EMANUELE FORMENTO, Ph.D
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Nationality: Italian

EDUCATION

2014–2018 **Ph.D. in Electrical Engineering**,
École Polytechnique Fédérale de Lausanne (EPFL), Switzerland.

Thesis Title: A computational approach for the design of epidural electrical spinal cord stimulation strategies to enable locomotion after spinal cord injury.

Thesis Directors: Prof. Micera Silvestro and Prof. Courtine Grégoire.

Defence Date: 06/12/2018

2012–2014 **Master's degree in Bioengineering** with minor in Neuroprosthetics,
EPFL, Switzerland.

2009–2012 **Bachelor's degree in Biomedical Engineering**,
Polytechnic University of Turin, Italy.

ACADEMIC EXPERIENCES

2019–Present **Postdoctoral scholar**, Prof. Jose M. Carmena's laboratory, UC Berkeley.

- Developing minimally-invasive brain-machine interfaces for abstract skill learning in animal models and humans.

2014–2018 **Ph.D. student**, Prof. Micera's and Prof. Courtine's laboratories, EPFL, Switzerland.

- Developed multiple computational models (e.g., spiking neural networks and musculoskeletal models) and performed electrophysiological, psychophysical and behavioral experiments to study the mechanisms of electrical spinal cord stimulation therapies for restoring walking after paralysis.
- Designed and patented novel stimulation strategies that optimize the efficacy of these therapies.
- Designed an electrical stimulation strategy that induces highly biomimetic neural activity.
- Collaborated with researchers across Europe in the development of the Human Brain Project neurorobotic simulation platform.

2014–2018 **Teaching Assistant** for the course of "Fundamentals of Neuroengineering" and "Sensorimotor Neuroprosthetics", EPFL, Switzerland.

- Organized, managed, and corrected exercise sessions and exams.
- Prepared and lectured a class in modeling for neuroengineering.

2014–2018 **Supervision of Students**, EPFL, Switzerland.

Student	*Project*	*Topic*
Miroslav Caban	Master thesis	Neuromusculoskeletal modeling
Manasi Cane	Master thesis	Finite element method modeling
Andreas Rowald	Master thesis	Data analysis and modeling

Ludovica Apa	Master thesis	Biomechanical modeling
Kelly Assouly	Master thesis	Muscle tendon vibration
Eleonora Borda	Semester project	Plasticity modeling
Eleonora Iaselli	Semester project	Plasticity modeling
Camille Blondin	Bachelor thesis	Spinal cord electrophysiology

2014–Present **Scientific article reviewer** for the following journals and conferences:

- Journal of Neuroengineering and Rehabilitation
- International Conference on Intelligent Robots and Systems
- International Conference on Biomedical Robotics and Biomechatronics
- International Conference on Neurorehabilitation.

2014 **Master thesis**, Prof. Micera's laboratory,
EPFL, Switzerland.

- Developed a prosthetic hand controller that decodes intended hand movements from electromyographic signals using multiple machine learning models, including artificial neural networks and linear discriminant analysis classifiers.

PROFESSIONAL EXPERIENCES

2013 **Second Sight**, 2–months internship, Lausanne, Switzerland.

- Developed a Matlab program that integrates an eye tracker into the Argus II Retinal Prosthesis System.

2012 **Laboratori Biomicron**, 3–months internship, Turin, Italy.

- Characterized a bioengineered polymeric device with barrier properties, for oral surgery.

HONORS AND AWARDS

2018 Nomination to the **Best Ph.D. Thesis Award** from the Electrical Engineering Doctoral School, EPFL, Switzerland.

2016 Major contribution to a publication winning the **Best Postdoc Paper Award** from the National Centers of Competence in Research Robotics of the Swiss National Science Foundation.

2014 Master degree with **Award of Excellence**, EPFL, Switzerland.

TECHNICAL SKILLS

- **6 years of experience in biomedical research** with strong skills in experimental design, biosignals acquisition and processing, electrophysiology, electrical neuromodulation, and electronics prototyping.
- **6 years of experience in data science** applied to neural and kinematic datasets, with expertise in feature engineering, supervised and unsupervised learning, classification and regression models, statistical analysis and data visualization.
- **Advanced knowledge in modeling** of spiking neural networks, musculoskeletal systems, and of the effect of electrical stimulation on the nervous system.
- **Excellent programming skills** in Python, Matlab, fluent in C++. Experienced with Git and parallel computing.

PERSONAL SKILLS AND LANGUAGES

- Problem solving and creative thinking
- Oral and written communication
- Italian (Native)
- English (Full professional proficiency)
- French (Professional proficiency)

PUBLICATIONS IN PEER-REVIEWED SCIENTIFIC JOURNALS

E. Formento, K. Minassian, F. Wagner, JB. Mignardot, C.G. Le Goff, A. Rowald, J. Bloch, S. Micera*, M. Capogrosso* and G. Courtine*. Electrical spinal cord stimulation must preserve proprioception to enable locomotion in humans with spinal cord injury. Nature Neuroscience, 21.12: 1728, 2018 (link).

E.M. Moraud, J.V. Zitzewitz, J. Miehlbradt, S. Wurth, E. Formento, J. DiGiovanna, M. Capogrosso, G. Courtine, and S. Micera. Closed-loop control of trunk posture improves locomotion through the regulation of leg proprioceptive feedback after spinal cord injury. Scientific Reports, Nature Publishing Group, 8.1: 76, 2018 (link).

E.M. Moraud*, M. Capogrosso*, E. Formento, N. Wenger, J. DiGiovanna, G. Courtine† and S. Micera†. Mechanisms underlying the neuromodulation of spinal circuits for correcting gait and balance deficits after spinal cord injury. Neuron, 89.4: 814-828, 2016 (link).

PEER-REVIEWED CONFERENCE PAPERS

P. Corsi, E. Formento, M. Capogrosso and S. Micera. Role of Renshaw Cells in the Mammalian Locomotor Circuit: A Computational Study. International conference on neurorehabilitation, 2018 (link).

PATENTS

E. Formento, M. Capogrosso, S. Micera, G. Courtine and K. Minassian. A sensory information compliant spinal cord stimulation system for the rehabilitation of motor functions. European patent, priority number EP20160206606 (link).

CONTRIBUTION TO INTERNTIONAL CONFERENCES

K. Bartholdi*, Q. Barraud*, E. Formento, A. Rowald, N. D. James, N. Cho, C. Kathe, L. Baud, T. Hutson, S. Micera, S. D. Giovanni, P. Musienko, M. Capogrosso and G. Courtine. Mechanisms through which epidural electrical stimulation restores locomotion after spinal cord injury. Neuroscience, 2018 (link).

E. Formento*, M. Capogrosso*, K. Minassian, F. B. Wagner, J. B. Mignardot, C. G. M. Le Goff, T. Milekovic, E. Bezard, J. Bloch, S. Micera and G. Courtine. Dimensions matter: Why do the spinal cords of humans and rodents respond differently to epidural electrical stimulation". Neuroscience, 2017 (link).

K. Z. Zhuang, N. Sommer, E. Formento, E. D'Anna, A. Billard and S. Micera. Grasp smarter, not harder: proportional control of an electromyographic prosthesis with a touch of automation. Neuroscience, 2017 (link).

E. Formento*, M. Capogrosso*, E.M. Moraud, G. Courtine† and S. Micera†. Mechanisms underlying the modulation of motor patterns during epidural electrical stimulation of the lumbar spinal cord. Neural Control of Movement Conference, 2016.

E. Formento*, M. Capogrosso*, E.M. Moraud, M. Caban, G. Courtine and S. Micera. A model of spinal sensorimotor circuits recruited by epidural stimulation of the spinal cord. Cosyne Conference, 2015 (link).

INVITED TALKS

E. Formento and S. Gribi. A biomimetic electrical neuromodulation strategy for neuroprosthetic applications. Invited talk at the neuroprosthetics annual research symposium of EPFL's Center for Neuroprosthetics, Geneva, Switzerland, 2018.

E. Formento. Dimensions matter: why do the spinal cords of humans and rodents respond differently to epidural electrical stimulation. Invited talk at IBM Thomas J. Watson Research Center, New York, USA, 2017.

E. Formento. Spinal neuromodulation for the recovery of locomotion after spinal cord injury. Invited speaker at Nexus, a workshop on robotics in medicine directed at the general public, 2016.

OUTREACH ACTIVITIES

E. Formento and S. Tata. A neuro-biomechanical model that highlights the ability of spinal sensorimotor circuits to generate oscillatory locomotor outputs. Human Brain Project Neurorobotics Blog, 2017, (link).

Active member of HackaHealth, an association organizing hackathons aiming at engineering personalized solutions for people with motor disabilities to improve their daily living, (link).

PUBLISHED COMPUTATIONAL MODELS

Repository containing the computational models developed in: E.M. Moraud*, M. Capogrosso*, E. Formento, N. Wenger, J. DiGiovanna, G. Courtine† and S. Micera†. Mechanisms underlying the neuromodulation of spinal circuits for correcting gait and balance deficits after spinal cord injury. Neuron, 89.4: 814-828, 2016 (link).

Repository containing the computational models developed in: E. Formento, K. Minassian, F. Wagner, JB. Mignardot, C.G. Le Goff, A. Rowald, J. Bloch, S. Micera*, M. Capogrosso* and G. Courtine*. Electrical spinal cord stimulation must preserve proprioception to enable locomotion in humans with spinal cord injury. Nature Neuroscience, 21.12: 1728, 2018 (link).

DISSERTATIONS

E. Formento. A computational approach for the design of epidural electrical spinal cord stimulation strategies to enable locomotion after spinal cord injury. PhD thesis at EPFL (link).

E. Formento. Advanced myoelectric control of bidirectional hand prosthesis. Master thesis at EPFL.

UNPUBLISHED WORK

K. Zhuang, N. Sommer, E. Formento, E. D'Anna, F. Petrini, G. Granata, G. Cannaviello, W. Raffoul, A. Billard and S. Micera. Shared proportional control of a dexterous myoelectric prosthesis. In preparation.

E. Formento*, E. D'Anna*, S. Gribi, S. Lacour and S. Micera. A biomimetic electrical stimulation strategy to induce asynchronous stochastic neural activity. In preparation.

K. Bartholdi*, Q. Barraud*, A. Rowald, E. Formento, N. D. James, T. Hutson, N. Cho, C. Kathe, J. Squair, L. Baud, N. Mestdagh, E. Jnoff, S. Micera, S. D. Giovanni, P. Musienko, M. Capogrosso and G. Courtine. Deconstruction of the sensorimotor circuits engaged by electrical spinal cord stimulation that restore locomotion after paralysis. In preparation.

†,*, equal contribution.