann	We14	11.30-13:00
Paper ID	Title	Authors	
22	Translation from Functional Training to Independent Living: The Importance of a Real-Time Feedforward-Feedback Approach	<u>Subhasis Banerji</u> , John Heng, Daphne Menezes, Shirish Hastak, Manasi Bane, Sharon Gerken and Dorothy Wi	
30	Ankle-foot orthoses in the rehabilitation after stroke: results of a randomized controlled trial	<u>Corien D.M. Nikamp</u> , Johan S. Rietman, Erik C. Prinsen, Hermie J. Hermens and Jaap H. Buurke	
85	A Novel Tool for Quantitative Assessment of Lower Limb Proprioception with Healthy Adults, Elderly, and Stroke Survivors	<u>Asya Mikhaylov</u> , Yogev Koren, Simona Bar-Haim and Ilana Nisky	
97	Accuracy of Single RGBD Camera-based Upper-limb Movement Tracking using OpenPose	<u>Timoth Dev</u> , Reetajanet Sureka, Samuelkamaleshkumar Selvaraj, Henry Prakash Magimairaj and Sivakumar Balasubramanian	
168	Gamification for BCI based Stroke Rehabilitation	<u>Marc Sebastián-Romagosa</u> , Martí de Castro-Cros, Eloy Opisso, Manel Ochoa, Dani Tost, Rupert Ortner, Josep Dinarès-Ferran and Christoph Guger	

SS2	Commanding Lower-Limb Exoskeletons by means of Brain-Machine Interfaces: Achievements and Challenges	Day	Time
	Organizers: Jose L. Contreras-Vidal (University of Houston, IUCRC BRAIN Center, USA) and Jose M. Azorin (Miguel Hernández University of Elche, BRAIN-UMH, Spain)	We14	16.00-17.30
Paper ID	Title	Authors	
131	Comparison of different brain-computer interfaces to assess motor imagery using a lower-limb exoskeleton	<u>Laura Ferrero</u> , Vicente Quiles, Mario Ortiz, Eduardo Iañez, Abel Navarro-Arcas, José Antonio Flores-Yepes, José Luis Contreras-Vidal and José María Azorín	
136	Optimizing calibration time for lower-limb Brain-Machine Interfaces	<u>Laura Ferrero</u> , Vicente Quiles, Mario Ortiz, Eduardo Iañez, José Luis Contreras-Vidal and José María Azorín	
159	Subject-Independent Detection of Movement-Related Cortical Potentials and Classifier Adaptation from Single-Channel EEG	<u>Mads Jochumsen</u>	

SS13	Human-machine interface for real-time wearable robots control	Day	Time
	Organisers: Yue Wen (Shirley Ryan AbilityLab, Chicago, USA) and Jose Pons (Shirley Ryan AbilityLab, Chicago, USA)	We14	17.30-19.00
Paper ID	Title	Authors	
139	kNN Learning Techniques for Proportional Myocontrol in Prosthetics	<u>Tim Sziburis</u> , Markus Nowak and Davide Brunelli	
160	Controlling an assistive robotic manipulator via a non linear Body Machine Interface	<u>Marco Giordano</u> , Fabio Rizzoglio, Giulia Ballardini, Ferdinando Mussa-Ivaldi and Maura Casadio	
161	Offline Repeatability Correlates with Real-Time Performance of Pattern Recognition Controllers	<u>Yuni Teh</u> and Levi Hargrove	
162	Understanding Human-Prosthesis Interaction via Reinforcement Learning-based Echo Control: A case study	<u>Ruofan Wu</u> , Minhan Li, Jennie Si and He Huang	

SS6	Simulation and Prediction of Human Motion	Day	Time
	Organisers: Javier Cuadrado and Urbano Lugris, University of La Coruña, Spain	We14	16.00-19.00
Paper ID	Title	Authors	
8	Adaptive Oscillators as Template for Modeling and Assisting Rhythmic Movements	<u>Renaud Ronsse</u>	
24	Converting Biomechanical Models from OpenSim to MuJoCo	<u>Aleksi Ikkala</u> and Perttu Hämäläinen	
34	Estimation of Ground Reaction Forces from Lower Limb Joint Kinematics during Walking	<u>Wendy Shui Kan Lam</u> and Ivan Vujaklija	
35	Effect of muscle modeling in the efficiency and accuracy of the forward-dynamics simulation of human gait	Francisco Mouzo, Florian Michaud, Mario Lamas, Urbano Lugris and <u>Javier Cuadrado</u>	
40	Sitting posture monitoring device for people with low degree of autonomy	Nerea Perez, <u>Patrick Vermander</u> , Elena Lara, Aitziber Mancisidor and Itziar Cabanes	
101	Rapid predictive simulations to study the interaction between motor control and musculoskeletal dynamics in healthy and pathological human movement	<u>Friedl De Groote</u> and Antoine Falisse	
110	Sit-to-stand models of older adults should include muscle nonlinearities and arms	<u>Matthew Millard</u> and Katja Mombaur	
114	Functional analysis of upper-limb movements in the Cartesian domain	Marco Baracca, Paolo Bonifati, Ylenia Nisticò, Vincenzo Catrambone, Gaetano Valenza, Antonio Bicchi, <u>Giuseppe Averta</u> and Matteo Bianchi	
116	A Machine Learning Approach for Near-Fall Detection based on Inertial and Force Data while using a Conventional Rollator	<u>Nuno Ferrete Ribeiro</u> , Ana Pereira, Joana Figueiredo, José A. Afonso and Cristina P. Santos	
135	Analysis of a predictive forward simulator of human gaits	<u>Thomas Bonis</u> , Nicolas Pronost and Saida Bouakaz	

WeR3	Active Life with Prosthesis	Day	Time
	Organizers: Shintaro Oyama (Nagoya Univ.) and Shingo Shimoda (RIKEN)	We14	10.00-11.30
Paper ID	Title	Authors	
6	Control of servomotor rotation in a myoelectric upper-limb prosthesis using a 16-channel sEMG sensor system	<u>Elisa Romero Avila</u> , Sebastian Becker, Elmar Junker and Catherine Disselhorst-Klug	
21	Compliant Control of a Transfemoral Prosthesis combining Predictive Learning and Primitive-based Reference Trajectories	<u>Sophie Heins</u> and Renaud Ronsse	
48	Design and Testing of a Fully-Integrated Electro-Hydrostatic Actuator for Powered Knee Prostheses	<u>Federico Tessari</u> , Renato Galluzzi, Nicola Amati, Andrea Tonoli, Matteo Laffranchi and Lorenzo De Micheli	
51	Controlling upper-limb prostheses with body compensations	Mathilde Legrand, <u>Nathanaël Jarrassé</u> , Charlotte Marchand, Florian Richer, Amélie Touillet, Noël Martinet, Jean Paysant and Guillaume Morel	
106	HandMECH - Mechanical Hand Prosthesis: Conceptual Design of a Two Degrees-of-Freedom Compliant Wrist	Ahmed Elsayed and <u>Ramazan Unal</u>	

WeR4	Legislation, safety and performance: regulatory aspects in wearable robots	Day	Time
		Organizers: Jan Veneman (Hocoma AG, Switzerland; MC Chair of COST Action 16116) and Gerdienke Prange / Leendert Schaake (Roessingh Research and Development, The Netherlands)	We14
Paper ID	Title	Authors	
5	CO-GUIDING: Ergonomic Analysis of a Hand Guidance System for Car Door Assembly	<u>Erika Paola Trivino Tonato</u> , Jawad Masood and Angel Dacal Nieto	
20	ATEX Certification for ALDAK Exoskeleton in Petrochemical Industry	<u>Ane Intxaurburu</u> , Iñaki Diaz, Juan Martin and Xabier Justo	
25	Acceptance of exoskeletons: questionnaire survey	<u>Lien Wioland</u> , Jean-Jacques Atain Kouadio, Latifa Debay and Hugo Breard	
98	Testing safety of lower limbs exoskeletons: current regulatory gaps	<u>Stefano Massardi</u> , David Pinto, Jan Veneman and Diego Torricelli	

WeR14	Application Industrial Exoskeletons	Day	Time
		Organizers: Elvira Planas and María Ducun (Mutua Universal, Mugenat)	We14
Paper ID	Title	Authors	
19	Subjective Perception of Shoulder Support Exoskeleton at Groupe PSA	<u>Jawad Masood</u> , Erika Paola Triviño Tonato, Maria Del Pilar Rivas Gonzalez, Maria Del Mar Arias Matilla and Ana Elvira Planas Lara	
38	MH-Forces, a Motion-Capture Based Method to Evaluate Workplace Ergonomics: Simulating Exoskeleton Effects	<u>Javier Marín</u> , Juan de la Torre and José. J Marín	
54	A Methodology to Assess the Effectiveness and the Acceptance of the Use of an Exoskeleton in a Company	Jose Antonio Tomás-Royo, <u>María Ducun-Lecumberri</u> , Ana Elvira Planas-Lara and Mar Arias-Matilla	
74	Designing an Integrated Tool Set Framework for Industrial Exoskeletons	Olmo A. Moreno F., Francesco Draicchio, Luigi Monica, Sara Anastasi, Darwin G. Caldwell and Jesús Ortiz	

WeR15	Benchmarking Wearable Robots	Day	Time
		Organizers: Diego Torricelli, PhD (Spanish National Research Council), Philipp Beckerle (Technische Universität Dortmund, Germany), Simona Crea (Scuola Superiore Sant'Anna, Italy), Jan Veneman (Hocoma AG, Switzerland).	We14
Paper ID	Title	Authors	
13	Wearable Robots Benchmarking: Comprehending and Considering User Experience	<u>Philipp Beckerle</u>	
29	Lower-Limbs Exoskeletons Benchmark Exploiting a Stairs-Based Testbed: the STEPbySTEP Project	Nicole Maugliani, Marco Caimmi, Matteo Malosio, Francesco Airoldi, Diego Borro, Daniel Rosquete, Sergio Ausejo, Davide Giusino, Federico Fraboni, Giuseppe Ranieri, Luca Pietrantoni and <u>Loris Roveda</u>	
33	Towards a unified terminology for benchmarking bipedal systems	<u>Anthony Remazeilles</u> , Alfonso Dominguez, Pierre Barralon and Diego Torricelli	
62	Limitation of Ankle Mobility Challenges Gait Stability While Walking on Lateral Inclines	Maarten Prins, <u>Nick Klufft</u> , Wieke Philippart, Han Houdijk, Jaap van Dieën and Sjoerd Bruijn	
119	Test method for exoskeleton locomotion on irregular terrains: testbed design and construction	<u>Adriana Torres-Pardo</u> , David Pinto-Fernández, Ellyn Belalcazar, Jose L. Pons, Juan C. Moreno and Diego Torricelli	

Thursday, 15

Thursday 15			
Auditorium A	Auditorium B		Private Room (password: walcon472b)
09:00 - 10:00 PLENARY TALK: NATALIE Mrachacz-Kersting (Auditorium A)			
10:00 - 11:30	SS4. User Experience in Robot-aided Rehabilitation and Assistance	WeR5. The testing of industrial exoskeletons	WeR7. Neuromechanical Modelling and Control for Wearable Robots: Enhancing Movement after Neuromuscular Injuries
11:30 - 13:00	SS8. Development of novel neural interfaces to improve neurorehabilitation	WeR8. Toward Efficient Human-Exoskeleton Symbiosis	WeR9. Soft wearable robots for health and industry
13:00 - 14:00 PLENARY TALK: NADIA DOMINICI (Auditorium A)			
14:00 - 15:00 TIME FOR LUNCH			
15:00 - 16:00 PLENARY TALK: VIVIAN K. MUSHAHWAR (Auditorium A)			
16:00 - 17:30	Poster session (ICNR) EXPOHALL	SS18. AITADIS session (spanish)	Poster session (WeRob) EXPO ROOM
17:30 - 19:00			
19:00 - 20:00 PLENARY TALK: ARUN JAYARAMAN (Auditorium A)			

User Experience in Robot-aided Rehabilitation and Assistance		Day	Time
SS4	Organizers: Iolanda Pisotta (Laboratory of Robotic Neurorehabilitation, Fondazione Santa Lucia, Rome, Italy) and Nevio Luigi Tagliamonte (Laboratory of Advanced Robotics and Human-Centered Technologies, Università Campus Bio-Medico di Roma, Rome, Italy)	Thu15	10.00-11.30
Paper ID	Title	Authors	
9	Wireless eye-tracking technology application and self-report measures to explore users' approach to Smart Home Systems (SHS)	Laura Angioletti , Federico Cassioli and Michela Balconi	
18	Learning teleoperation of an assistive humanoid platform by intact and upper-limb disabled users	Mathilde Connan , Marek Sierotowicz, Bernd Henze, Oliver Porges, Alin Albu-Schäffer, Maximo Roa and Claudio Castellini	
45	TestEd Information System: Automatic Evaluation of Exoskeletons Subjective Performance and User Experience	Angel Dacal-Nieto , Jawad Masood, Daniel Isai Vergara Alvarez and Mariana Dominguez Alves	
53	Perceived exertion during robot-assisted gait after stroke	Nina Lefeber , Emma De Keersmaecker, Eric Kerckhofs and Eva Swinnen	
126	Pilot testing of a new questionnaire for the assessment of user experience during exoskeleton-assisted walking	Iolanda Pisotta , Nevio Luigi Tagliamonte, Alessandra Bigioni, Federica Tamburella, Matteo Lorusso, Francesca Bentivoglio, Ilenia Pecoraro, Paola Argentieri, Fabio Marri, Loredana Zollo and Marco Molinari	

Development of novel neural interfaces to improve neurorehabilitation		Day	Time
SS8	Organizer: Filipe O. Barroso, Neural Rehabilitation Group – Cajal Institute (CSIC), Spain	Thu15	11.30-13.00
Paper ID	Title	Authors	
33	Highly Intuitive 3-DOF Simultaneous and Proportional Myocontrol of Wrist and Hand	Markus Nowak , Ivan Vujaklija, Claudio Castellini and Dario Farina	
42	A Portable P300-based Brain-Computer Interface as an Alternative Communication Device	Victor Martínez-Cagigal , Eduardo Santamaría Vázquez and Roberto Hornero	
62	Altered Motor Unit Territories after Intramuscular Botulinum Toxin Injection in Spastic Biceps Brachii Muscle	Sourav Chandra , Ales Holobar, Babak Afsharipour, William Zev Rymer and Nina L. Suresh	
70	Motor unit tracking across low contraction levels of biceps brachii muscle	Aljaž Frančič and Aleš Holobar	

AITADIS session (Spanish)		Day	Time
SS18	Organizers: Antonio del Ama (University Rey Juan Carlos, Spain), José María Azorín (University Miguel Hernández, Spain), Filipe Barroso (Neurorehabilitation Group – Instituto Cajal (CSIC), Spain), Ángel Gil (National Hospital for Paraplegics of Toledo, Spain), Juan C. Moreno (Neurorehabilitation Group – Instituto Cajal (CSIC), Spain), Antonio Oliviero (National Hospital for Paraplegics of Toledo, Spain), Jose L. Pons (Shirley Ryan AbilityLab, USA), Eduardo Rocon (Center for Automation and Robotics - CSIC, Spain), Diego Torricelli (Neurorehabilitation Group – Instituto Cajal (CSIC), Spain)	Thu15	16.00-19.00
Paper ID	Title	Authors	
54	Application of Capabilities of Upper Extremity Questionnaire during a robotic therapy based on Armeo®Spring exoskeleton	<u>Vicente Lozano-Berrio</u> , Ana de Los Reyes-Guzman, Monica Alcobendas-Maestro, Begoña Polonio-López and Ángel Gil-Agudo	
64	Safety, feasibility and acceptance with HANK ambulatory robotic exoskeleton in incomplete spinal cord injury patients.	<u>Álvaro Megía García</u> , Antonio José del Ama Rodriguez, Vicente Lozano Berrio, María Isabel Sinovas-Alonso, Natalia Comino Suárez and Ángel Manuel Gil Agudo	
89	Towards functional description of gait impairments after neurological diseases for the development of Personalized Robotic and Neuroprosthetic Wearable Systems for Walking Assistance	<u>María Isabel Sinovas-Alonso</u> , Ángel Manuel Gil-Agudo, Natalia Comino-Suárez, Álvaro Megía-García, Narda Murillo-Licea, Eloy Opisso-Salleras, Joan Vidal-Samsó and Antonio José del-Ama	
100	Implementation of an Exoskeleton for Neuromuscular Hand Rehabilitation	<u>Bastian Troncoso</u> , Pedro Alberti, Patricia Maldonado-Cardenas, Eduardo Peña and Patricio Barría	
104	Design and Implementation of a “Wireless-Hand” Mechatronic Prototype for the Control of a Robotic Hand	<u>Eduardo Peña</u> , Pedro Alberti, Sebastián Bustamante, Patricia Maldonado-Cardenas and Patricio Barría	
111	Development of an interface for the control of robotic exoskeletons based on Stroke rehabilitation techniques.	<u>Patricio Barria Aburto</u> , Rolando Aguilar, Daniel Unquen, Andre Moris, Asterio Andrade, Angel Biskupovic and Jose M. Azorin	
144	Analysis of frequency bands and channels configuration for detecting intention of change direction through EEG	<u>Vicente Quiles</u> , Laura Ferrero, Eduardo Iáñez, Mario Ortiz and José M. Azorín	
153	Gait analysis as an objective tool previous to Botulinum Toxin infiltration in Spinal Cord Injured patients: a case study	<u>Carolina Redondo Galán</u> , Silvia Ceruelo Abajo, Isabel Sinovas Alonso, Ana De Los Reyes Guzmán, Jorge Madrid Sánchez and Angel Gil Agudo	
173	Ewe: A Computational Tool to Assist People in Emergencies	<u>Ariel Luz</u> and Joseana Fechine	

The testing of industrial exoskeletons		Day	Time
WeR5	Organizers: Michiel de Looze (TNO) and Jawad Masood (CTAG).	Thu15	10.00-11.30
Paper ID	Title	Authors	
1	Evaluation of Two Upper-limb Exoskeletons for Ceiling Welding in the Naval Industry	<u>Francisco Mouzo</u> , Florian Michaud, Urbano Lugris, Jawad Masood and Javier Cuadrado	
16	The experience of plasterers towards using an arm support exoskeleton	Aijse de Vries, Frank Krause and Michiel de Looze	
23	Biomechanical evaluation of the effect of three trunk support exoskeletons on spine loading during lifting	<u>Idsart Kingma</u> , Axel Koopman, Michiel de Looze and Jaap van Dieën	
59	Assessing the efficiency of exoskeletons in physical strain reduction by biomechanical simulation with AnyBody Modelling System	<u>Lars Fritzsche</u> , Pavel Galibarov, Christian Gärtner, Jonas Bornmann, Michael Damsgaard, Rudolf Wall, Benjamin Schirrmeister and Jose Gonzalez-Vargas	
73	Back-support exoskeleton control using user’s torso acceleration and velocity to assist manual material handling	<u>Maria Lazzaroni</u> , Ali Tabasi, Stefano Toxiri, Darwin Caldwell, Idsart Kingma, Elena De Momi and Jesus Ortiz	

Neuromechanical Modelling and Control for Wearable Robots: Enhancing Movement after Neuromuscular Injuries		Day	Time
WeR7	Organizers: Guillaume Durandau and Massimo Sartori (University of Twente)	Thu15	10.00-11.30
Paper ID	Title	Authors	
10	Implications for the design of simple wearable assistive devices based on a neuro-musculoskeletal model	<u>Daniel F. B. Haeufle</u> and Katrin Stollenmaier	

44	Physical Therapy and Outdoor Assistance with the Myosuit: Preliminary Results	<u>Michele Xiloyannis</u> , Florian Leander Haufe, Jaime Duarte, Kai Schmidt, Peter Wolf and Robert Riemer
47	Predictive Simulation of Sit-to-Stand Movements	David Munoz, Leonardo Gizzi, Cristiano De Marchis and <u>Giacomo Severini</u>
63	SimBionics: Neuromechanical Simulation and Sensory Feedback for the Control of Bionic Legs	<u>Jose Gonzalez-Vargas</u> , Massimo Sartori, Strahinja Dosen, Herman van der Kooij and Johan Rietman
83	Benefits and potential of a neuromuscular controller for exoskeleton-assisted walking	<u>Nevio Luigi Tagliamonte</u> , Amy Wu, Iolanda Pisotta, Federica Tamburella, Marcella Masciullo, Matteo Arquilla, Edwin van Asseldonk, Herman van der Kooij, Florin Dzeladini, Auke Ijspeert and Marco Molinari

Toward Efficient Human-Exoskeleton Symbiosis		Day	Time
WeR8	Organizers: Juan C. Moreno (Neural Rehabilitation Group, Cajal Institute, Madrid, Spain) and Samer Mohammed (University of Paris-Est Créteil, UPEC, France)	Thu15	11.30-13.00
Paper ID	Title	Authors	
61	Direct Collocation-based Optimal Controller for Multi-Modal Assistance: Simulation Study	<u>Anh Tuan Nguyen</u> , Vincent Bonnet and Samer Mohammed	
78	A hybrid upper-body exoskeleton for motion assistance	<u>Shaoping Bai</u> , Muhammad Raza Ul Islam, Karl Damkjær Hansen, Jacob Nørgaard, C.Y. Chen and G. Yang	
103	Ultrasound-based Sensing and Control of Functional Electrical Stimulation for Ankle Joint Dorsiflexion: Preliminary Study	<u>Qiang Zhang</u> , Ashwin Iyer and Nitin Sharma	
108	Towards Crutch-Free 3-D Walking Support with the Lower Body Exoskeleton Co-Ex: Self-Balancing Squatting Experiments	Sinan Coruk, Ahmed Fahmy Soliman, Oguzhan Dalgic, Mehmet Can Yildirim, Deniz Ugur and Barkan Ugurlu	
113	Ankle Dorsiflexion Assistance using Adaptive Functional Electrical Stimulation and Actuated Ankle Foot Orthosis	<u>Carlos Canchola-Hernandez</u> , Hala Rifai, Yacine Amirat and Samer Mohammed	

Soft wearable robots for health and industry		Day	Time
WeR9	Organizers: Conor Walsh (SEAS Harvard), Jesús Ortiz (IIT-ADVR) and Richard Nuckols (SEAS Harvard)	Thu15	11.30-13.00
Paper ID	Title	Authors	
3	Feasibility and Effectiveness of a Soft Exoskeleton for Pediatric Rehabilitation	Michele A. Lobo and <u>Bai Li</u>	
60	FleXo - Modular flexible back-support passive exoskeleton	<u>Jesús Ortiz</u> , Jorge Fernández, Tommaso Poliero, Luigi Monica, Sara Anastasi, Francesco Draicchio and Darwin G. Caldwell	
75	A Model-based control strategy for upper limb Exosuits	Nicola Lotti, Francesco Missiroli, Michele Xiloyannis and <u>Lorenzo Masia</u>	
84	Mobile Unilateral Hip Flexion Exosuit Assistance for Overground Walking in Individuals Post-Stroke: A Case Series	<u>Richard Nuckols</u> , Franchino Porciuncula, Chih-Kang Chang, Teresa Baker, Dorothy Orzel, Asa Eckert-Erdheim, David Perry, Terry Ellis, Louis Awad and Conor Walsh	
115	Towards a Fabric-based Soft Hand Exoskeleton for Various Grasp Taxonomies	<u>Andrea Peñas</u> , Juan Maldonado, Orion Ramos, Marcela Munera, Patricio Barria, Mehran Moazen, Helge Wurdemann and Carlos A. Cifuentes	

Friday, 16

Friday 16			
	Auditorium A	Auditorium B	Private Room (password: walcon472b)
09:00 - 10:00	PLENARY TALK: ALES HOLOBAR (Auditorium A)		
10:00 - 11:30	SS9. "One size does not fit all": new approaches for a patient-tailored rehabilitation process	SS11. Neural correlates of cognitive-motor robotic neurorehabilitation	WeR16. Small-Medium Enterprises in the Wearable Robotics field: tools and opportunities to create a successful company
11:30 - 13:00	SS10. Joint stiffness: the sleeping giant of neuromechanics	SS12. Advances and Challenges on Artificial Sensory Feedback Techniques in Manipulation and Locomotion	WeR11. Digitalization and Artificial Intelligence applied to Wearable Technologies and Ergonomics
13:00 - 15:00	TIME FOR LUNCH		
15:00 - 16:00	PLENARY TALK: JOHN KRAKAUER (Auditorium A)		
16:00 - 17:30	SS14. Novel Developments of Non-Invasive Brain and Peripheral Stimulation in Neurorehabilitation	SS16. Technologies for daily robotic assistance & rehabilitation	WeR10. Musculoskeletal modelling to evaluate and optimize performance of wearable robotic devices
17:30 - 19:00	SS3. Towards patient-specific Robotic and Neuroprosthetic technologies and therapies for walking rehabilitation and assistance		
19:00 - 20:00	PLENARY TALK: MATTHEW MARINO (Auditorium A)		

SS9	"One size does not fit all": new approaches for a patient-tailored rehabilitation process	Day	Time
	Organizer: Michela Goffredo, PhD, Biomedical Engineer. Neurorehabilitation Research Laboratory, IRCCS San Raffaele Pisana, Rome (Italy).	Fri16	10.00-11.30
Paper ID	Title	Authors	
6	Closed-loop Acquisition of Training Data Improves Myocontrol of a Prosthetic Hand	<u>Donato Brusamento</u> , Andrea Gigli, Roberto Meattini, Claudio Melchiorri and Claudio Castellini	
82	Towards the use of neuromusculoskeletal modeling in clinical practice: a feasibility study in Parkinson Disease patients	<u>Marco Romanato</u> , Daniele Volpe, Massimo Sartori, Zimi Sawacha, Annamaria Guiotto and Fabiola Spolaor	
98	Comparison of Wearable Sensor Based Algorithms for Upper Limb Activity Detection	<u>Tanya Subash</u> , Ann David, Varadhan Skm and Sivakumar Balasubramanian	
103	Targeted muscle training with a hybrid body-machine interface	<u>Dalia De Santis</u> and Ferdinando A. Mussa-Ivaldi	
150	Source localization of simulated electroencephalogram of Virtual Epileptic Patient to investigate clinically feasible montages	<u>Zoe Herrick</u> , Ping Li and Anirban Dutta	

SS11	Neural correlates of cognitive-motor robotic neurorehabilitation	Day	Time
	Organizers: Joaquin Penalver-Andres, Dr. Karin A. Buetler, Dr. Eduardo Rocon, and Dr. Laura Marchal-Crespo	Fri16	10.00-11.30
Paper ID	Title	Authors	
37	Feature consistency criterion for motor imagery-based neuromodulation	<u>Carlos Alberto Stefano Filho</u> , J. Ignacio Serrano, Romis Attux, Gabriela Castellano, Maria Dolores del Castillo and Eduardo Rocon	
58	Real-Time Access to Attention and Attention-Based Brain-Machine Interfaces	Corentin Gaillard, Carine De Sousa Ferreira, Julian Amengual and <u>Suliann Ben Hamed</u>	
109	Agency and responsibility while controlling movement through brain computer interfaces for neurorehabilitation	<u>Maria V. Sanchez-Vives</u> , Mel Slater and Birgit Nierula	
128	Brain-computer interface-based neurorehabilitation: from the lab to the users' home	Carlos Escolano, Eduardo López-Larraz, Javier Minguez and <u>Luis Montesano</u>	
143	The Application Of Sensory Error Manipulations To Motor Rehabilitation And Diagnostics	<u>Belen R. Ballester</u> and Paul F. M. J. Verschure	

SS10	Joint stiffness: the sleeping giant of neuromechanics		Day	Time
	Organizers: M.L. van de Ruit (Delft University of Technology), A.C. Schouten (Delft University of Technology), E.H.F. van Asseldonk (University Twente), M. Sartori (University Twente).		Fri16	11.30-13.00
Paper ID	Title	Authors		
31	Identification of Time-varying Ankle Joint Impedance during Periodic Torque Experiments using Kernel-Based Regressio	<u>Gaia Cavallo</u> , Christopher P. Cop, Massimo Sartori, Alfred C. Schouten and John Lataire		
52	Robotic Approach to Characterize Ankle Stiffness in Multiple Sclerosis Patients during Standing and Walking	<u>Varun Nalam</u> , Ermytrude Adjei, Joshua Russell, Megan Eikenberry, Dean Wingerchuk and Hyunglae Lee		
55	A Muscle Model Incorporating Fiber Architecture Features for the Estimation of Joint Stiffness during Dynamic Movement	<u>Christopher P. Cop</u> , Alfred C. Schouten, Bart F. J. M. Koopman and Massimo Sartori		
56	Quantifying joint stiffness during movement: A quantitative comparison of time-varying system identification methods	<u>Mark van de Ruit</u> , Winfred Mugge and Alfred Schouten		
115	Apparent Stiffness and Damping as a Metric for Fall Risk	<u>Jordan Smith</u> , Robert Felmlee, Jozsef Laczko, Mary Crowe, Scott Steinbrink and Davide Piovesan		

SS12	Advances and Challenges on Artificial Sensory Feedback Techniques in Manipulation and Locomotion		Day	Time
	Organizers: Leonardo Cappello, Diego Torricelli, Daniele Leonardis		Fri16	11.30-13.00
Paper ID	Title	Authors		
67	Multi-Frequency Stimulation: Spatial Differentiation of Bone-Conducted Tactile Stimulation on the Elbow Bony Landmarks	<u>Raphael Maria Mayer</u> , Alireza Mohammadi, Ying Tan, Gursel Alici, Peter Choong and Denny Oetomo		
74	A User-Centered Approach to Artificial Sensory Substitution for Blind People Assistance	Barontini, Bettelani, Leporini, Averta and <u>Matteo Bianchi</u>		
105	Post-stroke voluntary movements improve when combined with vibration-induced illusion of movement	<u>Francesca Ferrari</u> , Courtney E. Shell, Zachary C. Thumser, Francesco Clemente, Ela B. Plow, Christian Cipriani and Paul D. Marasco		
108	Effects of non-in situ Vibrations on Hand Sensations: a Pilot Study	Anke Fischer, <u>Leonardo Cappello</u> , Leonard F. Engels and Christian Cipriani		
117	HaptiTrack: A novel device for the evaluation of tactile sensitivity in active and in passive tasks	<u>Simone Ciotti</u> , Matteo Bianchi, Davide Doria, Francesco Lacquaniti and Alessandro Moscatelli		

SS14	Novel Developments of Non-Invasive Brain and Peripheral Stimulation in Neurorehabilitation		Day	Time
	Organizers: Dr. Julio C Hernandez-Pavon (Northwestern University, Chicago, IL, USA) and Dr. Simon Avrillon(Northwestern University & Shirley Ryan AbilityLab, Chicago, IL, USA)		Fri16	16.00-17.30
Paper ID	Title	Authors		
49	Effect of Transcutaneous High-Frequency Alternating Current over Handgrip muscle strength	<u>Diego Serrano-Muñoz</u> , Julio Gómez-Soriano, David Martín-Caro, Rocío Lopez-Peco, Julian Taylor and Juan Avendaño-Coy		
78	Feasibility of transcutaneous spinal cord stimulation combined with robotic assisted gait training (Lokomat) for gait rehabilitation of an incomplete spinal cord injury subject	<u>Natalia Comino Suárez</u> , Julio Gómez Soriano, Diego Serrano Muñoz, Álvaro Megía García-Carpintero, Antonio J. del Ama Espinosa, Ángel M. Gil Agudo and Juan C. Moreno		
84	A phenomenon of Self-support Exercise in Severe Stroke Patients	<u>Fady Alnajjar</u> , Shingo Shimoda and Alistair Vogan		
106	Grey-box model-based analysis of the effects of anodal transcranial direct current stimulation on the reaction time in healthy human	<u>Namrata Kadambi</u> , Shilpa Ramnarayanan, Filip Stefanovic and Anirban Dutta		
134	Bilateral and multi-joint surface electrical stimulation for tremor reduction. An Essential Tremor pilot study	<u>Alejandro Pascual Valdunciel</u> , Beatriz Adán Barrientos, Alejandra García Álvarez, Miguel González Sánchez, Javier Pérez Sánchez, Juan Camilo Moreno Sastoque, Francisco Grandas Pérez, Filipe O. Barroso and José L. Pons		

SS3	Towards patient-specific Robotic and Neuroprosthetic technologies and therapies for walking rehabilitation and assistance	Day	Time
		Organizers: Antonio J. del-Ama (Eng, PhD) Assistant Professor. Rey Juan Carlos University, Spain; Josep M. Font-Llagunes (Eng, PhD) Associate Professor. Universitat Politècnica de Catalunya, Spain; and Juan C. Moreno (Eng, PhD). Tenure Scientist. Cajal institute-National Council for Scientific Research, Spain.	Fri16
Paper ID	Title	Authors	
12	Human-Centered Approaches for Patient-Specific Wearable Robots	<u>Philipp Beckerle</u>	
16	Effect of Gel Type and Anode Selection in Ankle Movements Elicited by a Multi-Field FES Device	<u>Aitor Martín</u> , Cristina Rodriguez-de-Pablo, Haritz Zabaleta, Eukene Imatz-Ojanguren and Thierry Keller	
72	A Preliminary Study on Prediction of Initial Contact Timing During Gait Using LSTM for FES Control	<u>Yuto Uwaseki</u> and Takashi Watanabe	
75	Smart wearable garment and rapid musculoskeletal modelling for accurate neuromechanical analysis	<u>Donatella Simonetti</u> , Bart F. J. M. Koopman and Massimo Sartori	
172	Exoskeleton Design using Subject-specific Synergy-driven Neuromusculoskeletal Models	<u>Marleny Arones</u> , Josep M. Font-Llagunes and Benjamin J. Fregly	

SS16	Technologies for daily robotic assistance & rehabilitation	Day	Time
		Organizers: Sangjoon J. Kim (Shirley Ryan AbilityLab, Chicago, USA) and Jose L. Pons (Shirley Ryan AbilityLab, Chicago, USA)	Fri16
Paper ID	Title	Authors	
23	An embedded implementation of EMG-driven control for assisted bilateral therapy	<u>Ana Cisnal</u> , Victor Moreno San Juan and David Sierra	
38	MERLIN: upper-limb rehabilitation robot system for home environment	<u>Ainara Garzo</u> , Javier Arcas Ruiz-Ruano, Iñigo Dorronsoro, Gabriel Gaminde, Je Hyung Jung, Javier Tellez and Thierry Keller	
61	Modular Hip Exoskeleton based training to improve physical activity and gait function: A community based translational robotic intervention	Chaithanya K Mummidisetty, <u>Chandrasekaran Jayaraman</u> , Matt Giffhorn, Sara Prokup, Bokman Lim, Jusuk Lee, Younbaek Lee and Arun Jayaraman	
81	A wearable sensorised thimble for assessment and rehabilitation of grasping	<u>Perla Maiolino</u> , Luigi Ottovoggio, Edoardo Montalesi, Simone Denei, Fulvio Mastrogiovanni, Maura Casadio and Giorgio Cannata	
86	Isometric force pillow: using air pressure to quantify involuntary finger flexion in the presence of hypertonia	<u>Caitlyn Seim</u> , Chuzhang Han, Marie Payne, Alexis Lowber, Claire Brooks, Maarten Lansberg, Kara Flavin, Julius Dewald and Allison Okamura	
91	Feasibility of Using Visual Cues for Evoking Self-induced Perturbations for Assessing Dynamic Balance During Walking	<u>Andrej Olenšek</u> , Matjaž Zadavec and Zlatko Matjacic	
112	A robot-aided rehabilitation platform for occupational therapy with real objects	<u>Christian Tamantini</u> , Martina Lapresa, Francesca Cordella, Francesco Scotto di Luzio, Clemente Lauretti and Loredana Zollo	
118	Effects of an overground robotic based gait training intervention on parameters provided by a smart-tip: an exploratory study in people with multiple sclerosis	<u>Leire Santisteban</u> , Ana Rodriguez, Asier Zubizarreta and Erika Otxoa	
154	Preliminary Clinical Evaluation of the X-Limb Hand: A 3D Printed Soft Robotic Hand Prosthesis	<u>Alireza Mohammadi</u> , Jim Lavranos, Ying Tan, Peter Choong and Denny Oetomo	

WeR16	Small-Medium Enterprises in the Wearable Robotics field: tools and opportunities to create a successful company	Day	Time
		Organizer: Roberto Conti (IUVO)	Fri16
Paper ID	Title	Authors	
35	Robotics industry, small and medium sized enterprises and intellectual property	<u>Enrico Bonadio</u>	

42	Private/public funding strategies for interactive robotics companies	<u>Arantxa Renteria-Bilbao</u>
45	RobotUnion project: accelerating startups in robotics	<u>Leire Martinez</u> and Arantxa Renteria
46	Starting up a surgical robotics company: the case of Kirubotics	<u>Arantxa Renteria</u> , Fernando Mateo and Leire Martínez
118	Redesigning Tax Incentives for Inclusive and Green Robotics in the European Union Reconstruction	<u>María Amparo Grau</u>

WeR11	Digitalization and Artificial Intelligence applied to Wearable Technologies and Ergonomics	Day	Time
	Organizers: Angel Dacal (Factory of the Future Area Responsible, CTAG, Automotive Technology Center of Galicia) and Barbara Andreon (Lead Researcher and Innovation, Wear Health).	Fri16	11.30-13.00
Paper ID	Title	Authors	
56	Exploration of Subject-specific Neuromusculoskeletal Modeling in the Control of Lower Limb Prosthetics	<u>Andrea Cimolato</u> , Leonardo S. Mattos, Elena De Momi, Matteo Laffranchi and Lorenzo De Michieli	
82	Optimizing active spinal exoskeletons to minimize low back loads	<u>Giorgos Marinou</u> and Katja Mombaur	
91	LSTM and CNN based IMU Sensor Fusion approach for Human Pose Identification in Manual Handling activities	Enrique Bances, <u>Adnan Mushtaq Ali Karol</u> and Urs Schneider	
93	Visual Feedback Strategy based on Serious Games for Therapy with T-FLEX Ankle Exoskeleton	<u>Angie Pino</u> , Daniel Gomez-Vargas, Marcela Munera and Carlos A. Cifuentes	
114	The Utilization Effects of Powered Wearable Orthotics in Improving Upper Extremity Function in Persons with SCI: A Case study	<u>Ghaith J. Androwis</u> , Steven Kirshblum and Guang Yue	

WeR10	Musculoskeletal modelling to evaluate and optimize performance of wearable robotic devices	Day	Time
	Organizers: Maarten Afschrift, Friedl De Groot, Sam van Rossum	Fri16	16.00-19.00
Paper ID	Title	Authors	
11	Predictive Gait Simulations of Human Energy Optimization	<u>Anne Koelewijn</u> and Jessica Selinger	
14	Reconstruction of Hip Moments through Constrained Shape Primitives	<u>Henri Laloux</u> and Renaud Ronsse	
17	Simulated exoskeletons with coupled degrees-of-freedom reduce the metabolic cost of walking	<u>Nicholas Bianco</u> , Patrick Franks, Jennifer Hicks and Scott Delp	
22	Model-Based Biomechanics for Conceptual Exoskeleton Support Estimation Applied for a Lifting Task	<u>Elena Gneiting</u> , Jonas Schiebl, Mark Tröster, Verena Kopp, Christophe Maufroy and Urs Schneider	
31	Calibrating an EMG-Driven Muscle Model and Regression model to estimate moments generated actively by back muscles for controlling an actuated exoskeleton with limited data.	<u>Ali Tabasi</u> , Maria Lazzaroni, Niels Brouwer, Idsart Kingma, Wietse van Dijk, Michiel de Looze, Stefano Toxiri, Jesús Ortiz and Jaap van Dieën	
66	Effect of Mono- vs. Bi-articular Ankle Foot Orthosis on Muscular Performance in the Lower Leg	<u>Mahdy Eslamy</u> , Florian Mackes and Arndt F. Schilling	
76	Ultrasound imaging of plantarflexor muscles during robotic ankle assisted walking: Effects on muscle tendon dynamics and application towards improved exoskeleton and exosuit control	<u>Richard Nuckols</u> , Sangjun Lee, Krithika Swaminathan, Conor Walsh, Robert Howe and Gregory Sawicki	
90	Simulation Platform for Dynamic Modeling of Lower Limb Rehabilitation Exoskeletons: Exo-H3 Case Study	<u>Sergey González-Mejía</u> , José Miguel Ramírez-Scarpetta, Juan C. Moreno and José Luis Pons	
101	Understanding Technology-induced Compensation: Effects of a Wrist-constrained Robotic Hand Orthosis on Grasping Kinematics	<u>Jan T. Meyer</u> , Charlotte Werner, Sarah Hermann, László Demkó, Olivier Lambercy and Roger Gassert	
110	The Effects of Vestibular Stimulation to Enhance Rehabilitation and Enable Robotic Exoskeleton Training for Persons with CP	<u>Ghaith J. Androwis</u> , Peter A. Michael and Richard Foulds	

POSTER SESSION

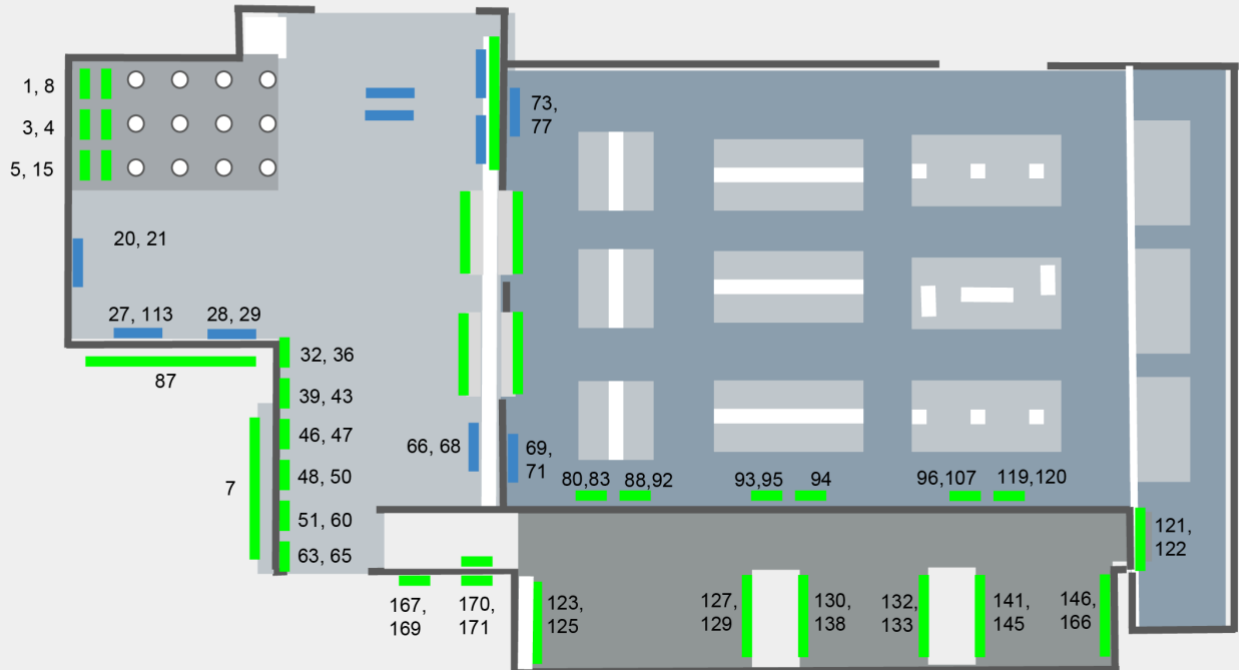
POSTER SESSION ICNR2020			Day	Time
			Thu16	16.00-19.00
Paper ID	Title	Authors		
1	A Random Forest based methodology for the development of an Intelligent Classifier of Physical Activities	Asier Brull, Sergio Lucas, Asier Zubizarreta, Eva Portillo and Itziar Cabanes		
2	Usability evaluation of SMA based exoskeleton: pilot testing in CVA patients	Dorin Sabin Copaci, David Serrano del Cerro, Isabel Alguacil Diego, Diego Fernández Vázquez, Francisco Molina Rueda, Juan Carlos Miangolarra-Page, Luis Moreno and Dolores Blanco		
3	Comparison of Configuration Postures for a Foot Drop Multi-Field FES Device	Aitor Martin, Cristina Rodríguez-de-Pablo, Haritz Zabaleta, Eukene Imatz-Ojanguren and Thierry Keller		
4	Wearable neurofeedback training for boosting attention regulation at the wheel	Davide Crivelli, Laura Angioletti and Michela Balconi		
5	Wearable neurotechnologies for neurocognitive empowerment in applied contexts	Davide Crivelli, Giulia Fronda, Laura Angioletti, Claudia Spinosa and Michela Balconi		
7	A powered ankle foot orthosis based on shaft twisted string actuation to assist persons with foot-drop: a feasibility study	Pedrin Denoth, Pascal Geitner, Lukas Krähenbühl, Eveline Graf and Konrad Stadler		
15	Effects of Decomposition Parameters and Estimator Type on Pseudo-Online Motor Unit Based Wrist Joint Angle Prediction	Dennis Yeung, Francesco Negro and Ivan Vujaklija		
20	Frequency Domain Analysis of EMG and HRV in Self-Support Exercise	Shingo Shimoda, Alvaro Costa Garcia, Hiroshi Yamasaki, Fady Alnajjar, Moeka Sonoo, Shotaro Okajima, Sayako Ueda, Ken-Ichi Ozaki and Izumi Kondo		
21	Towards a Myoelectric Prosthetic Wrist with Rigid and Compliant Behaviour	Patricia Capsi Morales, Cristina Piazza, Giorgio Grioli, Antonio Bicchi and Manuel Catalano		
27	Assessment of Clinical Requirements for a Novel Robotic Device for Upper-Limb Sensorimotor Rehabilitation after Stroke	Raphael Rätz, René M. Müri and Laura Marchal-Crespo		
28	Six weeks use of a wearable soft-robotic glove during ADL: preliminary results of ongoing clinical study	Anke I.R. Kottink, Corien D.M. Nikamp, Jacob H. Buurke, Foskea Bos, Corry K. van der Sluis, Marieke van den Broek, Bram Onneweer, Janneke M. Stolwijk-Swüste, Sander M. Brink, Johan S. Rietman and Gerdieneke B. Prange-Lasonder		
29	Allied Rehabilitation using web-based caregiver MEDIated Exercises for STROKE: the ARMED4STROKE trial design	Corien D.M. Nikamp, Gert Kwakkel, Erik C. Prinsen, Rinske H.M. Nijland, Marijn Mulder, Erwin E.H. van Wegen, Hermie J. Hermens and Jaap H. Buurke		
32	Quaternions-based Normal Gait Kinematics Model	Juan Carlos Gonzalez-Islas, Omar Arturo Dominguez-Ramirez and Omar Lopez-Ortega		
36	Proof-of-concept of POF-based pressure sensors embedded in a smart garment for impact detection in perturbation assessment	Letícia Avellar, Arnaldo Leal-Junior, Carlos Marques, Eduardo Rocon and Anselmo Frizera		
39	In vitro evaluation of a protocol and an architecture for bidirectional communications in networks of wireless implants powered by volume conduction	Laura Becerra-Fajardo, Jesus Minguillon, Camila Rodrigues, Filipe O. Barroso, José L. Pons and Antoni Ivorra		
43	Pathways of hemodynamic response during anodal transcranial direct current stimulation: a computational approach	Yashika Arora, Anirban Dutta and Shubhajit Roy Chowdhury		
46	On the crosstalk in motor unit spike train identification from high-density surface electromyograms	Matjaz Divjak, Lukas G. Wiedemann, Andrew J. McDaid and Ales Holobar		
47	sEMG-based classification strategy of hand gestures for wearable robotics in clinical practice	Nicola Secciani, Alberto Topini, Alessandro Ridolfi and Benedetto Allotta		

48	An Integrated Rehabilitation Platform based on Action Observation Therapy, Mixed Reality and Wearable Technologies	Paolo Mosna, Stefano Lanzi, Stefano Lazzarini, Massimiliano Gobbo, Monica Angelini, Riccardo Buraschi, Stefano Negrini, Maddalena Fabbri Destro, Pietro Avanzini, Giacomo Rizzolatti and Nicola Lopomo
50	Subscription Video on Demand (SVOD) platform accessibility verification method	Gema López-Sánchez and Francisco Utray
51	Effects of Parkinson's Disease and a Secondary Cognitive Task on Standing Postural Stability	Vu Phan, Daniel Peterson, Sutton Richmond and Hyunglae Lee
60	A music therapy serious game with dynamic difficulty adjustment for stimulating short-term memory	María Alejandra Gutiérrez Peñafiel, Juan José Rosero Calderón, Diego Enrique Guzmán Villamarin and Carlos Felipe Rengifo Rodas
63	Complementing hand physiotherapy through a Virtual Reality serious game	Margarida Pereira, Nuno Rodrigues, Eva Domingues, Jonas Kolbensschlag and Cosima Prahm
65	Inhibition of knee sensory receptors alters quadriceps muscle coordination in the rat	Cristiano Alessandro and Matthew Tresch
66	Investigation of Vibrotactile Transducers for a Bone Conduction Sensory Feedback System	Raphael Maria Mayer, Siyuan Chen, Zhuo Li, Alireza Mohammadi, Ying Tan, Gursel Alici, Peter Choong and Denny Oetomo
68	Simultaneous and Proportional Myocontrol of a Hand Exoskeleton for Spinal Muscular Atrophy: a preliminary evaluation	Marco Ricciardi, Alberto Topini, Nicola Secciani, Alessandro Ridolfi and Claudio Castellini
69	Augmented reality for rehabilitation tuning and assessment	Manuel Pezzerà, Eleonora Chitti and N. Alberto Borghese
71	A Study on Reference Range for Detection and Evaluation of Abnormal Foot Movement during Walking in Hemiplegic Subject Using Inertial Sensors	Taihei Noro, Takashi Watanabe, Katsunori Murakami and Naomi Kuge
73	Study of the ERD induced by Different Motor Tasks through non-invasive EEG Analysis to Improve Stroke Rehabilitation Outcomes	Santiago Ezquerro García, Arturo Bertomeu-Motos, Juan Antonio Barrios, José María Catalán Orts, Jorge Antonio Díez Pomares and Nicolas Garcia-Aracil
77	Gait Analysis Applying Novel Metrics	Juan Carlos Gonzalez-Islas, Omar Arturo Dominguez-Ramirez and Omar Lopez-Ortega
80	On Spatial Whitening of High-Density Surface Electromyograms in Compound Muscle Action Potential Decomposition by Differential Evolution	Matej Kramberger and Aleš Holobar
83	Preventing Cognitive Decline in Elderly Population through Neurofeedback Training: A Pilot Study	Eduardo Santamaría-Vázquez, Víctor Martínez-Cagigal, Daniel Rodríguez, Jaime Finat and Roberto Hornero
87	The Effect of Visual, Auditory, Tactile and Cognitive feedback in Motor Skill Training: A pilot study based on VR gaming	Fady Alnajjar, Qi An, Mohit Saravanan, Khaled Khalil, Munkhjargal Gochoo and Shingo Shimoda
88	A Transparent Lower Limb Perturbator to Investigate Joint Impedance During Gait	Ronald C van T Veld, Simone S Fricke, Ander Vallinas Prieto, Arvid Q L Keemink, Alfred C Schouten, Herman van der Kooij and Edwin H F van Asseldonk
92	Development of Impact Absorber Mechanism for Wearable Exoskeleton Using Shape Memory Alloy Spring	Hyunho Kim, Hyerim Jeon, Yongho Jeong and Yeongjin Kim
93	Real-time Cycling Cadence Estimation using an Inertial Sensor for Gamified Pedaling Therapy	Ana Rojo, Rafael Raya and Juan C. Moreno
94	Are Brain-Computer Interfaces Needed for Stroke Rehabilitation? Detection of Attempted Stroke Hand Motions from Surface EMG	Mads Jochumsen, Asim Waris and Imran Khan Niazi
95	Wearable sensor for multi-wavelength near-infrared spectroscopy of skin hemodynamics along with underlying muscle electromyography	Radhika Mujumdar, Mancheung Cheung, Shweta Kadam and Anirban Dutta
96	Human brain organoid platform for neuroengineering optical theranostics in neonatal sepsis	Sneha Karanth, Radhika Mujumdar, Jagdish Sahoo, Abhijit Das, Michal Stachowiak and Anirban Dutta
107	Explicitness of task instructions supports motor learning and modulates engagement of attentional brain networks	Joaquin Penalver-Andres, Karin A. Buetler, Thomas König, René M. Müri and Laura Marchal-Crespo
113	Designing a music-based game for training pattern recognition control of a myoelectric prosthesis	Diogo Bessa, Nuno Feixa Rodrigues, Eva Oliveira, Jonas Kolbensschlag and Cosima Prahm

119	A Parallel Actuated Haptic Device for De-Localized Tactile Feedback in Prosthetics	Daniele Leonardis, Leonardo Cappello, Christian Cipriani and Antonio Frisoli
120	A Compact Soft Exoskeleton for Haptic Feedback in Rehabilitation and for Hand Closing Assistance	Tommaso Bagneschi, Daniele Leonardis, Domenico Chiaradia and Antonio Frisoli
121	Simultaneous control of natural and extra degrees-of-freedom by isometric force and EMG null space activation	Sergio Gurgone, Daniele Borzelli, Paolo De Pasquale, Denise J. Berger, Tommaso Lisini Baldi, Nicole D'Aurizio, Domenico Prattichizzo and Andrea D'Avella
122	Adaptation to virtual surgeries across multiple practice sessions	Daniele Borzelli, Sergio Gurgone, Maura Mezzetti, Paolo De Pasquale, Denise J. Berger, Demetrio Milardi, Giuseppe Aciri and Andrea d'Avella
123	Clustering of Data that Quantify the Degree of Impairment of the Upper Limb in Patients with Alterations of the Central Nervous System	Leonardo Eliu Anaya Campos, Ivett Quiñones Urióstegui, Yannick Quijano González and Virginia Bueyes-Roiz
125	Artificial Neural Networks to Quantify Motor Skills in Children with Cerebral Hemiparesis	Leonardo Eliu Anaya Campos, Ivett Quiñones Urióstegui, Yannick Quijano González and Virginia Bueyes-Roiz
127	Effect of rollator assistance on sit-to-stand balance in older adults	Lizeth Sloom, Matthew Millard, Christian Werner and Katja Mombaur
129	Psychophysiological assessment of exoskeleton-assisted treadmill walking	Ilenia Pecoraro, Nevio Luigi Tagliamonte, Christian Tamantini, Francesca Cordella, Francesca Bentivoglio, Iolanda Pisotta, Alessandra Bigioni, Federica Tamburella, Matteo Lorusso, Paola Argentieri, Marco Molinari and Loredana Zollo
130	Kinematic and Functional Evaluation of a 3D Printed Robotic Hand	Virginia Bueyes-Roiz, Ivett Quiñones Urióstegui, Leonardo Eliu Anaya Campos, Jose Luiz Zavaleta-Ruiz, Gerardo Rodríguez-Reyes and Yannick Quijano
132	Different Stimuli Configuration in Paired Associative Stimulation Protocol: A Pilot Study.	Arantzazu San Agustín, Jose Luis Pons, Antonio Oliviero and Juan C. Moreno
133	Intensity Dependent Long-Term Potentiation and Inhibition in Paired Associated Stimulation by Transcranial Magnetic Stimulation: A Case Report	Arantzazu San Agustín, David Crevillén, Antonio Oliviero, Jose Luis Pons and Juan C. Moreno
138	Evaluation of balance abilities in expert Paralympic athletes with lower limb amputation	Giorgia Marchesi, Amy Bellitto, Elena Ricaldone, Alice De Luca, Carlo Sanfilippo, Karin Torre, Elisabetta Quinland, Jody Saglia, Valentina Squeri, Antonino Massone, Maura Casadio and Andrea Canessa
141	Towards Objective Assessment of Upper Limb Spasticity by Means of Collaborative Robots	Edwin Daniel Oña Simbaña, Ana Casanova, Anaëlle Gordillo, Carlos Balaguer and Alberto Jardón Huete
145	A novel biomarker for the prediction of functional outcome after stroke: The neural coupling mechanism	Belen Valladares, Meret Branscheidt, Levke Steiner, Volker Dietz and Andreas Luft
146	Human neuromarkers of tactile perception: state of the art in methods and findings	Gianna Cannestro, Moaed Abd, Erik Engeberg and Emmanuelle Tognoli
166	Surface EMG based Guidance Force Feedback System for Muscle-Specific Upper limb Training in Stroke Patients	Sojung Lee and Suncheol Kwon
167	Correlation between EEG band power parameters and functional scale in stroke patients	Marc Sebastián-Romagosa, Rupert Ortner, Josep Dinarès-Ferran and Christoph Guger
169	An open-source, wheelchair accessible and immersive driving simulator for training people with Spinal Cord Injury	Filippo Gandolfi, Amy Bellitto, Angelo Basteris, Andrea Canessa, Antonino Massone, Serena Ricci and Maura Casadio
170	Hybrid Actuation Mechanism for an Ultra Low-Cost Transhumeral Prosthesis: Preliminary Study	Tommaso Reboli, Silvia Meloni, Giulia Ballardini, Giorgio Carlini, Maura Casadio, Filippo Sante, Mario Serafica, Gabriele Vigo and Lucia Schiatti
171	Neural Coherence of Homologous Muscle Pairs during Direct EMG Control of Standing Posture in Transtibial Amputees	Aaron Fleming, Wetao Liu and Helen Huang

ICNR Posters location

Expo Hall 1



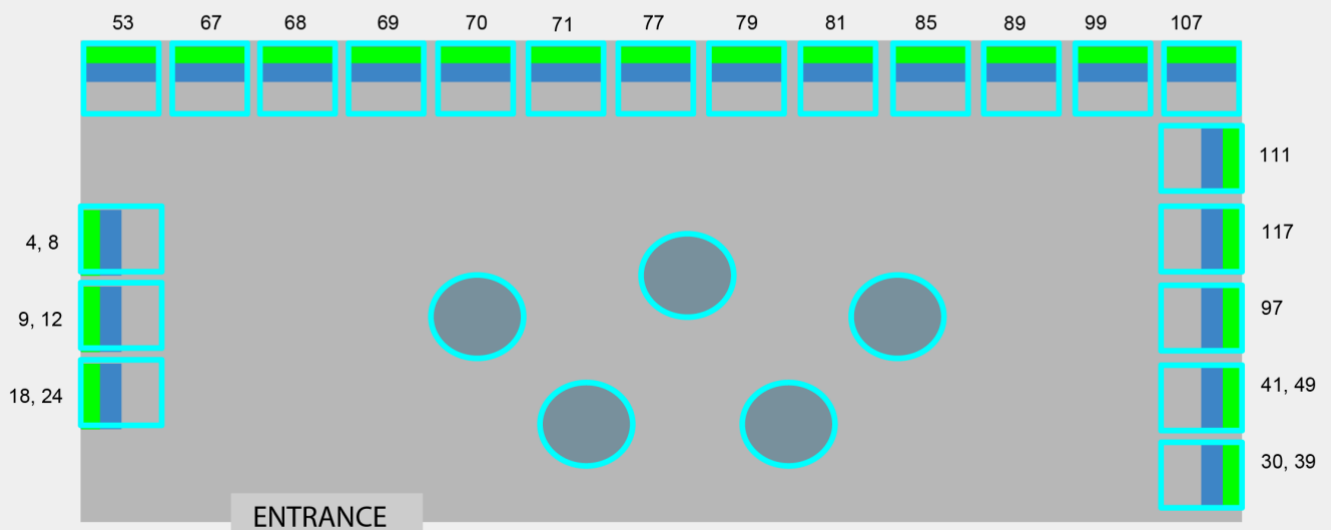
POSTER SESSION WeRob2020			Day	Time
			Thu16	16.00-19.00
Paper ID	Title	Authors		
4	Preliminary study of an exoskeleton index for ergonomic assessment in the workplace	Giorgia Chini, Christian Di Natali, Stefano Toxiri, Francesco Draicchio, Luigi Monica, Darwin Caldwell and Jesús Ortiz		
8	Effect of a new passive shoulder exoskeleton on the full body musculoskeletal load during overhead work	Arthur van der Have, Sam Van Rossom, Marco Rossini and Ilse Jonkers		
9	A New Terrain Recognition Approach for Predictive Control of Assistive Devices using Depth Vision	Ali Al-Dabbagh and Renaud Ronsse		
12	On the Design of Kalman Observers for Back-Support Exoskeletons	Erfan Shojaei Barjuei, Darwin G. Caldwell and Jesus Ortiz		
18	Performance Indicators of Humanoid Posture Control and Balance Inspired by Human Experiments	Vittorio Lippi, Thomas Mergner, Christoph Maurer and Thomas Seel		
24	Neuromusculoskeletal model-based controller for voluntary and continuous assistance in a broad range of locomotion tasks	Guillaume Durandau, Wolfgang Rampeltshammer, Herman van der Kooij and Massimo Sartori		
30	Methods for User Activity Recognition in Exoskeletons	Iñaki Diaz, Juan Martin, Xabier Justo Pereira, Carlos Fernandez and Jorge Juan Gil		
39	Energy cost of transport in overground walking of a transfemoral amputee following one month of robot-mediated training	Clara Beatriz Sanz-Morère, Elena Martini, Gabriele Arnetoli, Stefano Doronzio, Antonella Giffone, Barbara Meoni, Andrea Parri, Roberto Conti, Francesco Giovacchini, Thor Fridriksson, Duane Romo, Raffaele Molino-Lova, Simona Crea and Nicola Vitiello		
41	Exoskeleton Introduction in industry. Methodologies and experience of CRF	Massimo Di Pardo, Rossella Monferino and Felice Tauro		
49	A Methodology for Benchmarking Force Control Algorithms	Rudy Vicario, Andrea Calanca, Noè Murr, Matteo Meneghetti, Enrico Sartori, Guglielmo Zanni and Paolo Fiorini		
53	Survey on Control Strategies Designed for Powered Lower Limb Exoskeletons for Gait Training in Post-Stroke Rehabilitation	Jesus de Miguel-Fernandez, Joan Lobo-Prat and Josep Maria Font-Llagunes		
58	Smartwear with Artificial Intelligence (AI) in assessing workload in view of Ergonomics	Pekka Tolvanen, Riitta Simonen and Janne Pylväs		
67	Simulation-Based Optimization Methodology for Designing a Workspace with Exoskeleton	Zohar Potash, Jawad Masood and Raziel Rimer		
68	Pseudo-online muscle onset detection algorithm with threshold auto-adjustment for lower limb exoskeleton control	Juan Marvin Fernández García, Camila Rodrigues de Carvalho, Filipe O. Barroso and Juan C. Moreno		
69	A Design Tool for Passive Wrist Support	Ali Amooznandeh Nobaveh, Giuseppe Radaelli and Just Herder		
70	Can HDEMG-based low back muscle fatigue estimates be used in exoskeleton control during prolonged trunk bending? A pilot study	Niels Brouwer, Ali Tabasi, Alejandro Moya-Esteban, Massimo Sartori, Wietse van Dijk, Idsart Kingma and Jaap van Dieën		
71	A workaround for recruitment issues in preliminary WR studies: audio feedback and instrumented crutches to train test subjects	Matteo Lancini, Simone Pasinetti, Marco Ghidelli, Pietro Padovani, David Pinto-Fernandez, Antonio J. del-Ama and Diego Torricelli		
77	Pneumatic control system for exoskeleton joint actuation	Pavel Venev, Ivanka Veneva and Dimitar Chakarov		
79	PowerGrasp: Development Aspects for Arm Support Systems	Jan Kuschan, Jean-Paul Goppold, Henning Schmidt and Jörg Krüger		
81	Subjective assessment of Occupational Exoskeletons: feasibility study for a Custom Interview for Braces	Matteo Sposito, Darwin Caldwell, Elena De Momi and Jesus Ortiz		
85	The SoftPro Wearable System for Grasp Compensation in Stroke Patients	Leonardo Franco, Martin Tschiersky, Gerjan Wolterink, Federica Barontini, Mattia Poggiani, Manuel Catalano, Giorgio Grioli, Matteo Bianchi, Antonio Bicchi, Simone Rossi, Domenico Prattichizzo and Gionata Salvietti		

89	CANopen Robot Controller (CORC): An open software stack for human robot interaction development	Justin Fong, Emek Barış Küçüktabak, Vincent Crocher, Ying Tan, Kevin M. Lynch, Jose L. Pons and Denny Oetomo
97	The Impact of Exoskeletal-Assisted Walking on the Immune System of individuals with chronic spinal cord injury (SCI)	Anthony A. Arcese, Ann M. Spungen and Ona Bloom
99	3D Relative Motion Assessment in Lower-limb Exoskeletons: A Case of Study with AGoRA exoskeleton	Felipe Ballen-Moreno, Carlos A. Cifuentes, Thomas Provot, Maxime Bourgain and Marcela Múnera
107	HandMECH - Mechanical Hand Prosthesis: Conceptual Design of the Hand Compartment	Baris Baysal and Ramazan Unal
111	Robotic rehabilitation in cerebral palsy	Beatriz Moral, Óscar Rodríguez, Elena García, Eduardo Rocon and Sergio Lerma
117	Optimising balance margin in lower limb exoskeleton to assist user-driven gait stability	Xiruo Cheng, Justin Fong, Ying Tan and Denny Oetomo

WeRob Posters location



Expo Room



PLENARY LECTURES



Dr. Ales Holobar

Faculty of Electrical Engineering and Computer Science, University of Maribor

Title: Non-invasive muscle excitation assessment revised

Abstract:

In the recent two decades, methodologies for non-invasive surface electromyographic (sEMG) recordings of skeletal muscles and analysis of these recordings substantially improved our understanding of human motor system and human-machine interaction. They opened new ways to objective assessment of muscle synergies, robot-assisted rehabilitation, intuitive prosthetics, and objective assessment and tracking of various pathologies. However, assessment of muscle excitation out of sEMG recordings is frequently non-trivial as sEMG often reflects commands from central nervous system (CNS) as well as anatomical properties and geometric changes of recorded skeletal muscles. Discrimination of these factors requires advanced sEMG decomposition either into individual motor unit spike trains or into their cumulative spike train, removing motor unit action potentials (MUAPs) from sEMG recordings. Several sEMG decomposition techniques have been proposed in the past and in this talk we will review their properties in terms of methodological assumptions, muscle excitation assessment errors and experimental costs. We will systematically compare multichannel and single channel sEMG analysis and sEMG decomposition methodologies, such as independent component analysis (ICA), non-negative matrix factorisation (NMF), recently introduced cumulative activity index (CAI) and others. We will also outline the advantages and methodological limitations of these techniques in various rehabilitation applications, especially in rehabilitation after stroke.

Biosketch:

Aleš Holobar received his BS and PhD degree in Computer Science from the Faculty of Electrical Engineering and Computer Science (FEECS), University of Maribor (UM), Slovenia, in 2000 and 2004, respectively. In 1997, he joined the System Software Laboratory at FEECS, where he was employed as a researcher and teaching assistant. From 2005 to 2009, he was with Laboratory of Engineering of Neuromuscular System and Motor Rehabilitation at Politecnico di Torino, Italy, with support provided by Cassa di Risparmio di Torino and Institute for Scientific Interchange Foundations (from 2005 to 2006), and by a Marie Curie Intra-European Fellowship within the 6th European Community Framework Programme (from 2006 to 2009). In 2009 he returned to FEECS, University of Maribor, where he holds the position of full professor. He is currently the head of the System Software Laboratory and the head of the Institute of Computer Science at FEECS.

His main research interests include digital signal processing, with current activities focused on source separation, human-machine interfaces, biomedical signal processing and rehabilitation engineering. Up to now he co-authored 75 papers in peer reviewed journals, 4 book chapters and more than 100 conference contributions. He has co-organized more than 65 international workshops and seminars

on decomposition of compound signals, time-frequency analysis and extraction of information from noninvasively acquired biomedical signals.



Dr. Vivian K Mushahwar

University of Alberta. Division of Physical Medicine and Rehabilitation



Dr. Ferdinando A. Mussa-Ivaldi

Northwestern University and Shirley Ryan Ability Lab

Title: Model-based motor learning and its clinical implications

Abstract:

A growing body of evidence suggests that when we interact physically with our environments our brains form models of the deterministic connection between our actions and the ensuing sensory information. Theories of motor learning posit that the formation of internal models is a key mechanism through which the brain forms predictions about the outcomes of actions, overcoming certain limitations of the biological feedback system. Consistent with these theories, experiments with human-robot interactions have demonstrated the ability of the brain to capture the difference between random and deterministic forces. After a brief review of some earlier studies, I will focus on a family of human-machine interfaces that create a many-to-one mapping between body motions and movements of an external controlled object. In this context, the user learns to control the external object by forming an inverse model of the interface mapping. I will describe this learning process as a state-based dynamical system and will discuss how machine learning may connect with human learning to facilitate the acquisition of motor skills and their recovery after injury to the nervous system.

Biosketch:

Ferdinando (Sandro) Mussa-Ivaldi graduated in Physics from the University of Torino. In 1987 he obtained a PhD in biomedical engineering from the Politecnico of Milano. In 1982 he moved to the United States, to work at MIT in the laboratory of Emilio Bizzi in the Department of Brain and Cognitive Sciences. Although he planned to stay there for a brief training period, he left 11 years later to take a faculty position in Chicago at Northwestern University, where he is currently Professor of Physiology, Physical medicine and Rehabilitation and Biomedical Engineering. He joined the Rehabilitation Institute of Chicago, now the Shirley Ryam Ability Lab, and founded the Robotics Laboratory, dedicated to the study of human motor learning and to the rehabilitation after stroke and spinal cord injury through the interaction with intelligent machines. His areas of interest and expertise include robotics, neurobiology of the sensory-motor system, motor learning and computational neuroscience.



Dr. Natalie Mrachacz-Kersting
Aalborg University

Natalie Mrachacz-Kersting, Ph.D., obtained the M.Ed. degree in Human Movement Science from the University of Western Australia, Perth, Australia, in 1997, and the PhD degree in Biomedical Engineering from Aalborg University, Aalborg, Denmark in 2005. In 2005-2007 she has been a lecturer at the Department of Sport and Exercise Science, The University of Auckland, Auckland, New Zealand and in 2007-2009 an assistant professor in Motor Control at Aalborg University, Aalborg, Denmark. Since 2009 she has worked as associate professor at the Department of Health Science and Technology at Aalborg University, Aalborg, Denmark. There she is the head of two laboratories, the Motor Control Laboratory and the Neuroplasticity Laboratory. Her main research interest is focused on the role of feedback from muscle afferents in both motor control and neural plasticity.



Dr. Jonathan R. Wolpaw
*Director, National Center for Adaptive Neurotechnologies
Wadsworth Center. New York State Department of Health
Department of Neurology, Albany Stratton VA Medical Center
Department of Neurology, Neurological Institute, Columbia University*

Biosketch:

Over the past 30 years, Dr. Wolpaw's laboratory has developed and used operant conditioning of spinal reflexes as a model for defining the plasticity underlying learning. His group's recent work shows that reflex conditioning can guide spinal cord plasticity in spinal cord-injured rats and can thereby improve locomotion. Clinical researchers are now finding evidence that such conditioning can improve locomotion in people with partial spinal cord injuries. For the past 20 years, Dr. Wolpaw has also led development of EEG-based brain-computer interface (BCI) technology to provide non-muscular communication and control to people who are paralyzed. Most recently, his group has begun to provide BCI systems to severely disabled people for daily use in their homes.



Dr. John W. Krakauer

John C. Malone Professor of Neurology, Neuroscience, & PMR, Johns Hopkins University

Title: The behavioral and systems neuroscience of upper limb motor recovery after stroke

Abstract:

Why is restoring function in the arm and hand after stroke so hard? Here in attempt answer this question, I will discuss the components of the upper limb hemiparesis phenotype and make the case that we will likely have to target each component differently with respect to intervention. Spontaneous recovery, critical periods and novel interventions will also be discussed.

Biosketch:

Dr. Krakauer is currently John C. Malone Professor of Neurology, Neuroscience, and Physical Medicine and Rehabilitation, and Director of the Brain, Learning, Animation, and Movement Lab (www.BLAM-lab.org) at The Johns Hopkins University School of Medicine. He is also an external Professor at the Santa Fe Institute, and holds visiting positions at The Champalimaud Centre for the Unknown in Lisbon and at the Zuckerman Institute at Columbia University in New York.

Dr. Krakauer is also co-founder of the video gaming company MSquare Health, and of the creative engineering Hopkins-based project named the KATA Design Studio. KATA and MSquare are both predicated on the idea that animal movement based on real physics is highly pleasurable and that this pleasure is hugely heightened when the animal movement is under the control of our own movements. A simulated dolphin and other cetaceans developed by KATA has led to a therapeutic game, interfaced with an FDA-approved 3D exoskeletal robot, which led to a recently completed multi-site rehabilitation trial for early stroke recovery. Dr. Krakauer's book, "Broken Movement: The Neurobiology of Motor Recovery after Stroke" was published by the MIT Press in 2017.



Dr. Nadia Dominici

AMS. iBBA. Faculty of Behavioural and Movement Sciences. Vrije Universiteit Amsterdam

Title: *Modular organization of locomotion in human and animal*

Abstract:

In order to walk we must set into motion the body and the legs using literally hundreds of different muscles. The idea that the CNS may control these complex interactions between muscles by using a small number of elementary commands, also known as muscle synergies, has received considerable attention. We explored this idea by examining this modular organization in three different cases: 1. Evolution of number and type of muscle synergies during the development of walking in children, as it evolves from ‘stepping reflex’ in neonates to independent walking in toddlers. 2. Changes in cortico-synergy coherence accompanying short-term balance training in healthy adults. 3. Synergies-based neuromodulation therapies aimed to stimulate and improve gait quality after spinal cord injury.

Biosketch:

Nadia Dominici is an associate professor at the Faculty of Behavioural and Movement Science at Vrije Universiteit of Amsterdam where she works on the interplay between brain and muscular activity underlying independent walking in children, as well as on the biomechanics of human locomotion. After a master diploma in Physics, she obtained a PhD in Neuroscience at the University of Rome “Tor Vergata”, for work on the neurophysiology of locomotor development in children. She has held research positions at the Laboratory of Neuromotor Physiology of the Santa Lucia Foundation in Rome, where she focused on central pattern generation networks and on the development of locomotion in children, and at the Experimental Neurorehabilitation Laboratory at the University of Zürich, and EPFL in Lausanne, where she developed neurorehabilitation techniques to restore walking in animals after spinal cord injuries. She was awarded the Suzanne Klein-Vogelbach -Prize for the Research of Human Movement prize in 2013, and a 5-year NWO (Netherlands Organisation for Scientific Research) Vidi grant in 2015 and a 5-year ERC (European Research Council) Starting Grant in 2016.

**Prof. Sunil K. Agrawal**

Ph.D., Professor, Department of Mechanical Engineering and Department of Rehabilitation and Regenerative Medicine, Columbia University, New York, NY 10027, USA.

Title: Robotics to Characterize, Retrain, and Restore Human Movements

Abstract:

Neural disorders and old age limit the ability of humans to perform activities of daily living. Robotics can be used to probe the human neuromuscular system and create new pathways to characterize, relearn, or restore functional movements. Dr. Agrawal's group at Columbia University Robotics and Rehabilitation (ROAR) Laboratory has designed innovative technologies and robots for this purpose. These technologies have been tested on subjects in a variety of studies to understand the human cognitive and neuro-muscular response. Human experiments have targeted patients with stroke, cerebral palsy, Parkinson's disease, ALS, Vestibular disorders, elderly subjects and others. The talk will provide an overview of some of these technologies and scientific studies performed with them.

Biosketch:

Sunil K. Agrawal received a Ph.D. degree in Mechanical Engineering from Stanford University in 1990. He is currently a Professor and Director of Robotics and Rehabilitation (ROAR) Laboratory at Columbia University, located both in engineering and medical campuses of Columbia University. Dr. Agrawal has published more than 500 journal and conference papers, three books, and 15 U.S. patents. He is a Fellow of the ASME and AIMBE. His honors include a NSF Presidential Faculty Fellowship from the White House in 1994, a Bessel Prize from Germany in 2003, and a Humboldt US Senior Scientist Award in 2007. He is a recipient of 2016 Machine Design Award from ASME for "seminal contributions to design of robotic exoskeletons for gait training of stroke patients" and 2016 Mechanisms and Robotics Award from the ASME for "cumulative contributions and being an international leading figure in mechanical design and robotics". He is a recipient of several Best Paper awards in ASME and IEEE sponsored robotics conferences. He has also held international visiting positions that include Technical University of Stuttgart, Hanyang University in Korea, University of Ulster in Northern Ireland, Biorobotics Institute of SSSA in Pisa, Peking University in China. He has successfully directed 30 PhD student theses and currently supervises the research of 10 PhD students at ROAR laboratory. He is the founding Editor-in-Chief of the journal "Wearable Technologies" from Cambridge University Press. He is the Conference Chair for IEEE BioRob2020 to be hosted in New York city.

Website: <https://roar.me.columbia.edu>

Google Scholar Page:

https://scholar.google.com/citations?hl=en&user=zavGyr4AAAAJ&view_op=list_works&sortby=pub_date



Prof. Roger Gassert
ETH Zurich

Title: Towards Fully Wearable Exoskeletons for Assistance and Therapy in Daily Life

Abstract:

Wearable robots, e.g., in the form of powered lower and upper limb exoskeletons, promise to at least partially restore sensorimotor function in persons with stroke or spinal cord injury, thereby promoting their independence. While technology has evolved significantly over the past decades and an increasing number of products have entered the rehabilitation market, their application is still mostly limited to lab and clinical environments. Full wearability, critical for use in daily life, is often not achieved. Powered lower-limb exoskeletons are challenged in their ability to reproduce human gait and cope with daily “obstacles” such as uneven ground and stairs. In contrast, upper limb exoskeletons struggle to cope with the dexterity of the upper limb. This talk will present our efforts to overcome some of these challenges, through design tradeoffs, user-centered development, and benchmarking events such as the CYBATHLON, a championship for pilots with disabilities using state of the art assistive technology to compete in tasks inspired by activities of daily living. It will further propose ways in which our field could evolve to better promote access to fully wearable robots for assistance and therapy in daily life.

Biosketch:

Roger Gassert is Professor of Rehabilitation Engineering at ETH Zurich. He received an M.Sc. degree in microengineering and a Ph.D. degree in neuroscience robotics from the Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland, in 2002 and 2006, respectively. Following postdoctoral positions at Imperial College London, UK, Simon Fraser University, Canada, and ATR International, Japan, he was appointed Assistant Professor of Rehabilitation Engineering at ETH Zurich in 2008 and promoted to Associate/Full Professor in 2014/2019. His research is concerned with the development and application of robotics, wearable sensor technologies and non-invasive neuroimaging to assess, explore and restore sensorimotor function in persons with neuromotor impairments.

Roger Gassert is vice-president of the strategic advisory board of the CYBATHLON, a championship for people with disabilities competing with advanced assistive devices, and founding member of the International Consortium for Rehabilitation Robotics. He is member of the foundation board of Access for all and the cereneo center for interdisciplinary research in telerehabilitation, and advisory board member of the Innovation Centre for Assistive Technology of the Swiss Paraplegic Foundation. He also serves as Swiss National Contact Person for the Associate for the Advancement of Assistive Technology in Europe.

Website: <https://relab.ethz.ch/laboratory/team/roger-gassert.html>



Prof. Arun Jayaraman

Director Max Nader Center for Rehabilitation Technologies & Outcomes Research

Director & Business Development Officer, Office of Translational Research, Shirley Ryan AbilityLab

Associate Professor

Department of Physical Medicine & Rehabilitation

Department of Physical Therapy & Human Movement Sciences

Northwestern University

Title: What has happened in the Last Decade with Exoskeletons in Research and Clinical Care?

Abstract:

Robotic exoskeletons are an area of research and clinical care that has gained substantial attention and usage in recent times. Interestingly, the acceptance of these devices into everyday clinical practice and home use is still variable based on clinical research. The talk will discuss on how engineering and clinical science is being combined and performed simultaneously and sequentially to gain insight to clinical utility of wearable robots to specific clinical populations at the Shirley Ryan AbilityLab. We will discuss recent trials being completed at the AbilityLab and outcomes of these studies.

Background: Arun Jayaraman PT is the Director, Max Näder Center for Rehabilitation Technologies & Outcomes Research at the Rehabilitation Institute of Chicago. He is also an Associate Professor at Departments of Physical Medicine & Rehabilitation and Physical Therapy & Human Movement Sciences at Northwestern University. Dr. Jayaraman's group is a clinical lab that develops and executes both investigator-initiated and industry-sponsored research in prosthetics, rehabilitation robotics, and other assistive and adaptive technologies to treat physical disability. The lab conducts all its outcome research using advanced wearable patient monitoring wireless sensors and machine learning techniques in addition to the traditional outcome measures.



Prof. Israel Benavides
Ergonomics Engineer, Ford

Abstract:

As leading automotive manufacturer, Ford has great expertise for production process and setting of requirement and testing on exoskeletons. Ford Manufacturing engineering have been investigating several (passive) exoskeleton. Review of advantage and disadvantages. Benefits and inconvenience for workers. Last results of the investigations and next steps.

Background: Program Ergonomist Eng. for VOME Trim & Final – Ford of Europe for 5 years. Nuclear Engineer with Master of Sciences degree from the Moscow Energetic Institute.

Relevant Experience: Since 2015 monitoring of design, development and manufacturing of new vehicles to meet the Ford Ergonomics Global Standards. Exoskeleton line trials, analyzing 14 different models (4 for back and 10 for shoulders) during Ergonomic support at Ford Valencia plant in Spain.

Spanish National Prevention Award ASEPEYO 2018 for investigations on exoskeletons. Collaboration with the Biomechanical Institute of the Valencia University and the Hamburg University. Holding of conferences and participation in several Exoskeletons Events in Spain and Germany.



Prof. Matthew Marino
HeroWear

Title: The Skillful Art of Fitting Exoskeletons

Abstract: Exoskeleton technology must fit properly to be safe, reliable and effective. After observing and assisting users, producers, researchers, therapists, trainers, ergonomists and safety professionals fit and adjust exoskeletons for over 5 years, it's become apparent that fitting exoskeletons is a skillful art. There are many factors that play a role in user acceptance and adoption, but one of the most basic things that can be controlled is the fit of the exo technology. Beyond each exoskeleton's user manual and each exo producer's guidance, there are few practical tips, guidelines or resources to help users and professionals properly fit and adjust exo technology. The science behind exoskeleton fitting is also limited. This presentation will discuss why fitting exoskeletons is a skill and an art, the science behind exoskeleton fit, why good fit is so important, and practical tips for achieving a good fit for every exo user.

Background:

Matt is the Director of Ergonomics and Human Factors at HeroWear. A distinguished ergonomics consultant for numerous industries, Matt ensures the voice of users and workplace safety always stay top of mind.

Prior to HeroWear, Matt was the Practice Lead for Wearable Technology and Exoskeletons with Briotix Health LLP. Matt has been an active member of the ASTM F48 Committee on Exoskeletons since its 2017 inception, and he is a founding partner of the ASTM Exo Technology Center of Excellence. Matt has provided consulting services for clients in many industries, including manufacturing, logistics, warehousing, distribution, construction, agriculture, wholesale and retail trade, transportation, municipalities, utilities, healthcare, office settings, and tactical operations.

Matt has presented work at ergonomics, workers compensation, rehabilitation, safety, and health conferences around the world. He has collaborated on work with various universities, agencies, institutes and associations.

Matt received his B.S. in Rehabilitation Science and M.S. in Physical Therapy from Northeastern University. He is a Certified Professional Ergonomist (CPE), Certified Strength and Conditioning Specialist (CSCS), Tactical Strength and Conditioning Facilitator (TSAC-F), Certified Workers Compensation Healthcare Provider (CWcHP), Certified Personal Trainer (CPT), and Six Sigma Black Belt. He is also certified in all Functional Movement Systems screens, tests, and assessments (FMS, FCS, MCS, SFMA, and YBT).

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