Curriculum Vitae: Etienne BURDET

Swiss citizen born 5/6/65, male, married to MeiWen, children Jacques-ShiHao and Nicolas-ShiJie

Education

84-90	Study of Mathematics and Physics at ETH-Zurich
84-90	Study of Mathematics and Physics at ETH-Zurich
89	Masters in Mathematics
	(thesis in Differential Geometry, advisor W Ballmann, U Bonn)
90	Masters in Physics
	(thesis in Computational Neuroscience, advisor K Hepp, ETH-Zurich)
91-96	PhD studies in Robotics at ETH-Zurich
	(committee: G Schweitzer, ETH-Zurich; T Flash, Weizmann Institute of Science)
97-99	Postdoctoral education in Neurophysiology, Computational Neuroscience and Haptics
	(with TE Milner, McGill, Canada; M Kawato, ATR, Japan; JE Colgate, Northwestern U, USA)
Languages	Studied and worked in French (mother tongue), German and English

Professional experience

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2013-	**Professor and Chair in Human Robotics, Imperial College London**
16-18	Invited Professor, Nanyang Technological University (NTU), Singapore
2012-	Honorary Professor, University College London (UCL)
09-16	Invited Professor, Sorbonne Université
09-13	Reader in Human Robotics, Imperial College London
7-8.12	Invited Professor, EPFL, Switzerland
09-11	Consultancy for A*STAR, Singapore
05-08	Senior Lecturer in Bioengineering, Imperial College London
05-08	Senior Fellow, National University of Singapore (NUS)
99-04	Assistant Professor, National University of Singapore
98-08	Consultancy for ATR International, Japan
96-99	Postdoctoral Fellow, Simon Fraser U, Canada, and Northwestern U, USA
6-8.96	Visiting Researcher, Fujitsu Ltd, Numazu, Japan
91-96	Research Assistant at the Institute of Robotics, ETH-Zurich

Awards

2015	(UK) National Health System Innovation Challenge Prize
2012	Best IROS Jubilee Video Award, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS is one the two dominant robotics conferences)
2011	IEEE Transactions on Robotics Best Paper Award (TRO is the top robotics journal)
2010	Best Paper Award, Asean Oceanian Congress of Physical and Rehabilitative Medicine
2009	Apple Research and Technology Support Award
2009	Best Presentation Paper Award at IEEE International Conference on Rehabilitation Robotics (ICORR) (from over 200 submissions)
2006	Best Application Paper Award at IROS (chosen from 2166 submitted papers)
2004	Tier II Canada Research Chair (to attract the best researchers with promise of signicant potential) (http://www.chairs.gc.ca, the offer was declined)
2003	ATR Research Award (awarded to 4-5 people worldwide each year)
2001	Best Paper Award, Japanese Neural Networks Society (http://www.jnns.org)
1998	Advanced Researcher Award, Swiss National Science Foundations
1996	Prospective Researcher Award, Swiss National Science Foundations (see http://nfp.snf.ch/E/funding/individuals/mobility-fellowships)

Human Robotics Group (HRG, www.imperial.ac.uk/human-robotics)

The HRG directed by Etienne Burdet is composed of 10-20 postdoctoral researchers, graduate students and visitors with backgrounds in engineering, science and medicine. Alumni include over 50 MRes students, 24 PhD students and 22 postdoctoral researchers. We use an integrative approach of neuroscience and robotics to investigate human sensorimotor control, and to design efficient assistive devices and training systems, which are tested in human trials and commercialised, such as the TyroMotion MYRO or the spin-off https://gripable.co.

Scientific highlights
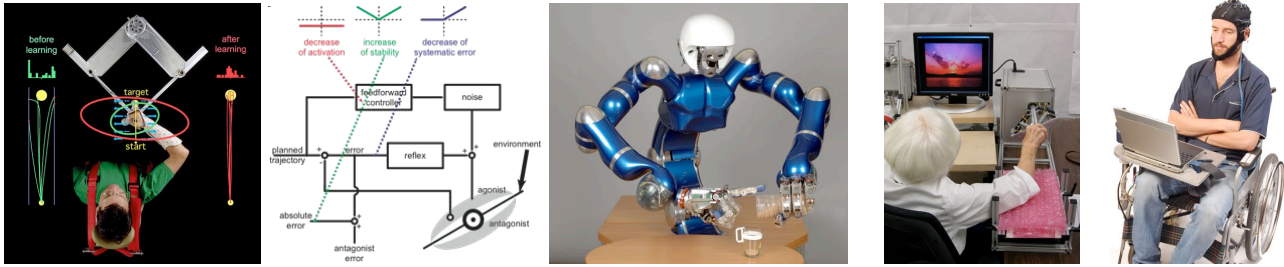
First clear evidence of impedance control in humans. Many tasks with tools are intrinsically unstable. For instance, motor noise can bring the screwdriver out of the screw, and during carving the knife can easily miss the intended motion due to unexpected material property. To understand how humans can learn to perform such tasks skilfully, we examined the adaptation of arm movements reaching a target with lateral instability (left panel in above figure). Our results demonstrated that the nervous system adapts muscles activation to produce appropriate force and impedance, the response to mechanical perturbations (Nature 414: 446-9, J Neuroscience 27(29): 7705- 16). The results (shown in the left panel) provided the first clear evidence for Neville Hogan's important impedance control hypothesis of 1985 (Biological Cybernetics 52: 315-31) and influenced two major research streams in human motor control, namely optimal control (Todorov 2004, Nature Neuroscience 7: 907-15) and the representation of uncertainty (e.g. Orban and Wolpert 2011, Current Opinion in Neurobiology 21: 629-35).

Impedance learning: in humans, for robots. To understand the learning of force and impedance in humans, we developed a computational model that can predict how sensory information is used to modify the motor commands to muscles during the whole learning process (J Neuroscience 28(44):11165-73, Biological Cybernetics 102: 31-44, second panel). The universality of this model was recognised by prominent neuroscientists such as Daniel Wolpert (Nature Review 2011) and Alain Berthoz (in his 2012 book on "Simplexity: Simplifying Principles for a ComplexWorld"), as well as leading rehabilitation technologists (e.g. Riener et al. 2010, J NeuroEngineering and Rehabilitation 7:43). Through implementations on industrial robots and novel variable impedance actuators (third panel, done in collaboration with DLR in Germany, a top robotics laboratory), we were able to demonstrate its adaptation capabilities to unknown environments and interacting humans (IEEE T Robotics 27(5): 918-30). This novel robotic adaptive control behaviour and the analysis of its dynamic properties were recognised by the 2011 best paper award from the IEEE Transactions on Robotics, which is the leading journal in the robotics field. We have extended this adaptive controller to trajectory adaptation, enabling a robot to interact with with rigid or soft object (Li et al. 2018, IEEE T Robotics).

Human neuromechanics. The synthesis of biomechanics and neural control approach we developed in human motor control research and the significant results we have obtained in this area retained the attention of the international community, and we were invited to write a book on theses topics by MIT Press. This book, "Human Robotics - neuromechanics and motor control" (http://mitpress.mit.edu/books/human-robotics) has been published in September 2013. It has been adopted for courses at various universities e.g. U Twente (IEEE T Haptics 7(2):270), UC (http://plaza.eng.uci.edu/course/engrmae/250/outline/2013-2014), UTA, and have been translated into Japanese (Maruzen) and Chinese (Tsinghua University Press).

fMRI compatible haptic interfaces to examine motor learning and recovery. To study the brain mechanisms of motor control in health and neural diseases, we designed the first robotic interface compatible able to interact with human motion during functional magnetic resonance imaging (fMRI) in collaboration with colleagues at EPF-Lausanne, Switzerland (IEEE/ASME T Mechatronics 11(2): 216-24). We had to develop non-traditional mechatronics to circumvent the problems caused by the intense magnetic field used in MRI. The robotic interfaces we have fabricated (for over 1M$ altogether) to investigate the neural mechanisms of human motor control are used by ATR International in Japan, U. Birmingham and U. Pisa. Using the interface at ATR, we could identify distinct fMRI correlates for force and impedance control in the premotor cortex (Journal of Neurophysiology 107: 126-33). More recently we developed pioneering fMRI compatible robotic interfaces to examine the development of neural activity in preterm infants at risk of cerebral palsy (IEEE T on Biomedical Engineering 41(6): 1181-92) in collaboration with Kings College. Using this tool, we could study the effect of a stroke on the

brain development (Neuroradiology 56: 985-94) and recently describe the evolution of brain activity in preterm infants from birth to age-corrected term (Cerebral Cortex 26 (1): 402-13).

Robotic wheelchair and brain controlled wheelchair. Recent surveys indicated that about 10% of potential users of power wheelchairs who received training found it extremely diffcult or impossible to use it for daily activities, and 40% found it difficult to manoeuvre the wheelchair. While this result demonstrates the need for a system to assist in the control of a powered wheelchair, however several robotic wheelchair projects (e.g. the recent EU-FP7 RADHAR project) highlighted that users do not like to be fully driven by an autonomous robot, and that there is a paucity of works that systematically investigated shared control with human subjects.

Based on our knowledge of motor adaptation, we have designed a robotic wheelchair system with adaptive path guidance (IEEE T Robotics 23(2): 245-55) that assists the user in manoeuvring while letting her or him in charge of the velocity control. We demonstrated with able bodied subjects and a low-cost robotic wheelchair that this novel shared control concept significantly reduces the effort produced by the wheelchair user (IEEE Neural Systems and Rehabilitation Engineering 16(2): 161-70; Assistive Technology 3(6): 315-24). This was successfully tested (at the Society for the Physically Disabled in Singapore, http://www.spd.org.sg/) by cerebral palsy and traumatic brain injury patients, who could not use a standard wheelchair (Neurorehabilitation and Neural Repair 23(5): 494-504). Using a similar concept, we have also developed the first brain-controlled wheelchair capable of manoeuvring in familiar environments (IEEE Intelligent Systems 22: 18-24, right panel, featured on Channel U (Mediacorp, Singapore). Different control modalities were tested including a P300 interface (based on a signal associated to a surprise) and μ/β frequency brain waves (IEEE T Neural Systems and Rehabilitation Engineering 18(6): 590-8).

Robot-assisted rehabilitation of the hand function. It is known that post-stroke survivors can improve their motor function by increasing the intensity of the physical therapy. However patients are typically sent home once they can walk, without recovering much of their hand functions, critical to many activities of daily living. Therefore, we have developed simple and compact robotic interfaces for rehabilitation of hand function with the goal to help patients train at home for in rehabilitation centres (HapticKnob, IEEE T Neural Systems and Rehabilitation Engineering 15(3): 356-66, Best Paper Award at IROS2006; HandCARE, IEEE T Neural Systems and Rehabilitation Engineering 16(6): 582-91), highlighted in New Scientist 7-4-2007, Nature 510:S8-S9; forelast panel in the figure of previous page). We have created a natural interface for implementing task-oriented-therapy (ToT) consisting of a force sensitive touch-screen table with instrumented objects, which as recently been commercialised by the Austrian company Tyromotion (tyromotion.com/en/products/myro). In collaboration with Paul Bentley, we have designed the gripAble handgrip, which is the first rehabilitation that can be used from the bedside to home. This device has been trialled by over 500 stroke survivors at Charing Cross and community centres (PLoS ONE 11(10): e0163413; Royal Society Open Science 4.2: 160961; Journal of NeuroEngineering and Rehabilitation 2017; UK PCT patent No. 2537580) has span-out to the gripAble.or company. I have also contributed to the foundation and I have been advising the neurofenix.com company developing affordable technology for home-based rehabilitation.

Computational neurorehabilitation. Our expertise in robot-assisted rehabilitation of hand function is illustrated by the recent review papers we have been invited to write in leading journals (Current Opinion in Neurology 23(6): 661-70; American Journal of Physical Medicine and Rehabilitation 91(11): 255-69). In view of the promises our motor learning research for adapting rehabilitation robots, I have been invited to participate to the first colloquium on "Computational Neurorehabilitation" (www.borchardcenter.org), which aims at promoting evidence-based rehabilitation and systematically investigate the neural basis for effective rehabilitation (Journal of NeuroEngineering and Rehabilitation 13: 42). I have also been invited by the EU COST Action TD1006 network on rehabilitation robotics to organise the first research school on this topics, which took place end of January 2014 (www.rehabilitationrobotics.eu/events/cost-action-td1006-winter-schoolcomputational-methods-neurorehabilitation.

Haptic communication between humans and with robots. Physical assistance enabled by haptic interaction is a fundamental modus for improving motor abilities, from a parent helping to guide their child during their first steps to a therapist supporting a patient. By examining the behaviours of two individuals when their right hands are physically connected, we could reveal how physical interaction with a partner changes one's own motor behaviour. In particular we could show that one improves with a better and even with a worse partner (Scientific Reports 4: 3824), which suggests advantages of interactive paradigms for sport-training and physical rehabilitation. Furthermore, we recently showed through computational modelling that haptic information

provided by touch and proprioception enables one to estimate the partners movement plan and use it to improve one own motor performance (Nature Human Behaviour 1: 45; PLoS Computational Biology 14(3): e1005971). We experimentally verified our model by embodying it in a robot partner, and checked that it induces the same improvements in motor performance in a human individual as interacting with a human partner. Interestingly, when interacting with several partners, the performance increases with the group size (eLife 8: e4132). These results provide important new insights into the neural mechanism of physical interactions in humans, and promise collaborative robot systems with human-like assistance. We recently developed a framework based on differential game theory in order to translate such results to improve the interaction between a robot and its human user (Nature Machine Intelligence 1(1): 36).

Contributions to Education (from 2009)

To learn is to establish connections. In my teaching I thus try to help students develop and establish connections between different areas within a field, amongst different fields and people, appropriately to their skills. I am further committed to providing students a strong base for critical thinking and enabling them to evolve with new knowledge and new technology.

Signals, Systems and Control

In this context, I have revamped the two-term "Signals and Systems" course for second year Bioengineering students at Imperial, which is a strategically important course as it provides them the mathematical bases to treat signals. This is vital, as Bioengineering students spend the third of their four years of study in Electrical or Mechanical Engineering, so need a sufficient level to successfully compete with students from these departments. Therefore, I introduced a novel system with progressive tutorials that the students have to solve weekly, and MatLab practical tutorials involving typical problems of signal processing and control design in Bioengineering, using for example audio signals and functional magnetic resonance imaging (fMRI) data processing.

Solving the weekly tutorials enables the students to assimilate the course material actively, during the whole term, rather than one week before the examinations. Students can ask questions during the courses, or at a weekly contact hour with teaching assistants. While my teaching of this course has been reduced to one half of the second term (with the new courses I have set up), my colleagues have kept this course structure and continue to use the extensive lecture notes that I have developed (which are appreciated by the students according to their feedback).

Introduction to Robotics

An introductory course in Robotics was required for the MSc in Human and Biological Robotics which I have set up. Traditional robotics courses start with the 3D kinematics using 3D geometric transformations. However, this may be unpleasant and prevent students from understanding the essence of robotics, "the intelligent connection of sensing to action" (Michael Brady). Therefore, this new course presents the kinematics, dynamics, control and motion planning concepts first in the 3 degrees-of-freedom of the plane (x, y, θ) so as to facilitate intuition and visualisation. Later on, these concepts are extended to 3D geometry. Theory is complemented by tutorials and practicals with robots and haptic interfaces from our labs that contribute to assimilating the material.

Neuromechanical Control and Learning

To analyse the way humans perform physical tasks, research and teaching classically focuses either on the biomechanical aspects (thus neglecting neural control), or conversely focus on the cognitive aspects (which may attribute effects of musculoskeletal dynamics to cognition). Therefore, research over the last 30 years (including our results of the last decade) has developed a synthesis of biomechanics and neural control which I decided to present in a course for final year undergraduate and graduate students.

This course provides the students with a comprehensive description of human motor control which integrates both aspects, beginning with muscle mechanics and control, and progressing in a logical manner to planning and behaviour. It is based on an approach reminiscent of physics, where models are developed based on evidence from physiological experiments. In addition to the lectures, students have to solve tutorials that help them to assimilate the concepts of multibody kinematic and dynamic modelling.

This course has evolved since 2009, and has lead to the book "Human Robotics: neuromechanics and motor control", written in collaboration with David Franklin of TUM and Theodore Milner of McGill, that was published by MIT Press in 2013 and has been translated into Japanese (Maruzen) and Chinese (Tsinghua University Press).

Human centred design of assistive and rehabilitation devices (H-CARD)

To develop Imperial students who are comfortable and experienced with interdisciplinary work across engineering, I have designed a new interdepartmental course on "Human centered design of assistive and rehabilitation devices" (HCARD) which has been supported by EnVision and the EU-FP7 HUMOUR project. Rehabilitation technology illustrates the paradigm for emergent systems to work with humans. As exemplified by smartphones,

the success of such systems depends on an intuitive interface, an attractive design based on a user analysis, and game-like applications. In H-CARD, groups of 4 students from Mechanical Engineering, Electrical Engineering, Computer Science and Bioengineering backgrounds therefore learn to design rehabilitation systems and assistive devices, integrating mechatronics, human factors and computer games:

- through lectures given by experts (clinicians and engineers) in these topics;
- by developing a complete system for rehabilitation or assistance;
- by collaborating with students of complementary background;
- by competing against other groups to develop "the best system".

This course completely fulfilled its objectives: year after year, students learn to work in interdisciplinary teams, develop systems by integrating mechatronics, human factors and a game-like interface. A description of this novel course is given a journal paper (IEEE PULSE 3(6): 51-8). This paper also describes the development of a wireless embedded platform for the investigation of sensing and actuation technologies and their integration into the human centred feedback systems at the heart of this course, which was developed within the EU-FP7 HUMOUR project. The H-CARD course generated great enthusiasm in the participating students (as is evident from their feedback) and was highly praised by the visitors of the final "competition" between the teams. All groups of students succeeded in providing an original and fully functional system in the two years this course was organised. This course with a limited number of students is largely overbooked every year. Furthermore, some of the ideas developed by the teams have advanced to a real projects, e.g. the product developed by neurofenix.com evolved from a prototype produced in H-CARD.

Research schools organisation

- "First winter school on computational methods for neurorehabilitation", EU COST Action network TD1006 on rehabilitation robotics, Obertauern, Austria, 27-31/01/2014.
- "Summer school on human sensing and applications to robotics and haptic displays", Lille, France, 18-22/05/2015.
- "Summer school in robotics - biology symbiosis", Imperial College London, UK, 19-21/09/2017.
- "EU COST Action network TD16116 winter school on Wearable Robotics", Kranjska Gora, Slovenia, 22-25/1/2019.
- "EU COST Action network TD16116 winter school on Wearable Robotics", Obertauern, Austria, 19-24/1/2020.
- Organisation of workshop on "Three-hand surgery", Hamlyn symposium, 7/7/2021, https://hamlynsymposium.org/events/three-hand-surgery/.
- Co-organisation of the "EU COST Action network CA16116 summer school on Wearable Robotics" which took place in Spain on 6-10/9/2021.
- Co-organisation (with Mohsen Kaboli @ BMW) of workshop on "New advances in tactile sensation, interactive perception, control, and learning", IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 27/9/2021.
- Co-organisation (with Tohoku and Surrey Universities) of workshop on "Advances in space robotics and back to Earth", IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 1/10/2021, https://sites.google.com/view/spacerobots2021/home.
- Co-organisation (with Carsten Mehring and Jonathan Eden) on an online Lecture series on sensorimotor augmentation.

Management (since 2009)

- I have been in charge of the writing workshop in the Department of Bioengineering at Imperial 2019-2022.
- I have been co-director of research from 2014-19.
- I have set up a new MSc on Human and Biological Robotics in 2016-2017, which involves lecturers from various engineering departments (www.imperial.ac.uk/study/pg/bioengineering/human-and-biological-roboticsmsc). This MSc is largely overbooked and will thus be extended to other departments.
- I am in the management committee of the the Imperial Robotics Forum (IRF) grouping over 20 laboratories at Imperial (www.imperial.ac.uk/robotics), which I have co-founded and coordinated during 2015-2017.
- From 2010 to 2013, I have been coordinating the MSc Neurotechnology stream of the MSc in Biomedical Engineering set up by the Department of Bioengineering. During this period the number of students has been growing from less than 10 to 40, making it the largest stream.
- I have been international coordinator for the department from 2009 to 2013, where I extended our network of exchange to Singapore and Australia.

External services (since 2009)

I have been Group Leader for neuroscience-based rehabilitation in the EU COST Action Network on Rehabilitation Robotics. I was in the Advisory Board of the EC-funded RobotCom project, and in the Executive Committee of the 'Robot Companions for Citizens' EC-FET flagship candidate. I have been advisor to the EC FP7 BETTER project in 2010, and served as reviewer for the EC FP7 RADHAR project from 2011 to 2013, for SPEXOR in 2017. I have served in the panel of the French INRIA Evaluation Committee on October 16-17 2013 in Paris. I have participated as panel member in the selection of the candidates for the SFI President of Ireland Future Research Leaders programme. I was a reviewer of the EC H2020 SPEXOR and LEVITATE projects. I was in the advisory board of Neurofenix.com until 2019. I was in the scientific advisory board of the French SMART Laboratories of Excellence on human-machine interaction (www.smart-labex.fr). I was co-workpackage leader in the EU COST Action CA16116 on Wearable Robots for Augmentation, Assistance or Substitution of Human Motor Functions (www.cost.eu/COSTActions/ca/CA16116). I am in the scientific advisory board of the Munich Institute of Robotics and Machine Intelligence, Technical University of Munich. I am in the editorial board of the IEEE Open Journal of Engineering in Medicine and Biology, and of the Cyborg and Bionic Systems journal.

I have been invited to evaluate the promotion application to full Professor of several colleagues at Nanyang Technological University, Singapore, Aalto University in Finland, Northwestern University and Johns Hopkins University, USA, and EPFL, Switzerland. In the last five years, I have reviewed grant applications for various funding agencies, including the Australian Research Council, ETH-Zürich, the Canada Foundation for Innovation, the UK BBSRC, the Swedish Research Council, Wellcome Trust, the French Agence Nationale de la Recherche (ANR), ESA, the UK EPSRC, and the Swiss National Foundation and the European Research Council. I have been in the panel for Professorship positions at the Universität Basel and Universität Erlangen-Nürnberg.

I have been co-chair of the Eurohaptics conference (www.eurohaptics2016.org), the premier meeting on haptics for 2016, which we have organised at Imperial on July 4-7, 2016. I have been co-chair of the IEEE International Conference on Rehabilitation Robotics (ICORR2017) and in the organisation committee of the RehabWeek2017 (the premier event in rehabilitation technology) that have taken place in London this July 2017. I have been in the organisation committee of the IEEE International Conference on Rehabilitation Robotics (ICORR2019) and of the RehabWeek2019 in Toronto. I have been in the organisation committee of ICRA2020, the leading robotics conference. I am in the IEEE Control Systems Society panel contributing on "Control with human-in-the-loop" to the "Control for societal-scale challenges 2030" roadmap.

I am co-organising about two workshops every year at dominant conferences in motor control, haptics, rehabilitation and robotics such as NCM, ICORR, Haptic Symposium, ICRA and IROS, and review about 10 papers each year for leading journals in these fields including Science, Science Robotics, Nature, Nature Human Behavior, Current Biology, J of Neuroscience, J of Neurophysiology, Experimental Brain Research, PLoS Computational Biology, Biological Cybernetics, J Neurorehabilitation and Neural Repair, IEEE Transactions on: Neural Systems and Rehabilitation Engineering, Mechatronics, Robotics, Haptics.

International recognition

Interest in my research is reflected in the many keynote lectures and presentations I have been invited to give (listed since 2009 below), and in the increasing number of citations shown in the figure below, with currently over 13000 citations and an H-factor of 55 (in Google Scholar).
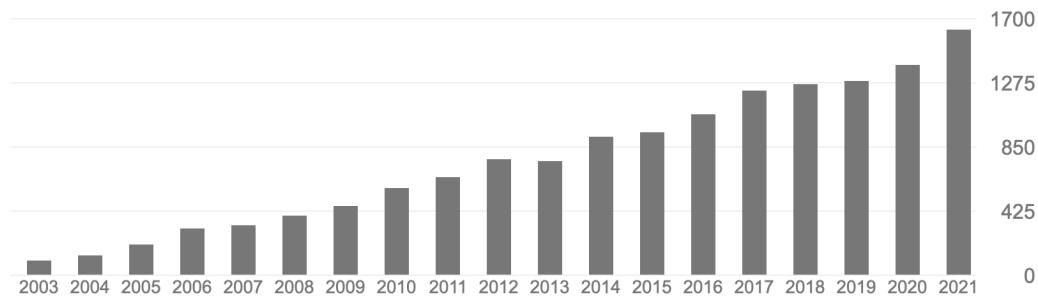

Figure 1: Evolution of citations corresponding to "etienne burdet" on https://scholar.google.co.uk/.

I am regularly invited to participate in European panels or committees, as well as to review research project and Professorship promotion as described above. My Human Robotics Group (HRG) attracts researchers worldwide. Since 2009, 23 scholars and senior researchers and over 50 research students stayed by us for a periods from 2 to 12 months. HRG is often visited by groups from America, Europe and Asia. For instance it was one of the sites selected by the American "WTEC Panel on European Research and Development in Mobility Technology for People with Disabilities" for their report that visited us on October 10, 2010 (www.wtec.org/reports.htm) and was visited several times by delegates of the Singapore government.

Alumni of the Human Robotics Group (HRG) have taken positions at leading universities, research institutes and high-tech companies worldwide. For instance, Ganesh Gowrishankar and Nathanael Jarrassé are (tenured) Senior Researchers at CNRS, Atsushi Takagi is Associate Professor at the Tokyo Institute of Technology, Eileen Su and Che Fai Yeong at University Teknologi Malaysia, Sivakumar Subramanian at CMC Vellore in India. Roger Gassert and Chenguang Yang are Professors at ETH-Zürich and at the University of the West of England, respectively, Themis Charalambous is Assistant Professor at Aalto University in Norway, Arash Arami at the U of Waterloo in Canada, Ildar Farkhatdinov and Yanan Li at Queens Mary U and the U of Sussex, in the UK, and Alejandro Melendez at Queensland U in Australia. Julius Klein and Brice Rebsamen are R&D engineer at Motivo and Zoox, both in California, Zhang Han at Princeton Plasma Physics Laboratory, Tee Keng Peng at A*STAR in Singapore, and Zeng Qiang at China National Petroleum Company.

Invited lectures and presentations (since 2009)

Keynotes and plenary lectures

Keynote lecture on "Robot-assisted rehabilitation of hand function with adapted sensorimotor and psychological feedbacks, Int Neurorehabilitation Symposium (INRS), Zürich Universität, Switzerland, 2/2/2009.

Plenary lecture on "Human robotics - from modelling of human motor function to robots for humans" at the Tecnologico de Monterrey Campus Estado de Mexico, 2/4/2009.

Keynote lecture on "Human-centred rehabilitation robotics", at the Int Convention for Rehabilitation Engineering and Assistive Technology (i-Create), Singapore, 23/4/2009. [i-Create is the leading Asian conference on rehabilitation technology]

Keynote lecture on "Adaptive motion guidance: in human, for robot, for humans" at the Journées Françaises de la Recherche en Robotique, at La Rochelle, France, 21/10/2011.

Keynote presentation on "Human robotics", Robotics panel, CNRS, Institut des sciences informatiques et de leurs intéractions, Paris, France, 14/12/2011.

Plenary lecture on "A theory of interactive motor behaviours" at the Int Conf on Social Robotics (ICSR) in Chengdu, China, 2/11/2012. [ICSR is the top conference in this emerging field]

Keynote lecture on "Towards an integrated approach of motor learning" at the Technically Assisted Rehabilitation Conference, Berlin, 14/3/2013.

Keynote lecture on "Human robotics", COBEM Int Congress of Mechanical Engineering, Ribeirao Preto, Brasil, 7/11/2013.

Keynote lecture on "Motor interaction with robots and other humans" at the IEEE/RSJ Int Conf on Robotics and Intelligent Systems, Chicago, USA, September 15, 2014. [IROS is one of the two top robotics conferences]

Keynote lecture on "Simple, neuroscience-based rehabilitation" at the IEEE Int Conf on Rehabilitation Robotics (ICORR), in Singapore, 13/8/2015. [ICORR is the leading rehabilitation robotics conference]

Plenary lecture on "Interaction control in humans and for robot", International Conference on Intelligent Robots and Applications (ICIRA 2015), 26/8/2015.

Invited lecture on "Collaborative Robots for Mobility Assistance and Rehabilitation", tutorial on Medical robotics, IEEE Int Conf on Robotics and Automation (ICRA), 20/5/2016. [ICRA is one of the two top robotics conferences]

Keynote Lecture on "Human-machine interaction and neurorehabilitation", 4th Daegu Gyeongbuk Institute of Science and Technology (DGIST) Global Innovation Festival, 1/12/2016.

Keynote Lecture on "Motor interaction and haptic communication between humans", Scientific workshop for the 10 years of the Intelligent Systems and Robotics (ISIR), Sorbonne Université, 15/6/2017.

Keynote Lecture on "Human-machine interaction and neurorehabilitation", Second Int Symposium on Biomedical Engineering, Tokyo Institute of Technology (Tokyo Tech), Japan, 9/11/2017.

Keynote Lecture on "Interaction control: in human, for robots" International Conference on Robot Intelligence Technology and Applications, Kuala Lumpur, Malaysia, 17/12/2018.

Keynote Lecture on "Haptic communication between humans and with robots", 5th anniversary of Euromov Conf, Montpellier France, 25/6/2018.

Keynote Lecture on "Human-machine interaction and neurorehabilitation", International Symposium on Embodied-Brain Systems Science, Osaka, 5/12/2018.

Keynote Lecture on "Interaction control: in human, for robots", Int Conf on Robot Intelligence Technology and Applications (RITA), Kuala Lumpur, 16/12/2018.

Keynote Lecture on "Haptic communication", Progress in Motor Control XII, Amsterdam, Netherlands, 8/7/2019.

Plenary Lecture on "Interaction control in humans and with robots", International Conference on Intelligent Robotics and Applications (ICIRA), Shenyiang, China, 9/8/2019.

Keynote Lecture on "Interaction between humans and with robots", European Conference for Cognitive Science, Bochum, Germany, 2/9/2019.

Keynote Lecture on "Interaction control in humans and with robots", Journée de la Recherche, Fédération. Demenÿ-Vaucanson, Université Paris-Sud, France, 19/11/2019.

Plenary Lecture on "Interaction control in humans and with robots", Chinese Control Conference, China, 27/7/2020 [Largest (Chinese) national control conference].

Keynote Lecture on "Haptic communication in humans and with robots", AsiaHaptics Conference, Beijing, China, 9/11/2020.

Paid lectures and seminars

Ten lectures on various aspects of robotics and neurotechnology in the context of the "Academic Leaders Programme" at Tecnologico de Monterrey (one of the top Mexican Universities), 30/3-3/4/2009.

Talk on "Robot-assisted rehabilitation of the hand function", Centro de Rehabilitacin Infantil, Mexico (CRIT-TELETON, http://www.e-mexico.gob.mx/wb2/ eMex/eMexCentrodeRehabilitacionTeleton), 1/4/2009.

Seminar on "Biological optimization in human motor control" at the European Research Network Programme in Sensorimotor Function in Health and Disease (ERNI-HSF) Workshop on "Computational principles of sensorimotor learning", Kloster Irsee, Swabia, Germany, 14-15/9/2009.

One week course on "Rehabilitation technology" organised at the Singapore National University Hospital, supported by the (Singapore) Health Manpower Development Plan. 30/11-4/12/2009.

Seminar on "Computational neuroscience as a tool for rehabilitation", at the International workshop on NeuroRehabilitation. Tokyo Institute of Technology, 15-16/2/2010.

Lecture on "Neuroscience and its use for rehabilitation" in the DFG-Graduiertenkollegs "prometei" (www.prometei.de) at TU Berlin, Germany, 22/4/2010.

Seminar on "Rehabilitation robotics" and "Assistive robotics" at the International Convention for Rehabilitation Engineering and Assistive Technology, (i-Create10), Shanghai, China, 24/7/2010.

Talk on "Human Robotics" at Shanghai Jiaotong University, China, 27/7/2010.

Seminar on "Human motor learning and neurorehabilitation", 2nd Annual Symposium on Advances in Neural Rehabilitation Engineering, Aalborg University, Danemark, 23-25/8/2010.

Seminar on "Rules of mechanical virtual reality and games for neurorehabilitation, Engineering faculty, Melbourne University, Australia, 14/10/2010.

Seminar on "Human Robotics" at Universität Tübingen, Germany, 25/10/2010.

Seminar on "Robot-assisted, neuroscience-based rehabilitation of the hand function", Third workshop on Biomedical Engineering, Lisboa University, 15/4/2011.

Seminar on "Impedance learning: in human, for robots" at the invitation of Nanyang Technological University, A*STAR-SIMTech, and the IEEE Robotics and Automation Chapter, Singapore, 7/2/2012.

Seminar on "Human Robotics", Faculty of Engineering, University of Cardiff, UK, 10/5/2012.

Seminar on "Social motor interaction", Workshop on "Social Robotics", University of Electronic Science and Technology of China (UESTC), Chengdu, China, 28/102012.

Invited lecture on "Interaction control in human and robot", School of Computing and Mathematics, University of Plymouth, UK, 12/2/2013.

Invited lecture on "Human robotics" in the College of Automation Science and Engineering at the South China University of Technology in Guangzhou, China, 10/4/2013.

Invited lecture on "Sensorimotor interaction: in humans, for rehabilitation robots", Brochard Colloquium on Computational Neurorehabilitation at Chateau de la Bretesche, France, 30/6-3/7/2013.

Invited lecture, on "Human Robotics" at TU Berlin, Germany, in the context of the Prometei graduate course, 4/7/2013.

ETH-Zürich distinguished robotics lecture on "Interaction control in humans, for robot", Switzerland, 13/12/2013.

Invited lecture on "Motor adaptation and optimisation", COST TD 1006 winter school on computational neurorehabilitation. Obertauern, Austria, 29/1/2014.

Bernstein seminar on "Interaction control with unknown environments and humans", Freiburg Universität, Germany, 25/2/2014.

Invited lectures on "Motor control", European Computational Motor Control Summer School. Mas des Violettes, Montpellier, France, 18/6/2014.

Invited lectures on "Interaction control in humans and strategies to facilitate motor recovery", Int Workshop and Summer School on Medical and Service Robotics (MESROB), EPFL, Switzerland, 10/7/2014.

Invited talk on "Interacting brains: involuntary sensorimotor mechanism of physical interaction between humans" in the Robotics Research Jam Sessions workshop, Centro E Piaggio, Università di Pisa, Italy, July 14, 2014.

Invited talk on "Simple rehabilitation of the hand function" in the Hamlyn Symposium, Imperial College London, UK, July 15, 2014.

Invited presentation on "Adaptive path guidance", Freiburg Universität, Germany, September 23, 2014.

Invited Lecture on "Skill transfer from human to robot" at the Singapore Institute of Manufacturing Technology (SimTech), 25/11/2014.

"Interaction control with unknown environments and with humans", Seminar, Division of Imaging Sciences Biomedical Engineering, Kings College London, UK, 9/12/2014.

Lecture on "Impedance control and learning", 23/2/2015, SAPHARI NMMI Winter School, in Roma, Italy (www.naturalmachinemotioninitiative.com/vsa-winter-school/c1hve).

Invited lecture on "Human Robotics - robotics of human, robotics for humans", U Miguel Hernandez, Elche U, Spain, May 4, 2015.

Invited lecture on "Interaction control", European summer school on computational neurorehabilitation, Mas des Violettes, Montpellier, France, July 1, 2015.

Invited lecture on "Interaction control in humans, for robots", Human machine interaction summer school, Bari, Italy, September 16, 2015.

Invited lecture on "Haptic interfaces for neuroscience investigations", Department of Microengineering, EPFL, Switzerland, March 9, 2016.

Invited presentation on "Sensorimotor interaction between humans", Japan-Europe international meeting on Embodied-Brain: Perspectives from Motor Control and Muscle Synergies, Taormina Sicily, Italy, May 31, 2016.

Invited lecture on "Interaction control: in humans, for robots", School on Advanced Neurorehabilitation, Bayona, Spain, June 7, 2016.

Invited Lecture on "Interaction control: in humans, for robots", Brains, Minds and MachinesWorkshop organised by the Italian Institute of Technology, Max Planck Institut für biologische Kybernetik and MIT's Center for Brains, Minds and Machines in Sestri Levante, Italy, June 22, 2016.

Invited lecture on "interaction control", European summer school on computational neurorehabilitation, Mas des Violettes, Montpellier, France, July 1, 2016.

Institute of Microengineering at Ecole Polytechnique Fédérale de Lausanne (EPFL) Distinguished Lecture on "Human-machine interaction for collaborative robotic systems", Switzerland, July 5, 2016.

Invited seminar on "Human robotics", JSPS EPSRC UK-Japan Workshop on Soft Robotics, Cambridge University, UK, July 15, 2016.

Invited presentation to Shanghai-Jiaotong University on "Neuroscience-based rehabilitation of the hand function", Imperial College London, July 19, 2016.

Invited Lecture on "Neuroscience-based, practical rehabilitation of the hand function", CMC Vellore, India, August 27, 2016.

Invited Lecture on "Sensorimotor interaction in humans", CIN Symposium on New Perspectives in Integrative Neuroscience, Universität Tübingen, Germany, September 30, 2016.

Invited presentation on "Embodiment of tool, limb and human partner", Workshop on the Impact of Technology on Embodiment, International Conference on NeuroRehabilitation, Segovia, Spain, October 18, 2016.

Invited presentation on "Neuroscience-based, practical rehabilitation of the hand function", TokyoTech-Imperial Workshop, Tokyo, Japan, November 4, 2016.

Invited presentation on "Interaction control: in humans, for robots", Institute for Risk and Uncertainty, Liverpool University, UK, February 7 , 2017.

Invited lecture on "Haptic interfaces for neuroscience investigations", Department of Microengineering, EPFL, Switzerland, April 7, 2017.

Invited seminar on 'Interaction control in humans, for robots", Cajal Institute, CSIC, Madrid, Spain, April 28, 2017.

Invited lecture on "A mechanism of haptic communication", Mini-Symposium on 'Neuroscience of human social interaction', Bernstein Center, Freiburg Universität, Germany, June 13, 2017.

Invited lecture on "Haptic communication", PACE Third Thematic Workshop, iit Genova, Italy, October 9, 2017.

Invited lecture on "Haptic communication between humans and with robots", First symposium on "Life and robotics - understanding humanity to inspire robots designed to assist humans, Springer Nature, Heidelberg, Germany, October 23, 2017.

Invited lecture on "Human robotics", Symposium on Robots, Brains and AI, ATR International, Kyoto, Japan, November 11, 2017.

Invited presentation on "Interaction control in humans and with robots", Workshop on Sensorimotor Control in Animals and Robots, Mathematical Bioscience Institute in Columbus, Ohio, USA, November 13, 2017.

Invited presentation on "Interaction control in humans and with robots", Workshop on Sensorimotor Control in Animals and Robots, Mathematical Bioscience Institute in Columbus, Darmstadt, Germany, March 13, 2018.

Invited presentation on "Human robotics for cerebral palsy", at the Assistive Technology Innovations for Communication and Mobility summit in San Francisco, USA, on May 3, 2018.

Invited lecture on "Human Robotics, robotics of humans and for humans", Università Campus BioMedico di Roma, June 14, 2018.

Course on "Human Robotics: neuromechanics and motor control", DGIST, Daegu, Korea, 10-12/7/2018.

Invited lecture on "Human-machine interaction and neurorehabilitation", Shanghai International Symposium on Human-Centered Robotics (HCR 2018), Shanghai, China, July 14, 2018.

Invited lecture on "Application prospect of robotic technology in neuro-rehabilitation", Assistive Technology for Pediatric Rehabilitation Symposium, I-Create, Shanghai, China, July 15, 2018.

Invited Lecture on "Human-machine interaction and neurorehabilitation", International Symposium on Embodied-Brain Systems Science, Tokyo, Japan, December 5, 2018.

Invited Lecture on "Human Robotics, robotics of humans and for humans", Università Campus BioMedico di Roma, Italy, 14/6/2018.

"Human Robotics: neuromechanics and motor control", Summer school on medical robotics, Daegu Gyeongbuk Institute of Science and Technology (DGIST), Korea, 9/7-13/7/2018.

Invited Lecture on "Human-machine interaction and neurorehabilitation", Symposium on Human Centered Robotics, Shanghai, China, 14/7/2018.

Invited Lecture on "Application prospect of robotic technology in neuro-rehabilitation", Assistive Technology for Pediatric Rehabilitation Symposium, I-Create, Shanghai, China, 15/7/2018.

Invited Lecture on "Human robotics", Huazhong University of Science and Technology, Wuhan, China, 25/12/2018.

Lecture on "Interaction control", EU COST Action network CA16116 Winter School on Wearable Robotics, Kranjska Gora, Slovenia, 23/1/2019

Invited Lecture on "Interaction control in humans and with robots", Symposium on Neuroscience and Robotics, Hotel Weisshorn, St-Luc, Switzerland, 2/2/2019.

"Augmented manipulation abilities in humans with 6-fingered hands", invited presentation at Jam Session, Università di Pisa, Italy, 19/6/2019.

Invited Lecture on "Limits of the human hand", Huazhong University of Science and Technology (HUST), Wuhan, China, 18/8/2019.

Invited Lecture on "Neuroscience-based rehabilitation", Barcelona Cognition, Brain and Technology School, Spain, 10/9/2019

Invited presentation on "Interaction between humans and with robots", : LIRMM Montpellier, France, 12/9/2019.

Invited Seminar on "Interaction between humans and with robots", Department of Engineering, Cambridge University, UK, 17/10/2019.

Invited Lecture on "Limits of the human hand", Chinese Academy of Science, Beijing, China, 11/11/2019.

Invited presentation on "Interaction control in humans and with robots", Tsinghua University, Beijing, China, 12/11/2019.

Invited presentation on "Limit of the Human Hand", Workshop on hand dexterity, Sorbonne Université, Paris, France, 28/11/2019.

Invited Lecture on "Haptic communication in humans and with robots", Colloque virtuel: Avancées en robotique collaborative, Sherbrooke, Canada, 8/5/2020.

Invited Lecture on "Interaction control between humans and with robots", Session Interactive GT6 "Conception de dispositifs pour l'intéraction homme-robot", Laboratoire des Sciences du Numérique de Nantes, France, 16/3/2021.

Lecture on "Sensor-based systems in neurorehabilitation" (with Aaron Yurkewich), Neurorehack, https://www.neurorehack.co 7/7/2021.

Tutorial on "Interaction control" (with Li Yanan, Takagi Atsushi, Jonathan Eden), IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 27/9/2021.

Invited Lecture on "Practical, neuroscience based robot-assisted rehabilitation", Webinar Series on Rehabilitation Robotics, University of Bath, UK, 13/5/2022.

Invited talks at workshops

Talk on "Neuroscience and its use for rehabilitation" at KT-Equal SPARC meeting on Robots supporting personal independence and rehabilitation, University of Herdfortshire, 24/11/2009.

Seminar on "Brain control strategies to navigate in familiar environments" at the UK-Japan workshop on Neural Interfaces, Newcastle University, 25-26/2/2010.

Seminar on "Robots can learn to control haptic interactions as humans do" at the Computational Motor Control Workshop at Ben-Gurion University of the Negev, Israel, 16/6/2010.

Talk on "Sensorimotor tricks to facilitate motor recovery" in the Workshop on Neurorehabilitation, IEEE Conf on Biomechatronics and Robotics (BIOROB), Roma, Italy, 24/6/2012.

Talk on "A theory of interactive motor behaviors", in the context of the workshop on "Optimality principles and adaptation in humanoid robotic control" that took place at the IEEE/RSJ Int Conf on Intelligent Robots and Systems (IROS) at Faro, Portugal, 7/10/2012.

Talk on "Human-like learning in industrial robots", in the context of the workshop on "Learning and Interaction in Haptic Robots" that took place on at the IEEE/RSJ Int Conf on Intelligent Robots and Systems at Faro, Portugal, 12/10/2012.

Invited lecture on the "Adaptive nature of human-human motor interaction" in the context of the workshop on Haptic Collaboration in Shared Control Tasks, IEEE Worldhaptics Conference, Daejeon, Korea, 14/4/2013 (with Atsushi Takagi).

Selected presentation on "Role assignment in human-human motor interaction" in the Annual Meeting of the Neural Control of Movements Society, in San Juan, Puerto Rico, 20/4/2013 (with Alejandro Melendez).

Invited presentation on "Kinematic and dynamic learning in humans and robots" in the context of the workshop on Computational Techniques in Natural Motion Analysis and Reconstruction, IEEE International Conference on Robotics and Automation (ICRA), Karlsruhe, Germany, 6/5/2013.

Invited presentation on "Haptic exploration without force or tactile sensing" in the context of the workshop on Research Frontiers in Electronic Skin Technology, IEEE International Conference on Robotics and Automation (ICRA), Karlsruhe, Germany, 6/5/2013.

Invited presentation on "Novel Robotic Solutions for Functional MRI Studies of Preterm Infants" at the IEEE Engineering in Medicine and Biology Society Conf, 4/6/2013 (with Alessandro Allievi).

Invited presentation on "The adaptive nature of human-human motor interaction" in the context of the EUCOST workshop on "The future concept and reality of Social Robotics: Challenges, Perception and Applications - Role of Social Robotics in current and future society". Bruxelles, 11-13/6/2013.

Selected presentation on "Interacting brains: sensory mechanism of physical interactions between humans" at Neural Control of Movement, 25/4/2014 (with G Ganesh and A Tsakagi).

Invited presentation on "Collaborative learning of visual and haptic cues for micro-manipulation" in the workshop on Experiences of Research on Robot Assistance for Industrial Environments, IEEE Int Conf on Robotics and Automation (ICRA), 31/5/2014.

Invited presentation on "BCI-without brain for robot-assisted rehabilitation" in the workshop on Artificial Intelligence in Rehabilitation Robotics, IEEE Int Conf on Robotics and Automation (ICRA), 31/5/2014.

Invited presentation on "Interaction control" in the workshop on "Lower Limb Exoskeletons for Rehabilitation and Assistance", IEEE International Conference on Robotics and Automation (ICRA), 1/6/2014.

Invited talk on Interacting brains: involuntary sensorimotor mechanism of physical interaction between humans in the Robotics Research Jam Sessions workshop, Centro E Piaggio, Università di Pisa, Italy, 14/7/2014.

Invited talk on "Simple rehabilitation of the hand function" in the Hamlyn Symposium, Imperial College London, UK, 15/7/2014.

Invited presentation on "Adaptive path guidance", Freiburg-Imperial Symposium on Computational Neuroscience and Neurotechnology, Freiburg Universität, 23/8/2014.

Invited presentation on "Sensorimotor exchanges between humans", Workshop on human movement understanding and neuromechanics, IEEE Int. Conf on Robotics and Automation (ICRA), May 26, 2015.

Invited presentation on "fMRI compatible robotic interfaces", Workshop on haptics for neuroscience and neuroimaging, IEEE Int. Conf on Robotics and Automation (ICRA), May 26, 2015.

Invited talk on "Motor interaction between humans", Department of Microengineering, EPFL, Switzerland, June 26, 2015.

Presentation on "wrist interfaces, a practical tool to study human neural control", Workshop on neuromechanics and technology for the wrist (beyond the wrist watch). IEEE Int Conf on Rehabilitation Robotics (ICORR), August 11, 2015.

Presentation on "Intention-based turning to control a lower limb exoskeleton" (with I Farkhatdinov), Workshop on Robotic systems for training and assistance of walking. IEEE Int Conf on Rehabilitation Robotics (ICORR), August 11, 2015.

Presentation on "Catching patients attention - Designing and delivering suitable therapy early after stroke" (with P Rinne), Workshop on motivational patient-tailored therapy with rehabilitation robots. IEEE Int Conf on Rehabilitation Robotics (ICORR), August 11, 2015.

Invited talk on "Robot-aided investigation of early brain function". Special session on New technological platforms to study children development, IEEE Engineering in Medicine and Biology Society Conf (EMBC), August 27, 2015.

Presentation on "Human robotics", Imperial College London Robotics Showcase, September 25, 2015.

Invited presentation on "Intention reading and intuitive shared control for assistive devices", Workshop on Cognitive Mobility Assistance Robots, IEEE Int Conf on Intelligent Robots and Systems (IROS), September 28, 2015.

Invited presentation on "Embodiment of limb, tool, and human partner", Workshop on the impact of technology on embodiment, Int Conf on Neurorehabilitation (ICNR), October 28, 2016.

Invited presentation on "Neuroscience-based, practical rehabilitation of the hand function", Workshop on advances and challenges on the development, testing and assessment of assistive robots: experiences from engineering and human science research, IEEE Int. Conf on Robotics and Automation (ICRA), May 29, 2017.

Invited presentation on "Human balance augmentation with lower limb exoskeleton robot" (with I Farkhatdinov), Workshop on mechanics of human locomotion and the development of wearable robotic systems, IEEE Int Conf on Robotics and Automation (ICRA), May 29, 2017.

Invited presentation on "Human and Biological Robotics at Imperial College London", GlobalTech Robotics Workshop Singapore, June 3, 2017.

Invited presentation on "Haptic Communication", COST Action on Rehabilitation Robotics meeting, Darmstadt, Germany, March 5, 2018.

Invited lecture on "H-CARD course on human centered design of assistive and rehabilitation devices", Workshop on Assistive Robotics, Queen Mary University of London, UK, March 28, 2018.

Invited talk on "Upper Limb Rehabilitation: from bedside to home" at the Innovations in Neurorehabilitation Technology, Imperial College MedTech Links, April 23rd, 2018.

Invited talk on "Motor Control of 6-fingered Hand", Workshop on Artificial Supernumerary Limbs for Clinical Neuroscience. Int Conf on Neurorehabilitation, Pisa, Italy, October 16, 2018.

Invited talk on "Motor control of 6-fingered Hand", Workshop on Artificial Supernumerary Limbs for Clinical Neuroscience, International Conference on Neurorehabilitation, Pisa, Italy, 16/10/2018.

Invited talk on "Clinical human-machine interaction", Royal College of General Practitioners Conference, Glasgow, UK, 4/10/2018.

Invited presentation on "Human-machine interaction and haptic communication", Workshop on Music, Computing, and Health, Lorentz Center, Leyden University, Netherlands, 5/3/2019.

Invited presentation on "Motor control of 6-fingered Hand", Workshop on Artificial Supernumerary Limbs for Clinical Neuroscience, Int Conf on Neurorehabilitation, Pisa, Italy, 16/10/2018.

Invited talk on "Haptic communication in humans and with robots", Workshop on AI and Its Alternatives in Assistive and Collaborative Robotics, Robotics Science and Systems, Freiburg, Germany, 23/6/2019.

Invited talk on "Game theory of robotic assistance", Workshop on "Autonomy and Intelligence in Robotic Rehabilitation and Assistive Technologies", IEEE Int Conf on Rehabilitation Robotics, Toronto, Canada, 24/6/2019.

Invited talk on "For the many not the few: from complex robots to simple rehabilitation devices", Workshop on "Simple or Complex Rehabilitation Robots? Choosing Appropriate Tools for Neurorehabilitation", IEEE Int Conf on Rehabilitation Robotics, Toronto, Canada, 24/6/2019.

Invited talk on "Influence of visual coupling on bimanual coordination in unilateral spastic cerebral palsy", IEEE Int Conf on Rehabilitation Robotics, Toronto, Canada, 27/6/2019.

Invited talk on "Haptic communication in collectives", Joint Action Meeting VIII, Genova, Italy, 13/7/2019.

Invited talk on "Proprioceptive haptics", Workshop on "New Advances in Tactile Sensation, Perception, and Learning in Robotics: Emerging Materials and Technologies for Manipulation (RoboTac 2019), IEEE/RSJ Int Conf on Robots and Intelligent Systems (IROS), Macao, 4/11/2019.

Keynote on "Adaptive impedance control for haptic exploration and manipulation in humans and robots", Workshop on Learning of Manual Skills in Humans and Robots, IEEE Int Conf on Robotics and Automation (ICRA), Paris, 31/5/2020.

Invited presentation on "Interaction control in humans and robots", Workshop on "Learning impedance modulation for physical interaction: Insights from humans and advances in robotics", IEEE/RSJ Int Conf on Robots and Intelligent Systems (IROS), Las Vegas, 29/11/2020.

Invited presentation on "Interaction control between humans and with robot", Workshop on "Neuromechanics: using robots to study sensorimotor function and impairment" at IEEE Int. Conf. on Biomedical Robotics and Biomechatronics (BioRob), New-York, 29/11/2020.

Invited presentation on "Regulation of muscle cocontraction to improve visuo-haptic perception", Symposium on "Body-machine interface for empowering humans: from rehabilitation to robot control", IEEE EMBS Int Conf on Neural Engineering, 4/5/2021.

Invited presentation on "Trimanipulation with body interfaces" (with J Eden), Symposium on "Movement augmentation with supernumerary limbs", IEEE EMBS Int Conf on Neural Engineering, 6/5/2021.

Invited talk on "Body adaptation to improve haptic sensitivity", Embodied Intelligence Conference, Cambridge University, 24/3/2022.

Alumni of HRG

PhD students

name	viva	current position
Alessandro ALLIEVI	2014	Group Leader at Bosch, USA
Carlo BAGNATO	2017	Group Leader, Franka Emika, Germany
Gerolamo CARBONI	2021	Group Leader, Johnson & Johnson, Netherlands
Dominique CHAPUIS	2009	Project Engineer, RUAG Space, Switzerland
Sofia DALL'ORSO	2019	Postdoctoral Research Associate, Chalmers University of Technology, Sweden
Ludovic DOVAT	2009	Group Leader, Helbling Technik, Switzerland
GANESH Gowrishankar	2009	Senior Researcher, CNRS, France
HUANG Hsien-Yung	2019	Postdoctoral Research Associate, Imperial College London
HUANG Yanpei	2021	Postdoctoral Research Associate, Imperial College London
Asif HUSSAIN	2013	CEO, ArtiCares, Singapore
Abdelhamid KADI-ALLAH	2009	Senior Analyst, Wellcome Trust, UK
Jindrich KODL	2010	Postdoctoral Researcher, Tübingen Universität, Germany
Olivier LAMBERCY	2009	Lecturer, ETH-Zürich, Switzerland
Alejandro MELENDEZ	2011	Senior Lecturer, Queensland University, Australia
Sharah Abdul MUTALIB	2019	Engineer at gripAble
Matjaz OGRINC	2017	Research Scientist, gripAble, UK
Brice REBSAMEN	2009	Senior software Engineer, Zoox, USA
SU Eileen	2010	Associate Professor, University Teknologi Malaysia
TAKAGI Atsushi	2015	Senior Scientist, NTT, Japan
Rejin Varghese	2021	Postdoctoral Research Associate, Imperial College London
YEONG Che Fai	2010	Associate Professor, University Teknologi Malaysia
ZENG Qiang	2009	R&D Manager, Kunlun Energy Company Ltd, Petrochina, China
ZHANG Han	2005	Lead Engineer, Princeton Plasma Physics Laboratory, USA
ZHAO Guoyong	2010	R&D Engineer, Seagate, Singapore

Postdoctoral researchers

name	period	current position
Sajeeva ABEYWARDENA	2020-2021	Postdoctoral Research Associate, Queens Mary University, UK
Arash ARAMI	2016-17	Assistant Professor, University of Waterloo, Canada
Sivakumar BALASUBRAMANIAM	2009-11	Associate Professor, CMC Vellore, India
Themistoklis CHARALAMBOUS	2009-10	Assistant Professor, Aalto U, Norway
Ildar FARKHATDINOV	2013-16	Assistant Professor, Queens Mary University, UK
Roger GASSERT	2006-07	Professor, ETHZ, Switzerland
Frank GONSALEZ	2013-2015	Research Engineering, IRT Jules Vernes, France
Sarah GUY		Hobbs Rehabilitation, UK
Nathanael JARRASSÉ	2011-13	Senior Researcher, CNRS, ISIR Paris, France
Julius KLEIN	2010-12	Senior Mechanical Engineer & Manager, Motivo, USA
LI Yanan	2015-17	Lecturer, University of Sussex, UK
Michael MACE	2015-17	CTO, gripAble, London, UK
Moritz MAUS		Software-Entwickler at Brunel, Germany
Andrew PENNYCOTT	2013-15	Development Engineer, Institute for Advanced Automotive Propulsion Systems, UK
Paul RINNE	2015-17	CEO, gripAble, London, UK
Nicholas ROACH	2010-12	
Riccardo SECOLI	2012	Postdoctoral Research Associate, Imperial College London, UK
Elisabeth WILHELM	2015-16	Postdoctoral Research Associate, ETH-Zürich, Swizerland
YANG Chenguang	2009-10	Professor, University of the South of England, UK
ZHOU, Chou-Han		Monash University, Australia

Visiting researchers

name	period	institution
Prof. Paulo Marcos AGUIAR	2014-15	Instituto Federal de Sao Paulo, Brasil
Prof. Jose AZORIN	2010	Universidad Miguel Hernandez de Elche, Spain
Hendrik BÖRNER	2019	Technische Universität München, Germany
Dr. Daniele Borzelli	2021-22	Catania University, Italy
Mrs. Chagit BRAIMAN	2014-15	Cornell University, USA
Prof. Domenico CAMPOLO	2010	Nanyang Technological University, Singapore
Prof. Enrique CHONG	2011-12	Monterrey Institute of Technology, Mexico
Prof. Andrea D'AVELLA	2013	Fondazione Santa Lucia, Italy
Dr. Elif CINSOY	2015-16	Sabanc U, Turkey
Prof. Domenico FORMICA	2018	Università Campus Biomedico di Roma, Italy
Dr. Consuelo GRANATA	2013-15	Sorbonne Université, France
Prof. HAYASHIBE Mitsuhiro	2022-23	Tohoku University, Japan
Dr. HOSHINA Masayuki	2014-15	Japanese patent office
Mrs. Ekaterina IVANOVA	2017-19	TU Berlin, Germany
Dr. Nathanael JARRASSÉ	2014	CNRS and Sorbonne Université, France
Prof. KIM Jongkyun	2019	Daegu Gyeongbuk Institute of Science and Technology (DGIST), Korea
Mrs. Tjaša KUNAVAR	2020	Joseph Stefan Institute, Slovenia
Dr. LEE Meng-Jung	2021-22	Freiburg Universität, Germany
Dr. LEE Seunghee	2019	Daegu Gyeongbuk Institute of Science and Technology (DGIST), Korea
Prof. LI Jing	2012	University of Plymouth, UK
Daniela LO PRESTI	2020	Università Campus Biomedico di Roma, Italy
LUO Jing	2019-20	South China University of Technology
Prof. NAMBU Isao	2011	Nagaoka University of Technology, Japan
Prof. Leonardo PEDRO	2014-15	Universidade Federal de Sao Carlos, Brasil
Dr. Eduardo ROCON	2010	CSIC Madrid, Spain
Mrs. Alejandra MEJIA TOBAR	2016	Tokyo Institute of Technology, Japan
Mrs. Cecilia DI VICARIIS	2022	Università di Genova, Italy

Masters (research)

name	period	institution
Carlo BAGNATO	2012	Università di Genova, Italy
Sven BECK	2014-15	ETH-Zürich, Switzerland
Niek BECKERS	2015	Twente University, Netherlands
Alfredo BELFIORI	2013-14	Politecnico di Milano, Italy
Camille BLONDIN	2019-21	Imperial College London, UK
Eugénie BOISSEAU	2018	Art et Métiers Paris Tech
BOY Eng Seng	2003	National University of Singapore
Francesca CALVARIO	2014	Università Biomedico di Roma, Italy
Gilles CAMARASA	2013	Université de Montpellier, France
Gerolamo CARBONI	2016	Università Campus BioMedico di Roma, Italy
David CHRISTE	2016	EPF-Lausanne
Jorge CIFUENTES ZAPIEN	2011	Tec Monterey, Mexico
Elisa CUCCO	2012	Universitá di Palermo, Italy
Ankur DHANIK	2005	National University of Singapore
Julia EBERT	2016	Imperial College London
Pascal ERNE	2014	ETH-Zürich, Switzerland
Mohammad ESMAEILI MALEKABAD	2012	Nanyang Technical University, Singapore
Arnaud GARNIER	2014	EPF-Lausanne, Switzerland
GANESH Gowrishankar	2004	National University of Singapore

Paul GRACIA	2014	Université de Strasbourg, France
Thomas GROSBERG	2016	Arts et Métiers ParisTech, France
Using HUTTER	2010	ETH-Zürich, Switzerland
Maxime Olivier JEANNERET GROSJEAN	2014-15	EPF-Lausanne, Switzerland
Hamed KAZEMI	2006-08	National University of Singapore
Nawal KINANY	2015	EPF-Lausanne, Switzerland
Victoria KOMISAR	2010-11	Imperial College London
Markus KÜHNE	2012	Sorbonne Université and TU-München
Jean-Luc LIARDON	2014	EPF-Lausanne, Switzerland
Luc LÖRTHSCHER	2013	ETH-Zürich, Switzerland
LONG Bo	2005	National University of Singapore
Pascale MEIER	2014	ETH-Zürich, Switzerland
Milena MERCADANDE	2018	Università Campus Biomedico di Roma
Martina MIRO	2014-15	Università di Genova, Italy
Achik NAZIR	2010	Sorbonne Université, France
Alessia NOCCARO	2019	Universitá Campus Biomedico di Roma
Daniel POLO	2012	Valladolid University, Spain
Brice PEDRONO	2010	Université de Montpellier, France
Francesco PETRINI	2010	Università di Roma Tor Vergata, Italy
Fabrice PHILIPPE	2015	EPF-Lausanne, Switzerland
Roxana RAMIREZ HERRERA	2011	Tec Monterey, Mexico
James RAPHEL		National University of Singapore
Pierre-Jean RAMON	2018	École Centrale de Marseille
Lucas RANDAZZO	2014	ENS Cachan, France
Andre RIBEIRO	2010	Porto University, Portugal
Francesco RIILO	2014	Università di Roma Tor Vergata, Italy
Riccardo RINALDI	2015	Università di Torino, Italy
Luca ROSALIA	2016	University of Glasgow
Basil SAFWAT	2005	Imperial College London
Audrey SCHENKER	2015	EPF-Lausanne, Switzerland
Robert STEINGRÄBER	2010	Technische Universität Berlin, Germany
Eugene TAN	2010	Nanyang Technical University, Singapore
TEE Keng Peng	2003	National University of Singapore
TONG Liuzhu	2012	National University of Singapore
Francesco USAI	2012-13	Università di Genova, Italy
Alexander VON MACH	2013	EPF-Lausanne, Switzerland
VU Thinh	2010	Nanyang Technical University, Singapore
WANG Fei	2004	National University of Singapore
ZHOU Shou-Han	2011-12	Melbourne University, Australia
Eline ZWIJGERS	2018	Twente University

Funding

Until 2008, I attracted over €2M of funding for my research from the Japanese company ATR, from the Singapore Ministry of Education and A*STAR, the Swiss National Foundations, and the UK Stroke Association. Grants as PI from 2009 with value over €100k are listed in the following table, with active grants in **bold**.

agency	project name	amount (total project)	period
EU-FP7 ICT-231724	HUMOUR: HUman behavioral Modeling forenhancing learning by Optimizing hUman-Robot interaction	504,395 € (2,562,000)	1/2009 - 12/2011
EU-FP7 ICT-231554	VIACTORS: Variable Impedance ACTuation systems embOdying advanced inteRaction behaviourS	461,426 € (3,350,000)	2/2009 - 1/2012
Singapore A*STAR	Assessment and training system for micromanipulation tasks in surgery	435,258 €	12/2008 - 12/2011
Singapore A*STAR	Digital stereo microscope technology	128,392 €	4/2009 - 3/2011
UK NIHR	Robot-assisted fMRI assessment of motor function in preterm and newborn infants	269,924£	1/2011 - 12/2012
EU-FP7 ITN-317488	CONTEST: Collaborative Network for Training in Electronic Skin Technology	320,273 € (3,810,437)	10/2013 - 9/2016
EU-FP7 ICT-601003	BALANCE: Balance Augmentation in Locomotion through Anticipative, Natural & Cooperative control of Exoskeletons	617,837 € (4,533,202)	1/2013 - 12/2017
EU-FP7 ICT-661626	SYMBITRON: SYMBiotic man-machine InTeRactiONs in wearable exoskeletons to enhance mobility for paraplegics	530,864 € (3,358,961)	10/2013 - 3/2018
EU-H2020 ICT-644727	COGIMON: COGnitive Interaction in MotiON	831,813 € (5,688,126)	1/2015 - 12/2018
UK EPSRC EP/N029003/1	MOTION: Morphological cOmputation of percepTion and actION	360,000£ (1,200,000)	7/2016 - 6/2019
Innovate UK	GripAble: A mobile-based therapy tool for hand and brain recovery	188,644£ (448,607)	10/2017 - 3/2019
EU-H2020 MSCA 843408	TRIMANUAL coordination assistance for hemiplegic strokes individuals	212,933.76 €	7/2019 - 6/2021
EU-H2020 MSCA 846679	INFANTPATTERNS: Development of kinematic and muscle PATTERNs in preterm INFANTs	212,933.76 €	10/2019 - 4/2022
UK EPSRC EP/R026092/1	FAIR SPACE: Future Artificial Intelligence and Robotics for SPACE	1,222,815£ (8,665,638)	11/2017 - 3/2022
EU-H2020 FET 829186	**PH-CODING: Predictive Haptic CODING**	**687,243.75 €** (2,988,285)	1/2019 - 9/2022
EU-H2020 ITN 861166	**INTUITIVE: Innovative Network for Training in toUch InteracTIVE interfaces**	**303,172.56 €** (4,150,872)	8/2019 - 7/2023
EU-H2020 FET 899626	**NIMA: Non-invasive Interface for Movement Augmentation**	**796,203.75 €** (3,076,488.75)	10/2020 - 9/2023
EU-H2020 ICT 871803	**CONBOTS: CONnected through roBOTS: physically coupling humans to boost handwriting & music learning**	**798,750.00 €** (4,810,796.25)	1/2020 - 12/2023
EU-H2020 ICT 871767	**REHYB: REhabilitation based on HYBrid neuroprosthesis**	**679,325.00 €** (7,153,873.75)	1/2020 - 12/2023
UK EPSRC EP/W036495/1	**MUVE: MUlti-limb Virtual Environment for full body and augmented interactions**	**1,025,345.20£**	8/2022 - 7/2024

Publications

Manuscripts of special interest are with a short comment (in **bold**) explaining the contribution.

Books

1. E Burdet (1996), Algorithms of Human Motor Control and their Implementation in Robotics, PhD Thesis, ETH-Zurich.
2. E Burdet, DW Franklin and TE Milner (2013), Human Robotics: neuromechanics and motor control. MIT Press. [**Synthesis of biomechanics and neural control based on comprehensive experimental results and computational modelling. This book has been translated into Japanese (Maruzen) and Chinese (Tsinghua University Press)**]

Journal papers

3. E Burdet (1995), A neural network model of the adaptive controller of the human arm. Archives of Physiology and Biochemistry 103(3).
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5. E Burdet and TE Milner (1998), Quantization of human motions and learning of accurate movements, Biological Cybernetics 78(4): 307-18. [**A stochastic optimal control formulation based on a discrete motion generation**]
6. E Burdet, A Codourey and L Rey (1998), Experimental evaluation of nonlinear adaptive controllers. IEEE Control Systems Magazine 18(2): 39-47 (invited). [**First experimental comparison of iterative and adaptive control**]
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8. J Luthiger and E Burdet (1999), A modular and sensor-oriented motion planner. Robotica 17: 87-95.
9. E Burdet and M Nuttin (1999), Learning complex task using a stepwise learning approach. Journal of Intelligent and Robotic Systems 24: 43-68.
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11. E Burdet, R Osu, DW Franklin, T Yoshioka, TE Milner and M Kawato (2000), A method for measuring hand stiffness during multi-joint arm movements. Journal of Biomechanics 33: 1705-09. [**This algorithm to estimate stiffness during movement has been in use for over 10 years**]
12. E Burdet, R Osu, DW Franklin, TE Milner, M Kawato (2001), The CNS skillfully stabilizes unstable dynamics by learning optimal impedance. Nature 414: 446-9. [**First direct evidence of impedance control (independent of force) in multi-joint arm reaching movements**]
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15. DW Franklin, E Burdet, R Osu, M Kawato and TE Milner (2003), Functional significance of stiffness in adaptation of multijoint arm movements to stable and unstable dynamics. Experimental Brain Research 151: 145-57. [**Comparison of force and impedance adaptation in stable vs. unstable interactions**]
16. R Osu, E Burdet, DW Franklin, TE Milner, M Kawato (2003), Different mechanisms in adaptation to stable and unstable dynamics. Journal of Neurophysiology 90(5): 3255-69. [**First study to describe motor adaptation both in stable and unstable novel dynamics**]
17. DW Franklin, R Osu, E Burdet, M Kawato and TE Milner (2003), Adaptation to stable and unstable dynamics achieved by combined impedance control and inverse dynamics model. Journal of Neurophysiology 90(5): 3270-82.
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19. KP Tee, E Burdet, CM Chew and TE Milner (2004), A model of endpoint force and impedance in human arm

movements, Biological Cybernetics 90: 368-75.

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21. E Burdet, KP Tee, I Mareels, TE Milner, CM Chew, DW Franklin, R Osu and M Kawato (2006), Stability and learning in human arm movements. Biological Cybernetics 94: 20-32.

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