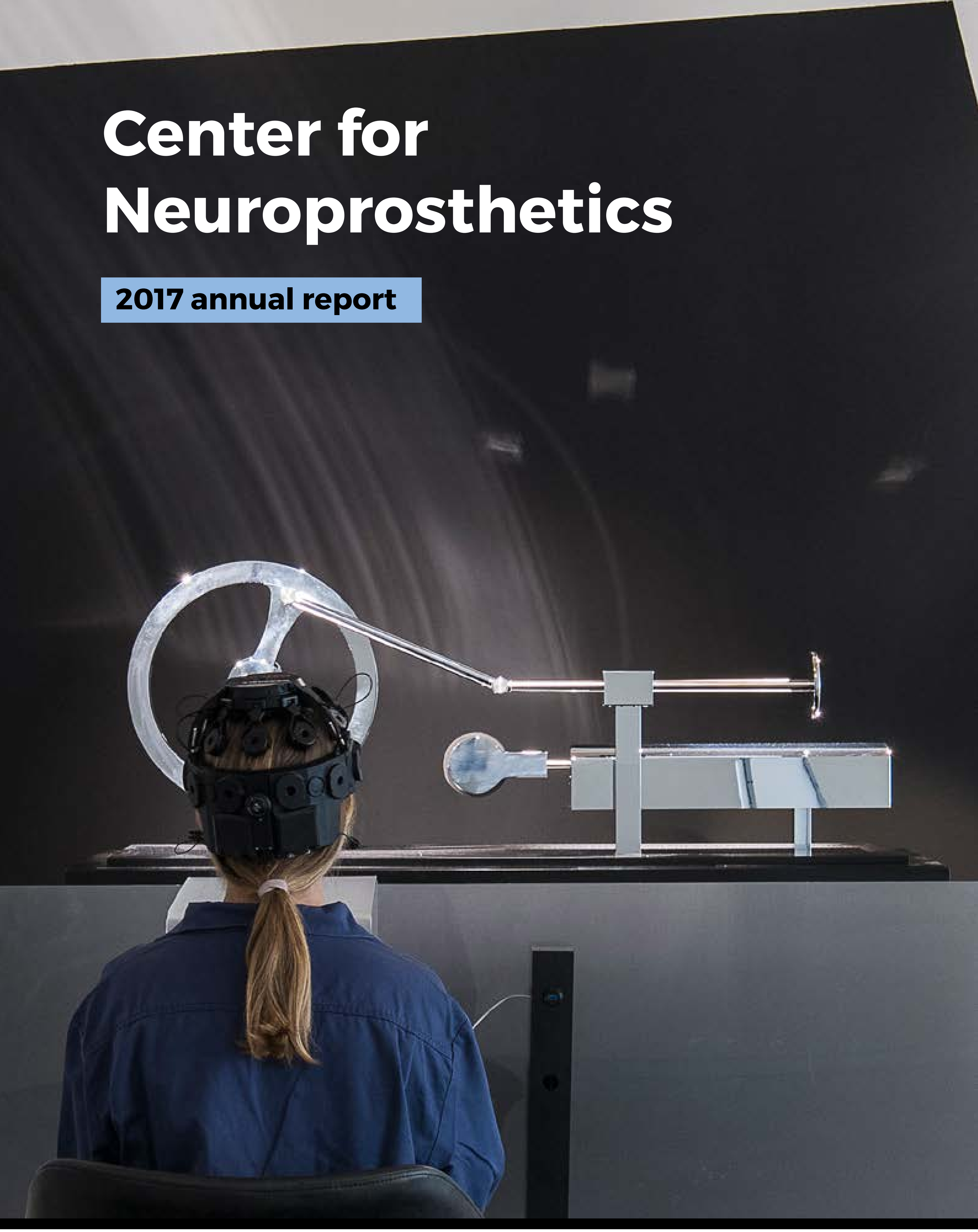
Center for Neuroprosthetics

2017 annual report



EPFL ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

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CNP

Mission

The Center for Neuroprosthetics (CNP) capitalizes on its unique access to advanced engineering, computer science, signal analysis, and brain research at the Swiss Federal Institute of Technology (Ecole Polytechnique Fédérale de Lausanne, EPFL). We strive to translate these advances to novel treatments in neurological and psychiatric diseases by developing new technologies that support, repair, replace and enhance functions of the nervous system.

The development of such technologies and devices, called neuroprostheses, depends on engineering advances, on medical know-how, and on the understanding of the neurobiological mechanisms for sensory perception, cognitive operations, and movement. For the restoration of motor functions, we aim to record and process the dedicated signals and to translate them into data that can ultimately drive artificial limbs, bodies and robots. For the restoration of sensory and cognitive functions, we design devices that produce signals to selectively activate and control brain circuits involved in perception and different cognitive functions.

Pursuing strengths in education at EPFL with our research and clinical partners, we are shaping the next generation of researchers in neuroprosthetics and empower the technology transfer from laboratory-based neuroprosthetics to startup companies with impact on industry and society.

Principal Investigators

Bertarelli Foundation Chair in Cognitive Neuroprosthetics
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Blanke Lab

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Bio

Olaf Blanke is founding director of the Center for Neuroprosthetics and holds the Bertarelli Foundation Chair in Cognitive Neuroprosthetics at the Ecole Polytechnique Fédérale de Lausanne (EPFL). He directs the Laboratory of Cognitive Neuroscience at EPFL and is Professor of Neurology at the University Hospital of Geneva.

The Blanke Lab (Bertarelli Chair in Cognitive Neuroprosthetics) has two missions: the neuroscientific study of consciousness and the development of cognitive neuroprostheses. For the first part, we investigate the brain mechanisms of body awareness, combining psychophysical and cognitive paradigms with all major neuroimaging techniques. We have pioneered the use of engineering techniques such as robotics, haptics, virtual reality, and their full integration with behavioral and physiological recordings (including MRI-compatible robotics), leading to the new research field of cognetics: the field of robotics and digital technologies dedicated to neuroscience research in cognition and consciousness studies.
Our clinical research projects focus on developing new diagnostic and therapeutic approaches along two main lines: Robotics in neuropsychiatry and Digiceuticals. Robotics in neuropsychiatry targets the design of wearable robotic devices for novel diagnostic and therapeutic solutions in schizophrenia and Parkinson's disease, focusing on hallucinations and psychosis. In our digiceutical projects we develop novel immersive digital devices and therapies for chronic pain and related conditions by integrating digital technologies (i.e. virtual reality) with brain stimulation and latest research from the cognitive neurosciences. Our devices induce technology-mediated pain relief in patients suffering from complex regional pain syndrome, phantom limb pain, and neuropathic leg pain in spinal cord injury.

Results Obtained in 2017

This year we pursued our efforts to understand the behavioral and neural correlates of self-consciousness and related aspects including interoception (Park et al., Cerebral Cortex 2017; Blefari et al., European Journal of Neuroscience, 2017; Salomon et al., Cortex, 2018), sleep (Kannape et al., Current Biology, 2017), agency (Marchesotti et al., Human Brain Mapping, 2017), metacognition (Faivre et al., Journal of Neuroscience 2017), or peripersonal space (Bernasconi et al., bioRxiv, 2017; Salomon et al., Cognition 2017; Grivaz et al., Neuroimage 2017).
Besides this fundamental research, major efforts in 2017 have been devoted to translate our work to the clinic. In digiceuticals, the novel immersive digital therapies we developed over the last years were validated in several clinical studies, in particular in patients with amputation (Serino et al., Brain, 2017), neuropathic leg pain (Pozeg et al., Neurology 2017), chronic regional pain syndrome (Solcà et al., Neurology, 2018), phantom limbs (Heydrich et al., Journal of Neurology, 2017), or breathing discomfort (Allard et al., Scientific Reports 2017). Together, these studies show the major impact digiceuticals and virtual reality has in treating chronic paion and various other neurological conditions.
We also conducted several studies further developing and testing our robotics in neuropsychiatry approach, relying on the clinical network we established last year in Geneva, Lausanne, and Sion. We used new robotic devices to control the induction of mild psychotic symptoms in healthy controls in two studies that are in final stages (Blondiaux et al., in preparation; Faivre et al., in preparation) and extended our investigations to patients with Parkinson's

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Team

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Selected Publications

Faivre N, Doenz J, Scandola M, Dhanis H, Bello Ruiz J, Bernasconi F, Salomon R, Blanke O (2017). Self-grounded vision: hand ownership modulates visual location through cortical beta and gamma oscillations. The Journal of Neuroscience 37: 11-22.

Grivaz P, Blanke O, Serino A (2017). Common and distinct brain regions processing multisensory bodily signals for peripersonal space and body ownership. NeuroImage 147: 602-618.

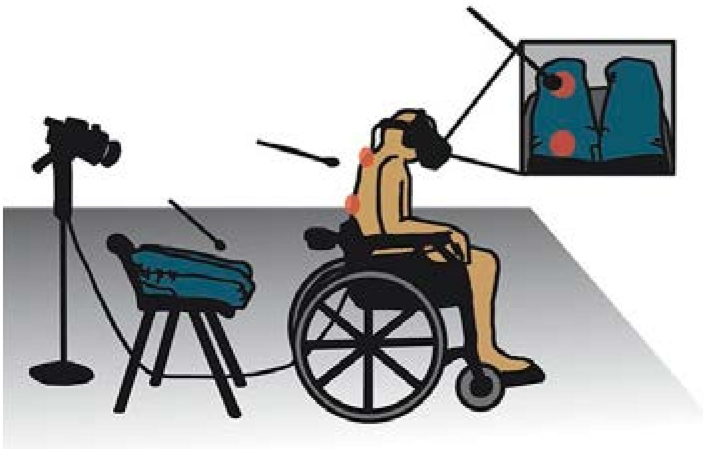
Pozeg P, Palluel E, Ronchi, R, Solca M, Al-Khodairy AW, Jordan X, Kassouha A, Blanke O (2017). Virtual reality improves embodiment and neuropathic pain caused by spinal cord injury. Neurology, 89(18), 1894-1903.

Serino A, Akselrod M, Salomon R, Martuzzi R, Blefari ML, Canzoneri E, Rognini G, van der Zwaag W, Iakova M, Luthi F, Amoresano A, Kuiken T, Blanke O (2017). Upper limb cortical maps in amputees with targeted muscle and sensory reinnervation. Brain, 140(11), 2993-3011.

Kannape OA, Perrig S, Rossetti AO, Blanke O (2017). Distinct locomotor control and awareness in awake sleepwalkers. Current Biology, 27(20), R1102-R1104.

Faivre N, Filevich E, Solovey G, Kühn S, Blanke O (2018). Behavioral, Modeling, and Electrophysiological Evidence for Supramodality in Human Metacognition. Journal of Neuroscience, 38(2), 263-277.

Park HD, Bernasconi F, Salomon R, Tallon-Baudry C, Spinelli L, Seeck M, Schaller K, Blanke O (2017). Neural sources and underlying mechanisms of neural responses to heartbeats, and their role in bodily self-consciousness: An intracranial EEG study. Cerebral Cortex, 28(7), 2351–2364.



Immersive virtual reality setup in which a participant sees touch cues applied to virtual legs while being touched on the back. The resulting phenomenon called virtual leg illusion was shown to improve embodiment and neuropathic pain caused by spinal cord injury. (Cover image Pozeg et al., Neurology, 2017).

Keywords

Multisensory and sensorimotor processing, consciousness, neuroscience, robotics, virtual and augmented reality, neuroimaging, fMRI, EEG, neurology, psychiatry.

Courtine Lab

http://courtine-lab.epfl.ch

Bio

Grégoire Courtine was trained in Mathematics, Physics, and Neurosciences. After a Postdoc in Los Angeles (UCLA), he established his own laboratory at Zurich. He was appointed Associate Professor at the Center for Neuroprosthetics at EPFL in 2012; and integrated the department of Neurosurgery at the University Hospital Lausanne (CHUV) in 2015. He founded the startup GTX Medical in 2015.

The mission of the laboratory is to develop neurotechnologies that improve functional recovery after neurological disorders such as spinal cord injury, stroke and Parkinson's disease. These developments are derived from a systematic investigation of the targeted neural mechanisms. This mechanism-based approach relies on synergies between multiple experimental models including in silico simulations (Human Brain Project) and long-lasting in vivo experiments in rodent (Campus Biotech) and nonhuman primate (University of Fribourg) models of neurological disorders—as well as clinical studies that are conducted at the Lausanne University Hospital (CHUV) in close collaboration with Prof. Jocelyne Bloch who leads the unit for functional neurosurgery.

Results Obtained in 2017

Neurotechnologies *(Biomaterials 2017, Nature Scientific Reports 2018)*: In collaboration with Prof. Micera, we characterized the long-term usability and bio-integration of intra-neural peripheral implants to improve lower limb functions. In parallel, we showed the importance of controlling mediolateral trunk posture in real-time for facilitating locomotion during rehabilitation.

Mechanisms of recovery from spinal cord injury *(Nature Neuroscience, 2018)*: We have identified the mechanisms through which electrochemical spinal cord stimulation and robot-assisted training restore volitional locomotion after clinically complete spinal cord contusions. We found that the motor cortex regained adaptive control over the paralyzed legs through *de novo* relays in the brainstem, where glutamatergic neurons that maintain residual projections below injury reside. Similar cortico–brainstem–spinal circuit reorganization may improve recovery in humans.

Clinical neurorobotic platform *(Science Translational Medicine 2017)*: We developed a body weight support system that optimizes gravity-dependent gait interactions during highly participative locomotion within a large and safe environment. An algorithm based on artificial intelligence personalizes multidirectional forces applied to the trunk based on patient-specific motor deficits. This gravity-assist enabled natural walking in non-ambulatory individuals with spinal cord injury or stroke, and enhanced skilled locomotor control in the less impaired subjects. These results highlight the importance of precise trunk support to delivering gait rehabilitation protocols and establish a practical framework to apply these concepts in clinical routine. A clinical trial started in 2016 is exploiting this platform to evaluate the ability of our therapeutic intervention to improve motor function after spinal cord injury.

Keywords

Spinal cord injury, neurorehabilitation, neuroprosthetics, neuroregeneration, brain-machine interface, robotics, EMG, kinematics, locomotion.

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Selected Publications

Mignardot JB, Le Goff CG, van den Brand R, Capogrosso M, Fumeaux N, Vallery H, Anil S, Lanini J, Fodor I, Eberle G, Ijspeert A, Schurch B, Curt A, Carda S, Bloch J, von Zitzewitz J, Courtine G (2017). A multidirectional gravity-assist algorithm that enhances locomotor control in patients with stroke or spinal cord injury. Science Translational Medicine, 9(399), pii: eaah3621.

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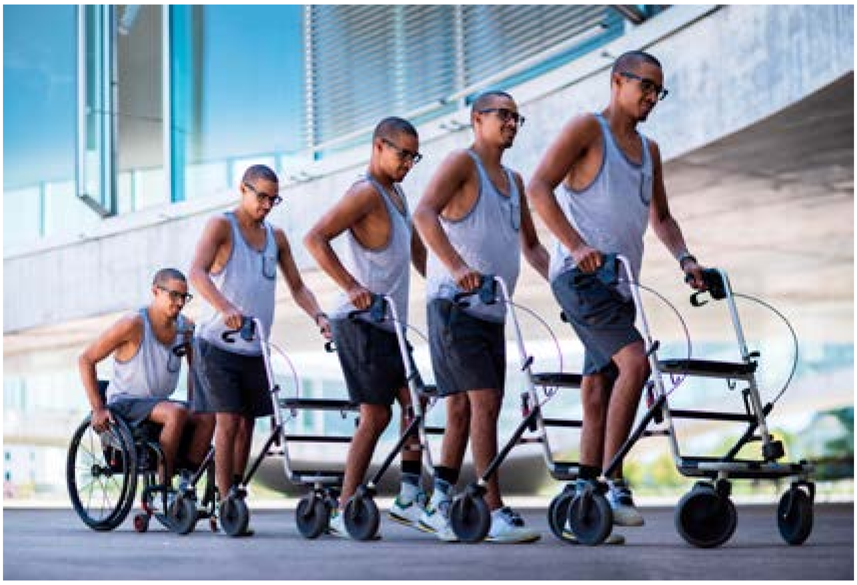
Florez JM, Shah M, Moraud EM, Wurth S, Baud L, Von Zitzewitz J, van den Brand R, Micera S, Courtine G, Paik J (2017). Rehabilitative Soft Exoskeleton for Rodents. IEEE Transactions on Neural Systhems and Rehabilitation Engineering, 25(2):107-118.

Wurth S, Capogrosso M, Raspopovic S, Gandar J, Federici G, Kinany N, Cutrone A, Piersigilli A, Pavlova N, Guiet R, Taverni G, Rigosa J, Shkorbatova P, Navarro X, Barraud Q, Courtine G, Micera S (2017). Long-term usability and bio-integration of polyimide-based intra-neural stimulating electrodes. Biomaterials, 122:114-129.

Asboth L, Friedli L, Beauparlant J, Martinez-Gonzalez C, Anil S, Rey E, Baud L, Pidpruzhnykova G, Anderson MA, Shkorbatova P, Batti L, Pages S, Kreider J, Schneider BL, Barraud Q, Courtine G (2018). Cortico–reticulo–spinal circuit reorganization enables functional recovery after severe spinal cord contusion. Nature Neuroscience, 21: 576–588.

Moraud EM, von Zitzewitz J, Miehlbradt J, Wurth S, Formento E, DiGiovanna J, Capogrosso M, Courtine G, Micera S. (2018). Closed-loop control of trunk posture improves locomotion through the regulation of leg proprioceptive feedback after spinal cord injury. Nature Scientific Report, 8(1):76.



Translational neurotechnologies
Rehabilitation of an individual with a spinal cord injury with electrical spinal cord stimulation.

Ghezzi Lab

http://lne.epfl.ch

Bio

Diego Ghezzi received his MSc in Biomedical Engineering (2004) and PhD in Bioengineering (2008) from Politecnico di Milano. He completed his postdoc at Istituto Italiano di Tecnologia (Neuroscience and Brain Technologies department), where he was promoted Researcher in 2013. In 2015, he was appointed PATT at EPFL, as member of the CNP.

Worldwide 190 million people are severely visually impaired and about 32 million are blind. In Europe, macular degeneration (16%) and glaucoma (12.2%) are considered the leading causes of blindness. Blindness is a widespread global public health issue, representing a significant personal and societal burden, limiting educational opportunities, affecting economic possibilities and reducing the quality of life. Retinal diseases, such as Renitnis pigmentosa or macular degeneration, represent an important cause of blindness, for which there is still no established prevention, treatment or cure. The mission of the laboratory is focused on the implementation of novel technological approaches to fight blindness, providing a fundamental advancement towards sight restoration in patients affected by retinal dystrophies, and translating our research findings into clinical practice. Currently the laboratory is active on 2 research lines: i) the development of an injectable, self-opening, and freestanding organic retinal prosthesis and ii) the development an intra-neural prosthesis for the direct stimulation of the optic nerve in blind patients.

Results Obtained in 2017

In 2017 we significantly moved forward in both projects. The injectable, self-opening, and freestanding organic retinal prosthesis has been fully fabricated and validated with laboratory tests. Inspired by intra ocular lenses, we designed a foldable and wide-field epiretinal prosthesis capable of achieving a wireless photovoltaic stimulation of retinal ganglion cells with a remarkable increase in its retinal coverage and in the number of stimulating pixels. Within a visual angle of 46.9 degrees, it embeds 2215 stimulating pixels, of which 967 are in the central area of 5 mm. It is foldable to limit the scleral incision during implantation and it has a hemispherical shape to remain in tight contact with the retina. We also demonstrate that the prosthesis is not cytotoxic, while accelerated ageing shows a lifetime of at least 2 years. Moreover, it fulfils optical and thermal safety requirements.
Second, we provided the proof-of-concept in the use of intra-neural electrodes for optic nerve stimulation. The prostheses have been fabricated and characterized in-vitro and with animal experiments. These data show the capability of intra-neural optic nerve stimulation to induce selective cortical activation with high spatial and temporal resolution.

Keywords

Neuroprosthetics; Visual prostheses; Organic neuroprosthetics; Fighting blindness; Neuro-optoelectronic interfaces; Optical stimulation.

Injectable, Foldable and Photovoltaic Wide-Field Epiretinal Prosthesiss

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Selected Publications

Parrini M., Ghezzi D., Deidda G., Medrihan L., Castroflorio E., Alberti M., Baldelli P., Cancedda L., Contestabile A. (2017). Aerobic Exercise and a BDNF-Mimetic Therapy Rescue Learning and Memory in a Mouse Model of Down Syndrome. International Journal of Scientific Reports, 7:16825.

Maya-Vetencourt JF, Ghezzi D, Antognazza MR, Colombo E, Mete M, Feyen P, Desii A, Buschiazzo A, Di Paolo M, Di Marco S, Ticconi F, Emionite L, Shmal D, Marini C, Donelli I, Freddi G, Maccarone R, Bisti S, Sambuceti G, Pertile G, Lanzani G, Benfenati F (2017). A fully organic retinal prosthesis restores vision in a rat model of degenerative blindness. Nature Materials, 16(6):681–689.

Antognazza M.R., Di Paolo M., Ghezzi D., Mete M., Di Marco S., Maya-Vetencour, J. F., Maccarone R., Desii A., Di Fonzo F., Bramini M., Russo A., Donelli I., Cilli M., Freddi G., Pertile G., Lanzani G., Bisti S. and Benfenati F. (2016). Characterization of a polymer-based, fully organic prosthesis for implantation into the subretinal space of rats. Adv. Healthcare Mater. 5(17): 2271–2282.

Feyen P., Colombo E., Endeman D., Nova M., Laudato L., Martino N., Antognazza M.R., Lanzani G., Benfenati F. and Ghezzi D. (2016). Light-evoked hyperpolarization and silencing of neurons by conjugated polymers. Sci. Rep. 6:22718.

Szczurkowska J., Cwetsch A., dal Maschio M., Ghezzi D., Ratto G.M. and Cancedda L. (2016). Targeted in vivo genetic manipulation of the mouse or rat brain by in utero electroporation with a triple-electrode probe. Nat. Prot. 11(3):399-412.

Hummel Lab

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Bio

Prof. Friedhelm Hummel is a certified neurologist. After his post-doctoral appointment at the NIH (USA) and in Tuebingen (Germany), he established 2006 the Brain Imaging and NeuroStimulation (BINS) Lab at the University Medical Center Hamburg (Germany). Furthermore, he worked also clinically, last as Vice-Director of the Dept. of Neurology. Since September 2016, he is appointed as Full Professor within the Defitech Foundation Chair in Clinical Neuroengineering and leads the Hummel-Laboratory at the CNP. He further holds an Associate Professorship of the Department of Clinical Neuroscience, University Medical

defitech fondation

CANTON DU VALAIS
KANTON WALLIS

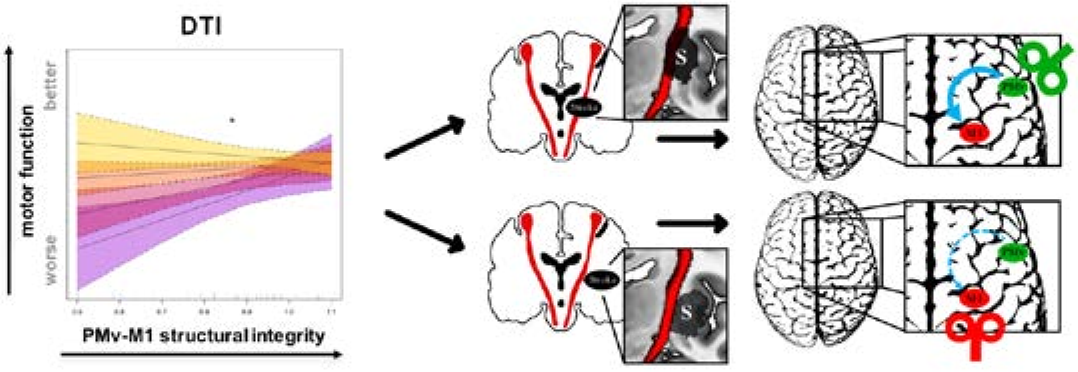
Stroke is the epidemic of the 21st century (global burden report), currently 3.7 Mio patients suffer in Europe from chronic impairment after stroke. Only 15% of the patients fully recovery and are reintegrated into normal life. Current neurorehabilitative treatments are applied in non-precision 'one suits all' strategies not leading to satisfying effects. There is a strong need to better understand underlying mechanisms after stroke to predict the course and magnitude of recovery and especially the responses to innovative treatments. This will allow to determine systems neuroscience 'biomarkers' to phenotype the individual patients, necessary to develop patient-tailored precision medicine approaches to enhance functional recovery after stroke.

The mission of the Hummel-Lab is to develop novel, innovative, safe and cost-effective treatment strategies, e.g. based on brain stimulation, BCI-technologies or the combination of neuro-technologies to enhance and accelerate the process of functional recovery in a precision medicine manner. The ever growing worldwide population with an increasing average age faces the challenges of aging-related cognitive, motor and sensory impairments. Consequently, an important agenda for societies in the 21st century is to focus on research towards the understanding of healthy aging and identify means for helping older adults to maintain sound minds and active lives, such as by brain stimulation and training. To achieve these goals, the Hummel-Lab applies an up-to-date multimodal systems neuroscience approach (structural / functional MRI, EEG, neuromodulation by mono-, multifocal TMS, tES) and multi-domain cognitive psycho-physics. Furthermore, it is focussing on interventions supporting healthy aging and functional recovery after stroke.

Results Obtained in 2017

In 2017, we determined the functional role of structural integrity within the motor network for residual motor functions after stroke and added to the understanding of underlying mechanism of stroke recovery (Schulz et al. 2017a,b,c, for review Koch & Hummel 2017). This study demonstrated that PMv-M1 structural connectivity is only relevant if the CST is significantly damage (see figure). These results point towards an non-invasive systems neuroscience biomarker based on structural MRI to determine outcome and potential treatment targets for patient-tailored interventions based on non-invasive brain stimulation (figure, for review Raffin & Hummel 2017, Morishita & Hummel 2017).

To further deepen the understanding of stroke recovery and to determine strong biomarkers for the phenotyping of stroke patients in the view of the prediction of degree of recovery, course of recovery and treatment outcome, within the CNP, we were able to acquire support within the ETH strategic focus area Personalized Health and Related technologies with the project 'Towards personalized precision medicine for stroke recovery: a multi-modal, multidomain longitudinal approach' (Coordination: F. Hummel) in tight collaboration with the clinical partners in Sion (Hopital Valais du Sion, Clinique Romande de Réadaptation and the Berner Klinik Montana). This study will allow us to address this topic in detail in a large sample of patients in a multi-modal, multi-domain way.



Towards patient-tailored precision treatment based on brain stimulation.

Structural MRI is used to determine structural integrity in the cortico-spinal tract (CST) and in cortico-cortical tracts (PMv-M1). Based on the damage to the CST patients are stratified to PMv or M1 stimulation in a patient tailored fashion

We demonstrated that different parts of the motor network including the cortico-spinal tract (CST), cortico-cortical and cortico-cerebellar connections are relevantly involved in the recovery process. For instance, we were able to demonstrate that the role of one tract, e.g. the premotor-motor connection (PMv-M1) might have a quite different functional role for recovery depending on the damage to another tract (CST).

(for details, see Morishita & Hummel, 2017).

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Selected Publications

Wessel MJ, Hummel FC (2017). Non-invasive Cerebellar Stimulation: a Promising Approach for Stroke Recovery? Cerebellum, 17(3):359-371.

Raffin E, Hummel FC (2017). Restoring Motor Functions After Stroke: Multiple Approaches and Opportunities. Neuroscientist, 1:1073858417737486.

Koch PJ, Hummel FC (2017). Towards precision medicine: Tailoring interventional strategies based on non-invasive brain stimulation for motor recovery after stroke. Current Opinion in Neurology, 30(4):388-397.

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Schulz R, Park E, Lee J, Chang W, Lee A, Kim YH, Hummel FC (2017). Synergistic but independent: Corticospinal and alternate motor fibres for motor recovery after stroke. NeuroImage Clinical 19,15:118-124.

Morishita T, Hummel FC (2017). Non-invasive Brain Stimulation (NIBS) in motor recovery after stroke: concepts to increase efficacy. Current Behavioral Neuroscience Reports, 4:280–289.

Keywords

Neuroimaging, Neurostimulation, Stroke Rehabilitation, Healthy aging, Motor control, Motor learning.

Lacour Lab

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Bio

Stéphanie P. Lacour received her PhD in Electrical Engineering from INSA de Lyon, (France), and completed postdoctoral research at Princeton University and the University of Cambridge (UK). She is the recipient of the 2006 MIT TR35, European Research Council ERC Starting and POC Grants, a SNSF-ERC Consolidator Grant and was elected a 2015 Young Global Leader by the World Economic Forum.

Bioelectronics integrates principles of electrical engineering to biology, medicine and ultimately health. The LSBI lab challenges and seeks to advance our fundamental concepts in man-made electronic systems applied to biology. Specifically, the focus is on designing and manufacturing electronic devices with mechanical properties close to those of the host biological tissue so that long-term reliability and minimal perturbation are induced in vivo and/or truly wearable systems become possible.
We use fabrication methods borrowed from the MEMS and microelectronics industries and adapt them to soft substrates like elastomers. We develop novel characterization tools adapted to mechanically compliant bioelectronic circuits. We evaluate in vitro, in animal models and ultimately on humans our soft bioelectronic interfaces. Our research involves synergic collaborations with colleagues in materials science, engineering and neuroscience, within EPFL, across Switzerland and the USA.

Results Obtained in 2017

The LSBI team is exploring novel device materials and their associated technologies to design and manufacture soft bioelectronic interfaces. They are broadly defined as microfabricated devices, distributed over large-areas, and with mechanical properties suited to comply the soft and dynamic biological tissues. In 2017, we have focused on three main goals: (1) build the science and engineering for novel elastic metallic films, (2) explore novel concepts for the design and manufacturing of soft surface and penetrating brain implants, and (3) advance the technology readiness levels of two of our leading technologies, namely biphasic Ga films and e-dura implants.

We developed a standard design to engineer elasticity in thin films supported by plastic carriers (Extreme Mech. Lett. 2017). We demonstrated that textured surfaces prepared with thermally drawn fibers are an efficient alternative to prepare 2D and 3D scaffolds for cell growth (Adv. Funct. Mat. 2017). We contributed to a review on potential therapeutical use of e-dura implants (JAMA Neurology 2017). We reported on the advantages of soft subdural implants for restoring walking with electrochemical stimulation of the spinal cord (JNE 2018). We engineered a soft optocuff – a minimally invasive optical peripheral nerve interface – as an efficient tool to support chronic studies of the PNS in mice using optogenetics (JNE 2018). Using customised in vitro stretchable microelectrode arrays, we found that changes in cardiac conduction velocity caused by acute stretch depend both on the amplitude and direction of deformation.

We also pursued our efforts in the evaluation of a range of tissue-matched implants including conformable auditory brainstem implants (ABI), soft electrocorticography implants (ECoG), and soft intracortical probes.

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Keywords

Thin film electronics; soft materials; neural implants; artificial skin

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Selected Publications

Buccarello A, Azzarito M, Michoud F, Lacour SP, Kucera JP (2018). Uniaxial strain of cultured mouse and rat cardiomyocyte strands slows conduction more when its axis is parallel to impulse propagation than when it is perpendicular. Acta Physiologica, available on-line.

Michoud F, Sottas L, Browne LE, Asboth L, Latremoliere A, Sakuma M, Courtine G, Woolf C, Lacour SP (2018). Optical cuff for optogenetic control of the peripheral nervous system. Journal of Neural Engineering, 15(1) 015002.

Bloch J, Lacour SP, Courtine G (2017). "Electronic dura mater meddling in the nervous system", JAMA Neurology, 74(4) 470-475.

Nguyen-Dang T, de Luca AC, Yan W, Qu Y, Page A, Lacour SP, Sorin F (2017). Controlled sub-micrometer hierarchical textures engineered in polymeric fibers and micro-channels via thermal drawing. Advanced Functional Materials, 27(10) 1605935.

de Luca AC, Fonta C, Raffoul W, di Summa P*, Lacour SP* (2017). In vitro evaluation of gel-encpasulated adiposed derived stem cells: Biochemical cues for in vivo peripheral nerve repair. Journal of Tissue Engineering and Regenerative Medicine, 12(3):676-686.

Vachicouras N, Tringides CM, Campiche PB, Lacour SP (2017). Engineering reversible elasticity in ductile and brittle thin films supported by a plastic foil. Extreme Mechanics Letters 15, 63-69.

** equal contribution*

Patterns for engineered elasticity in thin film supported by a flexible foil.

Micera Lab

http://tne.epfl.ch

Bio

Silvestro Micera is currently Associate Professor of Biomedical Engineering at the EPFL where he is holding the Bertarelli Foundation Chair in Translational NeuroEngineering. He is also Professor of Biomedical Engineering at the Scuola Superiore Sant'Anna (Italy). In 2009 he was the recipient of the "Early Career Achievement Award" of the IEEE Engineering in Medicine and Biology Society.

fondation bertarelli

The main goal of the TNE laboratory is to develop implantable neural interfaces and robotic systems aimed at restoring sensorimotor function in people with different kind of disabilities (spinal cord injury, stroke, amputation, etc...), starting from basic scientific knowledge in the field of neuroscience, neurology and geriatrics, and investigating further to gain new information by using advanced technologies and protocols. For this reason, our activities combine (i) technological developments (robotics, implantable neural interfaces, algorithms for closed-loop control and signal processing), (ii) experiments to understand the basic neuroscientific principles of motor control; (iii) integration and test of different types of hybrid neuro-prosthetic systems to restore sensory and motor functions. Starting from a background on signal processing and closed-loop control, we have been able to enlarge the focus of our scientific activities and now our team has the ability to investigate all the different issues related to the development and test of effective neural and rehabilitation systems. We are one of the few groups in the world able to study all these issues in an integrated and harmonized manner.

Results Obtained in 2017

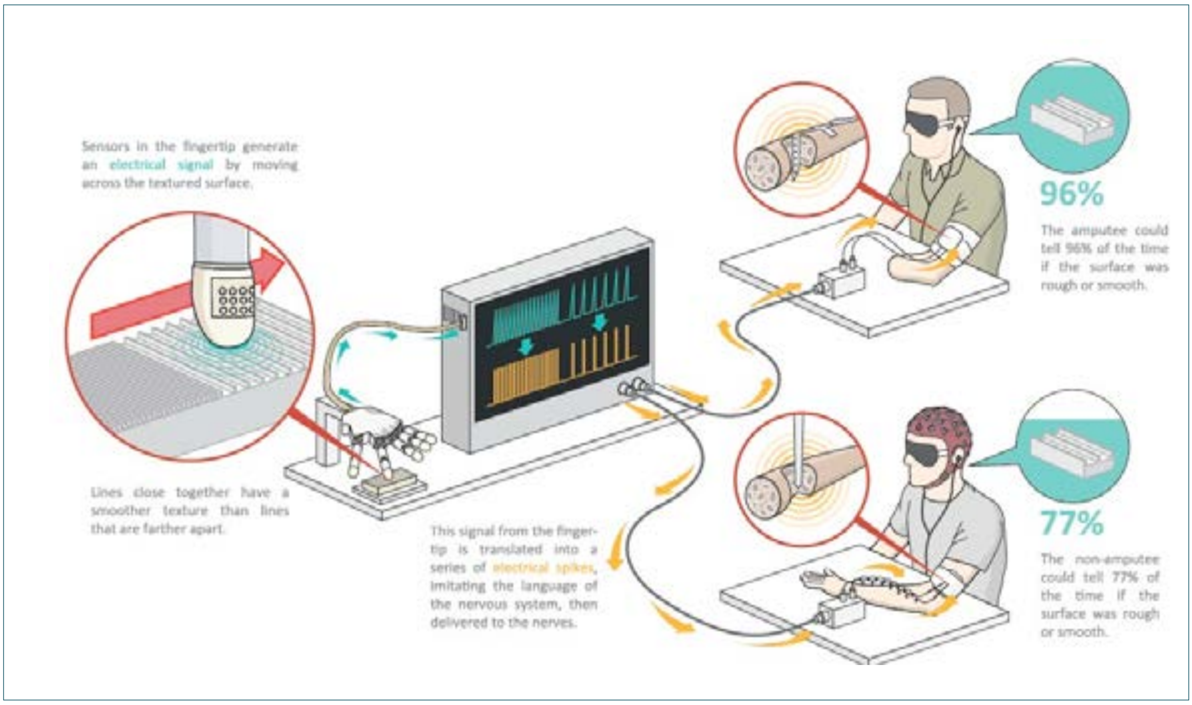
Bionic limbs. Recently, we concluded a long-term study with three amputees, providing the first demonstration of long-term stability and functional exploitability of intraneural arrays. We also concluded several studies to improve sensory and control strategies.

Neuroprosthesis to restore locomotion. Electrical neuromodulation of the spinal cord has been shown to reverse leg paralysis in rodent and primate models of spinal cord injury. In 2017 we developed new approaches to develop stimulation protocols in patients exploiting several computational models.

Neuroprosthesis for grasping function restoration. Grasping is one of our most important motor function. It allows us to interact naturally and intuitively with our environment. Regaining the capacity to grasp and manipulate objects is thus crucial for people living with upper limb paralysis. During 2017, the NeuGrasp project started addressing those issues by proposing and testing the use of intraneural electrical stimulation for enhanced selectivity in muscle recruitment using a reduced number of electrodes. We also successfully tested a wearable system for grasping restoration after stroke using non-invasive techniques.

Robot-based neurorehabilitation. The goal of Neuroprobes is to develop personalized robot-based upper limb motor rehabilitation protocols using ALEx (upper limb exoskeleton), targeting the specific kinematic performance of each patient based on the model previously proposed. We are currently performing a clinical trial on 48 acute-subacute stroke patients to compare the personalized approach with other approaches, including the standard physiotherapy and a standard robotic therapy.

Ultrasound-based peripheral neuromodulation. Focused Ultrasound Stimulation (FUS) is a non-invasive therapeutic tool with great potential, widely used on humans for ablation therapies and diagnostic imaging. We are currently developing a modeling framework to predict how low-intensity ultrasonic waves can modulate the activity of different types of peripheral fibers.



Restoration of texture discrimination in intact subjects and amputees

Team

Associate Professor
Silvestro Micera

Postdoctoral fellows
Fiorenzo Artoni
Andrea Crema
Francesco M. Petrini
Camilla Pierella
Stanisa Raspopovic
Katie Zhuang

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Marco Bonizzato
Edoardo D'Anna
Emanuele Formento
Nawal Kinany **
Théo Lemaire
Jenifer Miehlbradt
Jesus Minguillon Campos (Visiting)
Flavio Raschellà
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Ivan Furfaro
Christian Giang

Administrative Assistant
Martine Challand
Anouk Hein
Margarita Jotterand-Jimenez

*** jointly with Prof Van De Ville*

Selected Publications

Wurth S, Capogrosso M, Raspopovic S, Gandar J, Federici G, Kinany N, Cutrone A, Piersigilli A, Pavlova N, Guiet R, Taverni G, Rigosa J, Shkorbatova P, Navarro X, Barraud Q, Courtine G, Micera S. (2017). Long-term usability and bio-integration of polyimide-based intra-neural stimulating electrodes. Biomaterials, 122:114-129.

Monaco V, Tropea P, Aprigliano F, Martelli D, Parri A, Cortese M, Molino-Lova R, Vitiello N, Micera S (2017). An ecologically-controlled exoskeleton can improve balance recovery after slippage. Scientific Reports, 11;7:46721.

Artoni F, Fanciullacci C, Bertolucci F, Panarese A, Makeig S, Micera S, Chisari C (2017). Unidirectional brain to muscle connectivity reveals motor cortex control of leg muscles during stereotyped walking. Neuroimage, 159:403-416.

D'Anna E, Petrini FM, Artoni F, Popovic I, Simanić I, Raspopovic S, Micera S (2017). A somatotopic bidirectional hand prosthesis with transcutaneous electrical nerve stimulation based sensory feedback. Scientific Reports, 7(1):10930.

Tropea P, Mazzoni A, Micera S, Corbo M (2017) Giuliano Vanghetti and the innovation of "cineplastic operations". Neurology, 89(15):1627-1632.

Spalletti C, Alia C, Lai S, Panarese A, Conti S, Micera S, Caleo M (2017). Combining robotic training and inactivation of the healthy hemisphere restores pre-stroke motor patterns in mice. Elife, 27;6.

Keywords

Neuroprosthetics, Bionics, Hand prosthesis, Modelling and control.

Millán Lab

http://cnbi.epfl.ch

Bio

Prof. José del R. Millán holds the Defitech Foundation Chair in Brain Machine Interface since 2009, where he designs neuroprostheses (brain-controlled devices like robots, exoskeletons and communication aids) for augmenting interaction experiences and restoring lost functions. His research on brain-machine interfaces has received a number of awards and recognitions.

The Chair in Brain-Machine Interface laboratory (CNBI) carries out research on the direct use of human brain signals to control devices and interact with our environment. In this multidisciplinary research, we are bringing together our pioneering work on the two fields of brain-machine interfaces and adaptive intelligent robotics. Our approach to design intelligent neuroprostheses balances the development of prototypes, where robust real-time operation is critical, and the exploration of new interaction principles and their associated brain correlates. A key element at each stage is the design of efficient machine learning algorithms for real-time analysis of brain activity that allow users to convey their intents rapidly, on the order of hundred milliseconds. Our neuroprostheses are explored in cooperation with clinical partners and disabled volunteers for the purpose of motor restoration, communication, entertainment and rehabilitation.

Results Obtained in 2017

As in previous years, our work is focused on both: translational work with end users and general population, as well as basic research on Brain-Machine Interfaces (BMI). In the first line our BMI technology was at the core of the art-science exhibit Mental Work, where visitors employed a BMI to control artistic replicas of Industrial Revolution machines. Mental Work was opened on October 26, 2017 at EPFL ArtLab for 3.5 months and then travelled to Swissnex San Francisco in 2018. Apart from the artistic component, Mental Work is a unique large-scale experiment –we had almost 500 mental workers in Lausanne. Mental Work was widely covered by the general, specialized and scientific media, including the journal Nature. Translational work with end-users suffering from severe motor disabilities included analysis of longitudinal studies in challenging environments such as the training of two tetraplegic persons for the Cybathlon BMI race (Perdikis et al., 2017) and the demonstration that our methods for adaptive shared control enabled an almost lock-in person to play a brain-controlled game based on motor imagery without external recalibration for more than 8 months (Saeedi et al., 2017). Moreover, we also work on new BMI-based assistive solutions including lower limb exo-skeletons (Lee et al., 2017), hand exoskeletons, and spellers for communication. Last but not least, we have continued our work on BMI-mediated motor neurorehabilitation, extending and refining the approach on chronic patients to acute and subacute patients. This later work is being financed by a SNF-Sinergia project.

Prof. Millán's seminal and pioneering contributions to the field of brain-controlled robots was recognized with his elevation to IEEE Fellow.

Publications in 2017 covered the following main research lines:

- Adaptive shared control for BMI
- BMI control of exo-skeletons and robots
- Decoding of electro-corticogram correlates of speech
- Research methodologies for BMI
- Stroke motor rehabilitation

defitech fondation

Keywords

Brain-machine interfaces, Neuroprosthetics, Machine learning, Robotics, EEG.

Team

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Postdoctoral Fellows
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Anwesha Khasnobish
Kyuhwa Lee
Serafeim Perdikis
Luca Tonin

PhD students
Ruslan Aydarkhanov
Tiffany Corbet
Lucian Gheorghe
Fumiaki Iwane
Ping-Keng Jao
Zahra Khaliliardali
Stéphanie Martin
Bastien Orset
Michael Pereira
Luca Randazzo
Julien Rechenmann
Christoph Schneider

External students
Felix Bauer
Alvaro Serra

Guest researchers
Sareh Saeedi
Marija Ušćumlić

Research Engineers
Arnaud Desvachez
Frédéric Giraud

Administrative Assistant
Manuela da Silva
Frédérique Toulet

Selected Publications

Martin S., Mikutta C., Leonard M.K., Hungate D., Koelsch S., Shamma S., Chang E.F., Millán J.d.R., Knight R.T., Pasley B. (2017). Neural encoding of auditory features during music perception and imagery. Cerebral Cortex, 2017.

Perdikis S., Tonin L., Millán J.d.R. (2017). Brain racers: How paralyzed athletes used a brain-computer interface to win gold at the cyborg Olympics. IEEE Spectrum, 54(9): 44–51.

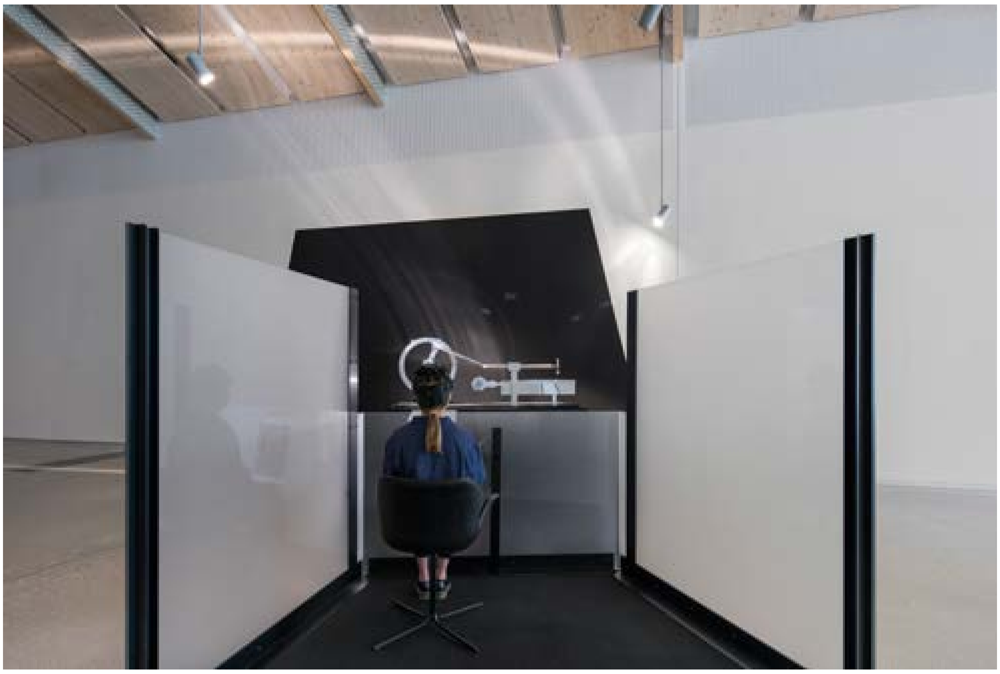
Saeedi S., Chavarriaga R., Millán J.d.R. (2017). Long-term stable control of motor-imagery BCI by a locked-in user through adaptive assistance. IEEE Trans. Neural Systems and Rehabilitation Engineering, 25(4): 380–391.

Tonin L., Pitteri M., Leeb R., Zhang H., Menegatti E., Piccione F., Millán J.d.R. (2017). Behavioral and cortical effects during attention driven brain-computer interface operations in spatial neglect: A feasibility case study. Frontiers in Human Neuroscience, 11: 336.

Lee K., Liu D., Perroud L., Chavarriaga R., Millán J. d. R. (2017). A brain-controlled exoskeleton with cascaded event-related desynchronization classifiers. Robotics and Autonomous Systems, 90: 15–23.

Ming B.-K., Chavarriaga R., Millán J.d.R. (2017). Harnessing prefrontal cognitive signals for brain-machine interfaces. Trends in Biotechnology, 35(7): 585–597..

Mental Work is an art-science exhibit Mental Work where visitors controlled a series of spectacular machines by brain activity alone. Mental Work is also a unique large-scale experiment, where data collected from hundreds of people will be made available to the scientific community to improve BMI technology.



Van De Ville Lab

http://miplab.epfl.ch

Bio

M.S. and Ph.D. in Computer Sciences from Ghent University, Belgium (1998, 2002), Post-doctoral Fellow at EPFL (2002-2005), Junior Group Leader of the CIBM Signal Processing Unit at University of Geneva (2005-2009), awarded SNSF professorship (2009), Associate Professor of Bioengineering since 2015 jointly affiliated with University of Geneva (Department of Radiology & Medical Informatics).

The Medical Image Processing Laboratory (MIP:lab) pursues the development and integration of innovative data-processing tools at various stages of the acquisition, analysis, and interpretation pipeline of neuroimaging data. We aim at obtaining new insights into brain function & dysfunction by approaches that are based on modeling the brain as a network and as a dynamical system. These new signatures of brain function are promising to interpret and predict cognitive and clinical conditions, and also to provide new avenues for neurofeedback based on real-time fMRI.

Results Obtained in 2017

We model functional brain networks at the system level based on whole-brain magnetic resonance imaging (MRI). By applying and extending graph theory, multiscale techniques and pattern recognition, we are able to identify and characterize brain networks in a meaningful way during cognitive tasks, as well as alterations by neurological conditions, which opens the potential for new imaging-based biomarkers that might for instance complement neuropsychological testing in prodromal stage of Alzheimer's Disease.

We also investigate temporal dynamics of these networks during spontaneous activity, for which we have pioneered subspace discovery methods and sparsity-driven deconvolution techniques that reveal meaningful, dynamic interactions between large-scale distributed networks. These techniques bring us closer to capturing the global brain state, which is essential for future development of invasive and non-invasive neuroprosthetics, such as neurofeedback based on real-time fMRI. In addition, we also look into the relationship between slow dynamics of fMRI and fast millisecond-scale EEG signals.

Keywords

Computational neuroimaging, network science, brain dynamics, signal processing, functional magnetic resonance imaging, electroencephalography.

Team

Associate Professor
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Naghmeh Ghazaleh
Nicolas Gninenko
Nawal Kinany**
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Serafeim Loukas
David Nguyen
Anjali Tarun
Daniela Zöller

Visiting fellows and students
Dr. Michal Bola
Prof. Olivier Gevaert
Dr. Christof Johannes Seiler
Mert Inan Stefano Moia
Silvia Obertino

Administrative Assistant
Manuela Da Silva

** jointly with Prof Blanke*
*** jointly with Prof Micera*

Selected Publications

Preti MG, Bolton T, Van De Ville D (2017). The Dynamic Functional Connectome: State-of-the-Art and Perspectives. NeuroImage, 160:41-54.

Karahanoglu F I, Van De Ville D (2017). Dynamics of Large-Scale fMRI Networks: Deconstruct Brain Activity to Build Better Models of Brain Function. Current Opinion in Biomedical Engineering, 3:28-36.

Van De Ville D, Demesmaeker R, Preti MG (2017). When Slepian Meets Fiedler: Putting a Focus on the Graph Spectrum. IEEE Signal Processing Letters, 24:1001-1004.

Grandjean J, Preti MG, Bolton T, Buerge M, Seifritz E, Pryce CR, Van De Ville D, Rudin M (2017). Dynamic Reorganization of Intrinsic Functional Networks in the Mouse Brain. NeuroImage, 152:497-508.

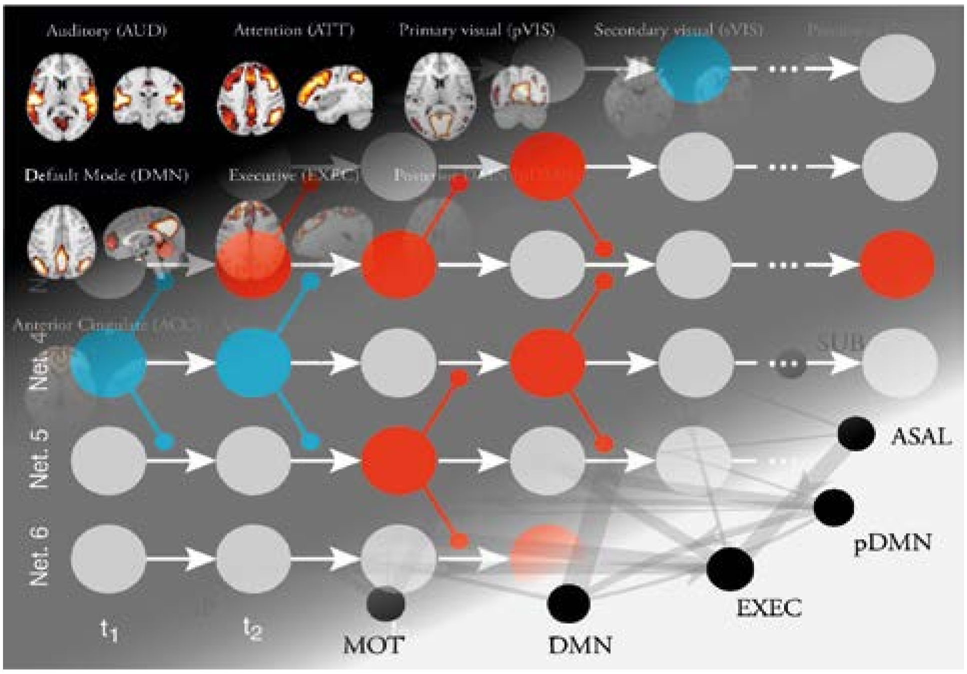
Koush Y, Ashburner J, Prilepin E, Sladky R, Zeidman P, Bibikov S, Scharnowski F, Nikonorov A, Van De Ville D (2017). OpenNFT: An Open-Source Python/Matlab Framework for Real-Time fMRI Neurofeedback Training Based On Activity, Connectivity And Multivariate Pattern Analysis. NeuroImage, 156:489-503.

Zoeller D, Schaer M, Scariati Jaussi E, Padula MC, Eliez S, Van De Ville D (2017). Disentangling Resting-State BOLD Variability and PCC Functional Connectivity in 22q11.2 Deletion Syndrome. NeuroImage, 149:85-97.

Pirondini E, Coscia M, Minguillon J, Millan J, Van De Ville D, Micera S (2017). EEG Topographies Provide Subject-Specific Correlates of Motor Control. Scientific Reports, 7:13229.

Preti MG, Van De Ville D (2017). Dynamics of Functional Connectivity at High Spatial Resolution Reveal Long-Range Interactions and Fine-Scale Organization. Scientific Reports, 7:12773.

Disentangling brain activity into functional networks (from "low level" sensory to "high level" cognitive ones) and exploring their interactions using computational temporal models show how these support essential features of brain function, as learning, coordinated cognition or stability in a changing enviroment



Research partners and activities

The Center for Neuroprosthetics draws upon EPFL's expertise in biology, neuroscience, brain imaging, and genetics as well as biomedical, electrical, mechanical engineering, micro- and nanotechnology. The Center also counts with EPFL's cutting edge research in signal analysis, theoretical and computational neuroscience. The CNP faculty pursues ambitious research projects within Europe's flagship Human Brain Project (www.humanbrainproject.eu) and two Swiss National Centers of Competence in Research, the NCCR in Robotics (www.nccr-robotics.ch) and the NCCR Synapsy in Psychiatric disease (www.nccr-synapsy.ch).

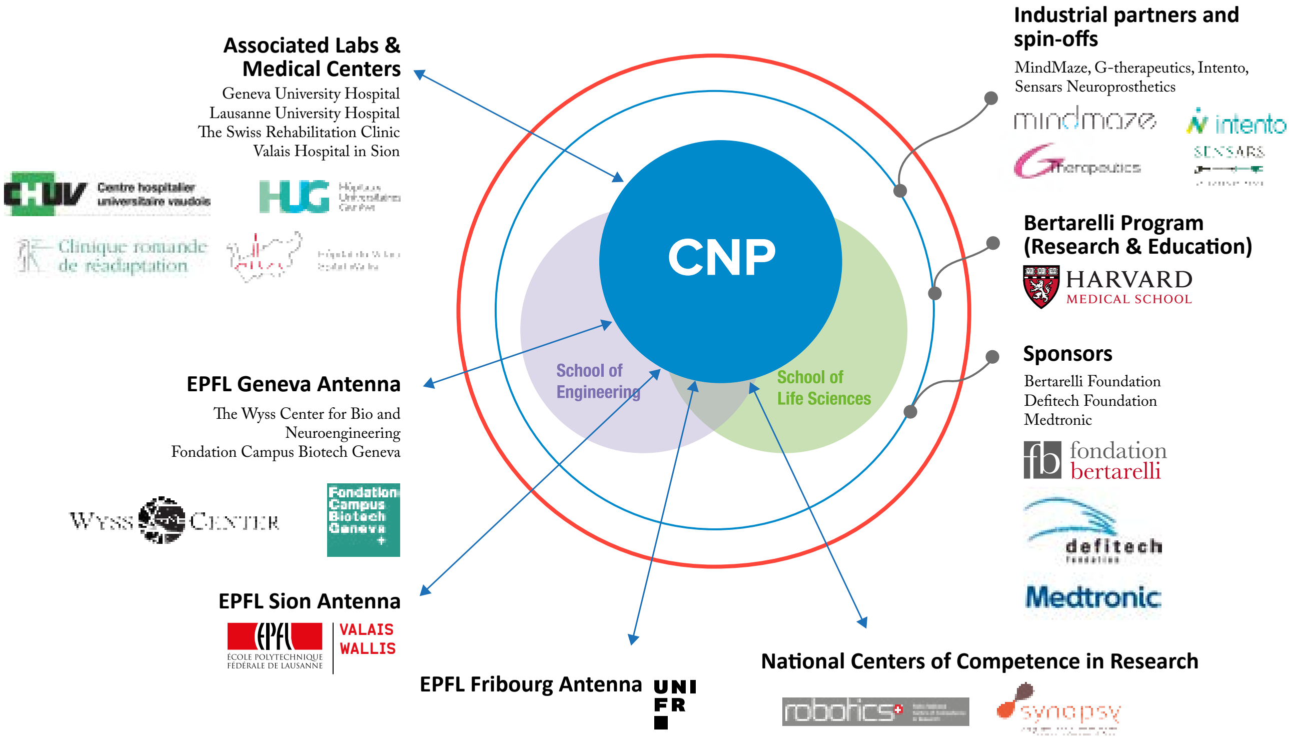
Neuroscience

Engineering

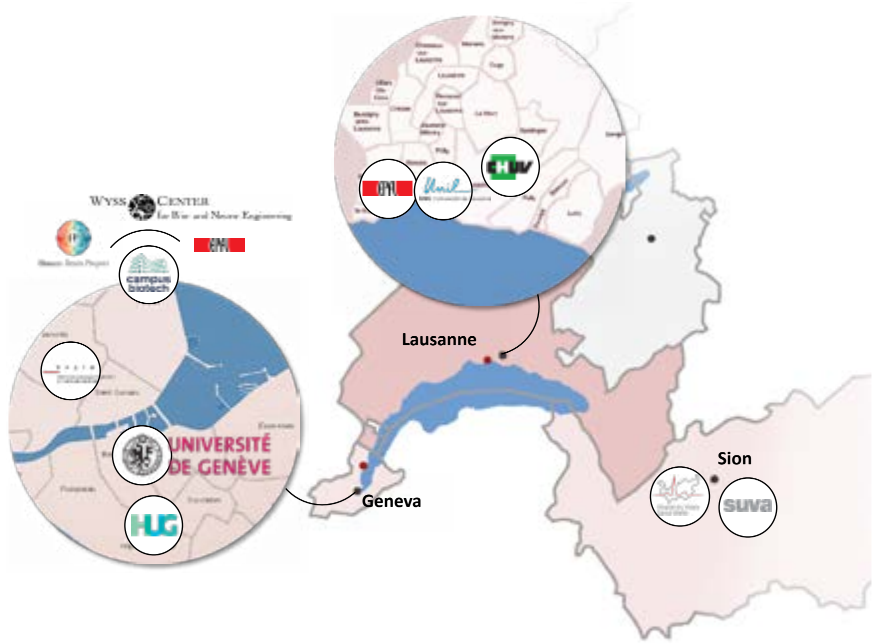
Medicine

Partners and associated medical centers

The Center for Neuroprosthetics is part of the School of Life Sciences and the School of Engineering. In addition, with the support from the Bertarelli foundation, a research collaboration dedicated to translational neuroscience and neuroengineering has been created between Harvard Medical School, EPFL's Institutes of Bioengineering and Neuroscience, and the Center for Neuroprosthetics.



The Center has strategic partnerships with Geneva University Hospital (Hôpitaux Universitaires de Genève, HUG), Lausanne University Hospital (Centre Hospitalier Universitaire Vaudois, CHUV), and the Swiss Rehabilitation Clinic in Sion (Clinique Romande de Réadaptation, CRR), as well as with the regional biomedical industry.



Associated laboratories

EPFL
AMINIAN Kamiar, Laboratory of Movement Analysis and Measurement.
BLEULER Hannes, Robotic Systems Laboratory
BOULIC Ronan, Immersive Interaction Group
IJSPEERT Auke, Biorobotics Laboratory
PAIK Jamie, Reconfigurable Robotics Laboratory

CHUV
BLOCH Jocelyne, Stereotactic and Functional Neurosurgery Program, Department of Neurosurgery
MURRAY Micah, IONTA Silvio, Laboratory for Investigative Neurophysiology
RAFFOUL Wassim, Department of Plastic and Reconstructive Surgery
SERINO Andrea, Department of Clinical Neuroscience

HUG
JANSSENS Jean-Paul, ADLER Dan, HERITIER BARRAS Anne-Chantal, IANCU FERFOGLIA Ruxandra, Department of Pneumology and Neurology
SCHNIDER Armin, GUGGISBERG Adrian, Cognitive Neuro-Rehabilitation Laboratory, Neurorehabilitation Clinic
SCHALLER Karl, MOMJIAN Shahan, Department of Neurosurgery

The Wyss Center

The Wyss Center for Bio & Neuroengineering and the CNP collaborate in research projects and supervise research platforms at Campus Biotech.

The Wyss Center is an independent, not for profit, research organization that aims to transform neurotechnology research ideas into clinical solutions. The Center advances technology to the marketplace to help people with nervous system disorders live independent lives. Established by a generous donation from the Swiss entrepreneur and philanthropist Hansjörg Wyss, and based at Campus Biotech in Geneva, the Wyss Center presents a new model in translational neurotechnology research. Over the course of the past year the Wyss Center has provided support and scientific, business and regulatory expertise to the CNP researchers.

Selected highlights 2017

January 2017

CNP united at Campus Biotech

Five years after the creation of the Center for Neuroprosthetics, the community of EPFL neuroprosthetics researchers are finally united under one roof at Campus Biotech. The first phase of the move of the CNP laboratories to Campus Biotech occurred in June 2015 and concerned the laboratories of Professors Blanke, Millán and Van De Ville, moving to the H4 and H8 buildings, joined in September 2016 by Professor Hummel's team. For the second phase, the laboratories of Professors Courtine, Ghezzi, Lacour and Micera moved to the neighbouring B3 building in November 2016 and in January 2017. From being dispersed across different buildings at the EPFL main Campus, we are now immediate neighbours to realize our scientific and translational projects.

March 2017

Bertarelli Symposium 2017 hosted at Campus Biotech

The 2017 Symposium of the Bertarelli Program in Translational Neuroscience and Neuroengineering, which took place at Campus Biotech in Geneva on Friday, April 7th, 2017. Every other year, the Bertarelli Program in Translational Neuroscience and Neuroengineering holds a Symposium in Switzerland. The theme for this year's Symposium is "Perception, Learning and Memory: Neuroengineering Perspectives". The event included speeches from several distinguished worldwide leaders, EPFL and CNP members such as Margaret Lingistone (Harvard), Cristina Alberini (New York University), Michel Kahana (U. Penn), Johannes Gräff (EPFL) as well as our new EPFL President Martin Vetterli.

May 2017

Immersive virtual-reality creation software for everyone

Imverse, a CNP spinoff, has developed a software that lets users convert 360-degree images from 2D into 3D and both manipulate and create virtual-reality content in real time with the help of virtual-reality glasses. The system was unveiled at the World VR Forum in Crans-Montana, Switzerland, from 11 to 14 May.

Stroke patients take the lead in their rehabilitation

The CNP and NCCR Robotics spin-off Intento has developed a patient-controlled electrical-stimulation device that helps stroke victims regain mobility in paralyzed arms. The promising results of the first clinical study are published in Archives of Physical Medicine and Rehabilitation. Every year, 17 million people worldwide suffer strokes, and a third are left paralyzed on one side of their body. But current rehabilitation solutions are not always effective in improving mobility declines after the first few month. This is where CNP and NCCR Robotics startup Intento comes in with a new device that can help patients regain mobility in their arms. Lausanne University Hospital (CHUV) conducted a clinical study on the device and has now published the encouraging results in Archives of Physical Medicine and Rehabilitation.

Intento device for stroke rehabilitation

August 2017

Launching phase two of EPFL's Valais expansion

The Canton of Valais, the City of Sion and the Swiss Federal Institute of Technology in Lausanne (EPFL) held their annual strategy committee meeting on Wednesday, 30 August. Building on the achievements of the EPFL Valais Wallis campus over the past three years, the parties have officially launched the second phase of EPFL's Valais expansion. At the committee meeting, the Canton of Valais and EPFL signed the second amendment to the 19 December 2012 agreement on the creation of the EPFL Valais Wallis campus, thereby formalizing the agreement in principle reached in December 2016. A new EPFL building that will host a research center on alpine and extreme environments will be constructed on the Energypolis campus in Sion. The rehabilitation and health cluster and the green chemistry and energies-of-the-future hub will also be strengthened.

August 2017

BROWN - EPFL - ETH joint Summer School & Exchange Program

The BROWN-EPFL-ETHZ exchange program was kicked-off during this year's summer school in Zermatt, August 2017. The goal of this joint Summer School on Neurophysiology for Neural and Biomedical Engineering is to provide a comprehensive course on the latest concepts of neurophysiology and neural-engineering. The 5-day program bought the fundamental knowledge of the main experimental tools available to a broad class of participants from Switzerland, US and the rest of the world.

Mental Works exhibit at EPFL ArtLab

October 2017

Mental Work opening at EPFL ArtLab

Mental Work employs Brain-Machine Interfaces (BMI), developed at EPFL in José Millán's lab, to activate four spectacular machines based on slider cranks, standard mechanisms of the Industrial Revolution. By directly connecting brain activity to these mechanical movements, Mental Work comes full circle to connect over 200 years of human-machine interaction. In collaboration with the artist Jonathon Keats, the cultural producer Michael Mitchell and EPFL ArtLab, Millán and his team at Campus Biotech have built the first factory dedicated to the Cognitive Revolution: ushering in a new era of human-machine interfaces. The data collected during the factory's operational hours will be used by the neuroscientific community to improve BMI and our understanding of the human brain.

November 2017

Prof Friedhelm Hummel receives ETH Board grant for stroke research

The ETH Board has awarded a team of researchers from the Center of Neuroprosthetics (CNP) at EPFL led by Friedhelm C. Hummel 3 million Swiss francs towards research into personalized precision medicine for stroke recovery within the Personalized Health and Related Technologies (PHRT) program.

The PHRT is one of the strategy focus areas of the ETH Board. Its mission is to enable the use of the large amount of health- and illness-related data currently available in order to develop and improve personalized treatment for patients. In that framework, the PHRT works closely with the Swiss Personalized Health Network initiative and the ETH Board's strategic focus on Data Science. Following their first call for proposals, a team of four Professors in EPFL's Center for Neuroprosthetics – Friedhelm Hummel, Olaf Blanke, Silvestro Micera, and Dimitri van de Ville – submitted a project entitled: "Towards personalized precision medicine for stroke recovery: a multi-modal, multidomain longitudinal approach", which has now been approved and awarded with 3 million Swiss francs for a period of 36 months.

December 2017

Professor Gregor Rainer was named as Associate Professor of Life Sciences in the School of Life Sciences (SV)

Gregor Rainer is a globally renowned neuroscientist. His research focuses on the section of the cerebral cortex which forms part of the visual system and enables visual perception. Gregor Rainer will hold a joint professorship at EPFL and the University of Fribourg, where he also works as Coordinator of the Swiss Primate Competence Centre for Research. His research direction and experience will make a significant contribution to advancing translational neuroscience at EPFL through the use of new approaches.

Distinguished Lectures in Neuroprosthetics

With the support of the Wyss Center

Using functional near-infrared spectroscopy (fNIRS) to understand deafness and brain plasticity, February 2017
By Prof. Colette McKay, The Bionics Institute of Australia.

Hearing the light: Optogenetic Stimulation of the Auditory Nerve, April 2017
By Prof. Tobias Moser, University of Göttingen Medical Center, Germany.

Slow Frontal-Midline Oscillations as a Gear-Box in the Brain, April 2017
By Prof. Paul Sauseng, Department of Psychology, Ludwig-Maximilian-University Munich, Germany.

Brain Recovery and Neuroimaging, May 2017
By Prof. Maurizio Corbetta, Department of Neuroscience University of Padua, Italy.

Frontal Cortex and Human Behavior: a View From Direct Brain Recordings, June 2017
By Prof. Robert T. Knight, University of California, USA.

Mechanisms of motor learning and how to modulate it in health and disease, June 2017
By Prof. Leonardo G. Cohen, NINDS, National Institutes of Health, USA.

Soft wearable robots for the community and the home, September 2017
By Prof. Connor J. Walsh, Harvard University, USA.

Visual restoration: validations of the photovoltaic retinal prosthesis and of optogenetic therapy in non-human primates, November 2017
By Prof. Dr. Serge Picaud, Institut de la Vision, Paris, France.

Selected seminars in 2017

Beyond onsets: object persistence along the visual pathway, February 2017
By Prof. Leon Y. Deouell, Hebrew University of Jerusalem, Israel.

Cellular therapies for spinal cord injury: what might they achieve? October 2017
By Prof. John Riddell, University of Glasgow, UK.

Miniaturized Implants to Interface with the Peripheral and Central Nervous System, October 2017
By Prof. Thomas Stieglitz, IMTEK - Institut für Mikrosystemtechnik, Germany.

Can we learn more from partial responses about action monitoring? October 2017
By Prof. Frank Vidal, Université de la Méditerranée, Marseille, France.

Neurotechnology for restoring and enhancing sensorimotor, autonomic, and cognitive functions, November 2017
By Prof. Douglas J. Weber, University of Pittsburgh, USA.

Applications of local field potentials for closed-loop neural interfaces, December 2017
By Prof. Andrew Jackson, Newcastle University, UK.

Teaching

Students enrolled in a Master program at EPFL have the possibility to obtain an inter-faculty specialization in neuroprosthetics. This “Mineur” in neuroprosthetics covers the essential courses in neurosciences and neuroengineering in the field of neuroprosthetics, including medical applications. The programme is coordinated by Prof. José del R. Millán (School of Engineering, STI) and Prof. Olaf Blanke (School of Life Sciences, SV).

http://cnp.epfl.ch/teaching

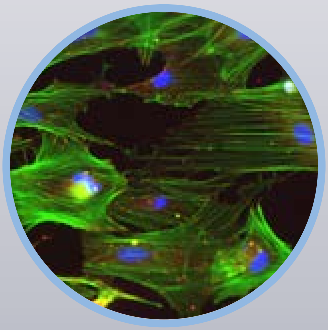
Bertarelli Program in Translational Neuroscience and Neuroengineering

The goal of the Bertarelli Program in Translational Neuroscience and Neuroengineering is to facilitate basic discoveries in neuroscience towards translation by creating stronger ties between basic neuroscientists, engineers and clinicians. The Program bridges two of the world’s great universities, namely Harvard University’s Medical School (HMS), with more than two centuries of leadership in alleviating human suffering caused by disease, and the Ecole Polytechnique Fédérale de Lausanne (EPFL), with special strength in engineering and technology. Prof. Blanke is co-Director of the Program on the EPFL side, together with former Dean of Engineering Prof. Demetri Psaltis.

Kirsty and Ernesto Bertarelli meet a group of EPFL awardees of Bertarelli Fellowships, on the occasion of the annual Bertarelli Symposium (Campus Biotech, April 7, 2017). Photo: Fondation Bertarelli ©

The Bertarelli Research Grants fund EPFL-HMS collaborative projects over a period of three years. The program additionally funds EPFL Master students to study at HMS and HMS medical students to study at EPFL.

http://ptnn.epfl.ch/



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