Curriculum vitae

January 19, 2018

General information

BERRET Bastien

Date of birth: July 31, 1981

Family situation: marital relationship (2 children)

Professional situation: Maître de Conférences (~ tenured assistant professor), UFR STAPS, Univ. Paris-Sud, Université Paris-Saclay, "Complexité, Innovation, Actvités Motrices et Sportives" (CIAMS) laboratory, EA4532

Nationality: French

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Scientific education

From May 2009 to Aug. 2012 Postdoctoral researcher at the Italian Institute of Technology (IIT, Genoa, Italy), Robotics, Brain and Cognitive Sciences (RBCS) department, dir. Prof. G. Sandini, collaborations with Dr. F. Nori and Dr. S. Panzeri.

From Dec. 2005 to Dec. 2008 PhD in computational neurosciences and mathematics, supported by the CNES (Centre National d'Etudes Spatiales) and the Regional Council of Bourgogne, at INSERM U887 laboratory (Univ. Bourgogne, Dijon, France), entitled: "The integration of gravity during the planning and control of human arm or whole-body movements". Advisors: Pr. T. Pozzo (Neurophysiologist) and Pr. J-P. Gauthier (Mathematician). **Jury** (defense on Dec. 15th 2008, in french/english):

Mme Tamar Flash	Professeur, Weizmann Institute of Science, Israël	Rapporteur
M. Philippe Souères	Directeur CNRS, LAAS-CNRS, Toulouse	Rapporteur
M. Rémi Langevin	Professeur, Université de Bourgogne	Examinateur
M. Charalambos Papaxanthis	Professeur, Université de Bourgogne	Examinateur
M. Thierry Pozzo	Professeur, Université de Bourgogne	Directeur de thèse
M. Jean-Paul Gauthier	Professeur, Université de Toulon	Directeur de thèse

From 2004 to 2005 Master in Computer Sciences, Image processing and Medical Imaging, at Univ. Bourgogne.

From 2003 to 2004 Preparation and admissibility to the "agrégation de mathématique" ('admissibilité'), national competitive examination in mathematics, at Univ. Bourgogne.

From 2001 to 2003 BSc & MSc in Mathematics, at Univ. Bourgogne.

From 1999 to 2001 Post-secondary preparatory school / classes preparing for entrance examinations to the French "Grandes Ecoles" (CPGE) – Dijon. Speciality: Maths, Physics and Informatics. Admissibility to competitive exams.

Career

Curriculum

Nov. 2017 Habilitation à Diriger des Recherches (HDR), Intitulé : "Optimalité et Modularité du Mouvement Humain : du contrôle optimal aux synergies musculaires". Jury : Benoît Bardy, Michel Desmurget, Etienne Burdet, Thierry Pozzo, Frédéric Jean & Michel-Ange Amorim

From 2017 to 2022 Institut Universitaire de France (IUF), junior member

From 2015 to 2019 "Prime d'encadrement doctoral et de recherche" (PEDR) (national doctoral supervision and research award) from CNU 74 (top 20% of applicants).

Since Sept. 2012 Assistant Professor (« Maître de Conférences ») in CIAMS laboratory, UFR STAPS, Univ. Paris-Sud, Université Paris-Saclay, Orsay, France.

2009 Qualification in CNU 74 (STAPS), 69 (Neurosciences) and 26 (Applied Maths)

Highlights

- Journal cover for a Journal of Neuroscience article in 2009 (`http://hebergement.u-psud.fr/berret/papers/coverJN2009.png`)
- Press release for a PLoS Comp Biol article in 2008 (`http://www.eurekalert.org/pub_releases/2008-10/plos-thb102108.php`)

Metrics (as of September 2017) h-index (according to Google Scholar): 16

Number of citations (according to Google Scholar): 651

Supervision work

Master student (1st year) – duration of internship ~7 weeks I supervise 1st year Master students on a regular basis to initiate them to research. For illustrative purposes, since I am in Univ. Paris-Sud, I supervised two students in 2013-2014 (in co-supervision with Dr. C. Teulier (Univ. Paris-Sud) and Dr. D. Pradon (Garches-UVSQ), on muscle synergies and three students in 2015-2016 (in co-supervision with Dr. E. Yiou, P. Fourcade (n=1) and T. Deroche and C. Castanier (n=2), on the integration of gravity in the postural control during vertical arm raising and the investigation about the cost of time (cf. research project), respectively. In 2016-2017, I co-supervised 3 students on to continue those projects.

Master student (2nd year) – duration of internship ~4-6 months

I Yung	
Date:	from Jan. 2012 to Sept. 2012
Location:	Italian Institute of Technology (Genoa) and University of Genoa
Title:	« Comparison of Open-Loop Stochastic Optimal Control Algorithms of Variable Impedance Manipulator for Unstable Tasks »
Role:	Main supervisor (100%)
Last known position:	PhD student at Umea University (Sweden)
Related Publications:	1 publication from the supervision (IEEE proceedings - IROS)

Anthony Supiot	
Date:	from Jan. 2015 to June 2015
Location:	Univ Paris-Sud & Hôpital Raymond Poincaré (Garches)
Title:	« Effect of speed on muscle synergies during walking in healthy subjects »
Role:	Co-Supervisor 50% (with Dr. Didier Pradon)
Last known position:	PhD student at UVSQ (I now co-supervise his work still on muscle synergies during walking in post-stroke or spinal cord injury patients)

Florian Vidal	
Date:	from Jan. 2016 to June 2016
Location:	LIMSI CNRS
Title:	« Perception of French sign language: comparison between avatars and real signers »
Role:	Co-Supervisor 33% (with Dr. Annelies Braffort & Dr. Elise Prigent)

Elodie Hinnekens	
Date:	from Jan. 2016 to Sept. 2016
Location:	Univ Paris-Sud, CIAMS
Title:	« Effect of cognitive constraints and dual tasks on muscle synergies during healthy walking »
Role:	Co-Supervisor 50% (with Dr. Caroline Teulier)
Last known position:	PhD student with Dr. Caroline Teulier at CIAMS laboratory (I now co-supervise her work)

Simon Bastide	
Date:	from Feb. 2017 to June 2017
Location:	Univ Paris-Sud, CIAMS and CEA-LIST
Title:	« Impact of wearing an exoskeleton on upper-limb human motricity »
Role:	Co-Supervisor 50% (with Dr. Nicolas Vignais and Dr. Franck Geffard)
Last known position:	PhD student with me (50%), Nicolas Vignais (30%) and Franck Geffard (20%)
Related publication	1 paper in Computer Methods in Biomechanics and Biomedical Engineering

Malala Vonjiniaina	
Date:	from Feb. 2017 to June 2017
Location:	Univ Paris-Sud, LIMSI
Title:	« Perception of French Sign Language: influence of the level of degradation of the virtual signer and of the level of the FSL observer »
Role:	Co-Supervisor 33% (with Dr. Annelies Braffort & Dr. Elise Prigent)

PhD Student supervision

Ioannis Delis	
Date:	Jan. 2010 – Apr. 2013 (completed)
Location:	Italian Institute of Technology (Genoa, Italy)
Title:	« Novel single-trial computational approaches to the identification of modular muscle activation patterns and their evaluation in task space »
Role:	Co-supervisor (33% with Prof. Stefano Panzeri and Prof. Thierry Pozzo) - unofficial
Last known position:	post-doctoral fellow at Columbia University, New York
Related Publications:	6 publications from PhD work (J. Neuroscience, J. Neurophysiology, Front. Comp. Neurosc. x3 in a Research Topic, x1 Front. Human Neurosc.)

Pauline Hilt	
Date:	from Sept. 2012 to Dec. 2015 (completed)
Location:	Université de Bourgogne, Laboratoire INSERM U1093 Cognition, Action et Plasticité Sensorimotrice
Title:	« Motor decision and modular control of a hyper-redundant system »
Role:	Co-director (50% with Prof. Thierry Pozzo, Université de Bourgogne) - official
Last known position:	post-doctoral fellow at Italian Institute of Technology, Ferrara
Related Publications:	1 publication from PhD work (Scientific Reports) – 1 article submitted

Vu Van Hoan	
Date:	from Sept. 2012 to Dec. 2016 (completed)
Location:	Univ. Paris-Sud, CIAMS, Orsay
Title:	« Identification and simulation of motor command in 3D multijoint and unconstrained movements »
Role:	Co-director - 50% with Prof. Brice Isableu (Univ. Aix-Marseille) - official
Last known position:	post-doctoral fellow at the Institut des Sciences du Mouvement, Marseille
Related Publications:	2 publications from PhD work (in Neuroscience and Scientific Reports)

Mohamed Benchiheub	
Date:	from Sept. 2013 to Nov. 2017 (completed)
Location:	LIMSI-CNRS
Title:	« Analysis and modeling of movements in French Sign Language »
Role:	Co-director - 50% with Dr. Annelies Braffort (LIMSI-CNRS, DR1 CNRS) - official
Last known position:	ATER, Department of Informatics, Univ. Paris-Sud
Related Publications:	2 publications in peer-reviewed conference proceedings (ACM), 1 article in preparation

Simon Bastide	
Date:	started in Oct. 2017
Location:	Univ. Paris-Sud, CIAMS, CEA-LIST
Title:	« Adaptation of Humans to the interaction with an upper-limb exoskeleton: analysis and modeling of control laws »
Role:	Co-director - 50% with Dr. Nicolas Vignais (30%) and Franck Geffard (20%) - official

Finally, I am involved as a collaborator/co-supervisor in two PhD theses of previous Master students (see above, E. Hinnekens and A. Supiot).

Teaching, pedagogic and administrative duties

Since I am "Maître de Conférences" at Univ. Paris-Sud, I have been involved in the following teaching activities:

Topic	Degree	Nature	Annual hours (~TD)
"Pré-requis Scientifiques"	L1	TD	20h
"Planification & contrôle du geste et de la posture"	L3 APA&S	CM	4h
		TD	4h
"Biomécanique"	L1	CM	13.5h
		TD	13.5h
"Statistiques"	L3 Management	TD	15h
"Analyse de données et statistiques « niveau 2 » Matlab"	M2 PCMPS	TD	10h
"Traitement du Signal - Matlab"	M2 ISMH	TD	30h
"Maths pour le mouvement humain"	M1 ISMH	CM	30h
		TD	30h
"Théories du Contrôle Moteur"	M1 PCMPS/ISMH	CM	7.5h
		TD	5h

Legend: CM = lecture, TD = tutorial classes, PCMPS="Psychologie, Contrôle Moteur et Performance Sportive", ISMH="Ingénierie et Sciences du Mouvement Humain"

Total service per year

2012-2013 : 150h ~TD ("décharge néo-MCF" from Univ. Paris-Sud)

2013-2014 : 150h ~TD ("décharge néo-MCF" from Univ. Paris-Sud)

2014-2015 : 192h ~TD

2015-2016: 192h ~TD

2016-2017: 202.25h ~TD

N.B. : within UFR STAPS at Univ. Paris-Sud, pedagogic duties can be equivalent to a fixed amount of practical tutorials hours (~TD hours) (e.g. 20h/year are counted for the Master program responsibility)

Pedagogic duties

- In charge of an e-learning project – AAP CEVU 2014 – budget 27 k€ (2014-2015)

  Creation of online courses for the teaching of movement biomechanics for undergraduate students (L1 STAPS). It consisted in creating 11 webcasts (~10 minutes each), interactive animations in 3D powered by Unity (e.g. basketball game to let student better apprehend a ball's trajectory in the gravity field), multiple-choice questionnaires to check the student's understanding after watching the webcast etc.

  Online lessons were followed by ~500 students

  Tutorial classes were also created to resolve sport biomechanics exercises in small groups (~30 students / group, TD)

- In charge of Master program (M1 « Psychologie, Contrôle Moteur et Performance Sportive » (PCMPS) - mention STAPS) for 2 full years (2015-2017)

  With the newly created Université Paris-Saclay, new Masters were developed and ported by several Universities and Engineer Schools to reinforce collaborations and reduce costs.

  The Master Program PCMPS is part of the "Sport and Human Movement Science School" (`http://www.universite-paris-saclay.fr/en/education/school/sports-sciences-and-human-movement`).

  It opened in September 2015 but the work started in 2014 by anticipation.

  My role was to recruit the teachers, select the students/candidates, organize the exams, create the schedule, supervise internships, organize oral examinations, maintain the website of the formation (`http://`

universite-paris-saclay.fr/en/education/master/human-movement-sport-sciences), invite professional speakers and interaction with companies and sport federations, and manage any other issue related to the Master program.

- In charge of the teaching of Biomechanics for the Bachelor (« Licence Staps », L1, L2 to L3 levels at Univ. Paris-Sud).

  Biomechanics is taught at several levels in the department and by several teachers for undergraduates. My role is to supervise and coordinate the teaching of biomechanics at UFR STAPS at Univ. Paris-Sud (~700 undergraduates involved and more than 10 teachers + teachers who are external to the institution/university and must be recruited specifically to teach those lessons).

Administrative duties

- Creation and maintenance of a specific website to handle exams for the whole UFR STAPS (~90 teachers concerned and all the formations, Bachelors & Masters). The website allows teachers to select exams to supervise in real time and automatically, and it counts their hours up. The aim was to simplify the life of secretaries and teachers of UFR STAPS. Programmed in Python.

Scientific activity

Invited talks (lab seminars and workshops)

- « The Cost of Time in Motor Control and its relation to the idiosyncrasy of movement vigor and individual traits », Third PACE Thematic Workshop "Robotics", Italian Institute of Technology, Genoa (Italy), October, 2017
- « Why don't we move slower: the cost of time in the neural control of movement », LSIS Semirar, Université Toulon-Var, Toulon (France), May, 2016
- « Why don't we move slower: the cost of time in the neural control of movement », iCODE final congress, Gif-sur-Yvette (France), May, 2016
- « Direct and inverse optimal control for arm movement planning in humans », M2H Euromov Semirar, Montpellier (France), February, 2014
- « Why do humans move the way they do? Direct and inverse optimal control approaches », Journées de l'Université de Toulon, Toulon (France), April, 2013
- « Why do we move the way we do? An inverse optimal control approach », Séminaire d'Automatique du Plateau de Saclay, Laboratoire L2S-Supélec, Gif-Sur-Yvette (France), January, 2012
- « Integration of gravity during the motor planning of human movements», LAAS-CNRS, Toulouse (France), Feb., 2009
- « Integration of gravity during the motor planning of human movements », LSIS, Toulon (France), March, 2009
- « Integration of gravity during the motor planning of human movements », Italian Institute of Technology, Genoa (Italy), September, 2008

Co-organization of a workshop

Conference: IROS 2012

Title: « Optimality principles and adaptation in humanoid robotic control »

Location: Vila Moura, Portugal

Date: October, 7th, 2012

Co-organizers: S. Ivaldi (ISIR-UPMC), B. Berret (IIT/Univ. Paris-Sud), O. Sigaud (ISIR-UPMC), F. Nori (IIT)

Main speakers: Stephen Scott (Queen's university, Canada), Etienne Burdet (Imperial College, UK), David Franklin (Cambridge, UK), Jean-Paul Laumond (LAAS-CNRS, FR)

Scientific collaborations (currently active)

National

- Univ. Bourgogne (Prof. Thierry Pozzo, Prof. Charalambos Papaxanthis & Dr. Jérémie Gaveau), Dijon
  Topic: study of whole-body movements and muscle synergy organization, role of gravity in motor planning, eye/hand coordination in free endpoint reaching tasks
- ENSTA-ParisTech (Prof. Frédéric Jean, Palaiseau)
  Topic: study and modeling of human movement pace from the optimal control viewpoint and inverse optimal control
- Univ. Versailles Saint-Quentin – Raymond Poincaré Hospital (Dr. Didier Pradon, Garches), laboratory "Handicap Technological and Clinical Research Group (GRCTH)
  Topic: study of muscle organization during healthy and pathological gait using the space-by-time modularity
- LIMSI-CNRS (Dr. Annelies Braffort, CNRS, Orsay)
  Topic: study of French sign language from the motor control viewpoint using 3D motion capture techniques, with a modeling perspective

International

- Italian Institute of Technology of Genoa (Dr. Francesco Nori, Italy)
  Topic: Variable impedance actuators mimicking the co-contraction properties of human muscles and modeling in the open-loop stochastic optimal control framework
- Italian Institute of Technology of Genoa (Dr. Gabriel Baud-Bovy, Italy)
  Topic: Investigating the cost of time using haptic interfaces and an isometric reaching task
- Columbia University (Dr. Ioannis Delis, US, soon lecturer in Leeds University)
  Topic: design and development of new muscle synergy extraction methods to improve existing models: towards synergy extraction without time normalization and capturing the role of sensorimotor feedback

Diffusion of scientific work

- Creation of a personal academic webpage (`http://hebergement.u-psud.fr/berret/`) including software and codes related to publications
- Member of the "experimentarium" (organism of scientific popularization) from 2006 to 2008
  `http://experimentarium.u-bourgogne.fr/spip.php?page=article_a&id_rubrique=16&id_auteur=132`

Research Grants

2014 Co-PI for an « AAP Attractivité Paris-Sud » project : « Development of motor primitives during the first year of life: sensorimotor study and modeling approach » with Dr. C. Teulier (50%) – budget 23 k€

2014-2016 PI of a project within iCODE (Institute for Control and Decision) (IDEX Paris-Saclay) – budget 15.6k€: 'Theoretical foundation of inverse optimal control and application to the identification of a time cost in human movements'. Collaborators: F. Jean (ENSTA), T. Deroche (CIAMS). Link: `http://www.icode-institute.fr/`

2012 and 2013 PhD grants from Univ. Paris-Sud and the doctoral school « École Doctorale 566, Sciences du Sport, de la Motricité et du Mouvement Humain », ~100k€ twice

2016-2019 Member of the steering committee (CoPil) of iCODE (Institute for Control and Decision) coordinated by Prof. Yacine Chitour ("AAP Institut de Recherche Stratégique" within Paris-Saclay). Involved in the "Exo" Research Initiative coordinated by Samer Alfayad (~300 k€ for the challenge "Exo" for building and developing an adjustable size whole-body exoskeleton).

2017-2022 Junior member of IUF (75 k€)

2017 PhD grant from IDI (IDEX Paris-Saclay) for investigating motor control with upper-limb exoskeletons (~100 k€)

2017 ERM project (Shared Research Equipment) to create a platform for exoskeleton and human motor control research (55 k€)

Professor Invitation

- Dr. Francesco Nori (June, 2015 - 1 month)
  Invitation of Dr. Francesco Nori at Univ. Paris-Sud (CIAMS) in the framework of a research project related to inverse optimal control approaches to human movement and humanoids, and application to their duration (cf. iCODE grant)

Referee for international journals

- PLoS Computational Biology, PLoS One, Experimental Brain Research, Frontiers in Computational Neuroscience, Frontiers in Human Neuroscience, Journal of Neurophysiology, IEEE transactions on Industrial Electronics, IEEE transactions on Control Systems Technology, IEEE proceedings (IROS, Humanoids, BioRob...), International Journal of Social Robotics, Journal of Neuroscience Methods, Journal of NeuroEngineering and Rehabilitation
- "Outstanding Elsevier reviewer" award in 2014
- Review Editor for Frontiers in Computational Neuroscience

Project and thesis expertise

- Expertise of an INSEP (« Institut national du sport, de l'expertise et de la performance ») project in 2013
- Member of PhD thesis committee (April 2017) at University of Genoa and IIT of Genoa
- Member of scientific committee for the ACAPS meeting (Dijon, 2017)

List of publications

International Journal Publications (peer-reviewed)

29. P. M. Hilt, I. Delis, T. Pozzo, and B. Berret, Space-by-time modular decomposition effectively describes whole-body muscle activity during upright reaching in various directions, ***Front. Comput. Neurosci.***, 2017

28. V. H. Vu, B. Isableu, and B. Berret, Adaptive use of interaction torque during arm reaching movement from the optimal control viewpoint, ***Scientific Reports***, 2016

27. J. Gaveau, B. Berret, D. Angelaki, and C. Papaxanthis. Direction-dependent arm kinematics reveal optimal integration of gravity cues, ***eLife***, 10.7554/eLife.16394, 2016

26. B. Berret and F. Jean, Why don't we move slower? The value of time in the neural control of action, ***The Journal of Neuroscience***, 36(4):1056-1070, 2016

25. V. H. Vu, B. Isableu, and B. Berret, On the nature of motor planning variables during arm pointing movement: compositeness and speed dependence, 328:127–146, ***Neuroscience***, 2016

24. P. Hilt, B. Berret, C. Papaxanthis, P. Stapley, and T. Pozzo, Evidence for subjective values guiding posture and movement coordination in a free-endpoint whole-body reaching task, ***Scientific Reports***, 6, Article number:23868, 2016

23. I. Delis, S. Panzeri, T. Pozzo, and B. Berret, Task-discriminative space-by-time factorization of muscle activity, ***Front. Hum. Neurosci.***, 9:399, 2015

22. B. Berret, A. Bisio, M. Jacono, and T. Pozzo, Reach Endpoint Formation during the Visuomotor Planning of Free Arm Pointing, ***European Journal of Neuroscience***, 40(10):3491-3503, 2014

21. J. Gaveau, B. Berret, L. Demougeot, L. Fadiga, T. Pozzo, and C. Papaxanthis, Energy-related optimal control accounts for gravitational load: comparing shoulder, elbow and wrist rotations, ***Journal of Neurophysiology***, 111(1):4-16, 2014

20. I. Delis, S. Panzeri, T. Pozzo, and B. Berret, A unifying model of concurrent spatial and temporal modularity in muscle activity, ***Journal of Neurophysiology***, 111(3):675-693, 2014

19. I. Delis, B. Berret, T. Pozzo, and S. Panzeri, A methodology for assessing the effect of correlations among muscle synergy activations on task-discriminating information, ***Front. Comput. Neurosci.***, 7:54 2013

18. I. Delis, B. Berret, T. Pozzo, and S. Panzeri, Quantitative evaluation of muscle synergy models: a single-trial task decoding approach, ***Front. Comput. Neurosci.***, 7:8, 2013

17. E. Chiovetto, B. Berret, I. Delis, S. Panzeri, and T. Pozzo, Investigating reduction of dimensionality during single-joint elbow movements: a case study on muscle synergies, ***Front. Comput. Neurosci.***, 7:11, 2013

16. C. Alessandro, I. Delis, F. Nori, S. Panzeri, and B. Berret, Muscle synergies in neuroscience and robotics: from input-space to task-space perspectives, ***Front. Comput. Neurosci.***, 7:43, 2013 (Review)

15. S. Ivaldi, O. Sigaud, B. Berret, and F. Nori, From Humans to Humanoids: the Optimal Control Framework, ***Paladyn Journal of Behavioral Robotics***, 3(2):75-91, 2012 (Review)

14. A. Sciutti, L. Demougeot, B. Berret, S. Toma, G. Sandini, C. Papaxanthis, and T. Pozzo, Visual gravity influences arm movement planning, ***Journal of Neurophysiology***, 106(4):2086-102, 2012

13. B. Berret, E. Chiovetto, F. Nori, and T. Pozzo, Evidence for Composite Cost Functions in Arm Movement Planning: An Inverse Optimal Control Approach, ***PLoS Comput Biol***, 7(10):e1002183, 2011

12. B. Berret, E. Chiovetto, F. Nori, and T. Pozzo, Manifold reaching paradigm: how do we handle target redundancy?, ***Journal of Neurophysiology***, 106(4):2086-102, 2011

11. A. Tolambiya, E. Thomas, E. Chiovetto, B. Berret, and T. Pozzo, An Ensemble Analysis of Electromyographic Activity During Whole Body Pointing with the use of Support Vector Machines, ***PLoS One***, 6(7):e20732, 2011

10. J. Gaveau, C. Paizis, B. Berret, T. Pozzo, and C. Papaxanthis, Sensorimotor adaptation of point-to-point arm movements after space-flight: the role of the internal representation of gravity force in trajectory planning, ***Journal of Neurophysiology***, 106(2):620-9, 2011

9. E. Chiovetto, B. Berret, and T. Pozzo, Tri-dimensional and triphasic muscle organization of whole-body pointing movements, ***Neuroscience***, 170(4):1223-1238, 2010

8. L. Fautrelle, C. Prablanc, B. Berret, Y. Ballay, and F. Bonnetblanc, Pointing to double-step visual stimuli from a standing position: very short latency (express) corrections are observed in upper and lower limbs and may not require cortical involvement, ***Neuroscience***, 169(2):697-705, 2010

7. I. Delis, E. Chiovetto, and B. Berret, On the Origins of Modularity in Motor Control, ***The Journal of Neuroscience***, 30(22):7451-7452, 2010 (journal club)

6. J-P. Gauthier, B. Berret, and F. Jean, A Biomechanical Inactivation Principle, ***Proceedings of the Steklov Institute of Mathematics***, 268:93-116, 2010

5. L. Fautrelle, B. Berret, E. Chiovetto, T. Pozzo, and F. Bonnetblanc, Equilibrium constraints do not affect the timing of muscular synergies during the initiation of a whole body reaching movement, ***Experimental Brain Research***, 203(1):147-58, 2010

4. B. Berret, F. Bonnetblanc, C. Papaxanthis, and T. Pozzo, Modular control of pointing beyond arm's length, ***The Journal of Neuroscience***, 29(1):191-205, 2009

3. B. Berret, C. Darlot, F. Jean, T. Pozzo, C. Papaxanthis, and J-P. Gauthier, The Inactivation Principle: Mathematical Solutions minimizing the Absolute Work and Biological Implications for the Planning of Arm movements, ***PLoS Comput Biol***, 4(10):e1000194, 2008

2. B. Berret, J-P. Gauthier, and C. Papaxanthis, How humans control arm movements, ***Proceedings of the Steklov Institute of Mathematics***, 261:44-58, 2008

1. C. Paizis, C. Papaxanthis, B. Berret, and T. Pozzo, Reaching beyond arm length in normal aging: adaptation of hand trajectory and dynamic equilibrium, ***Behavioral Neuroscience***, 122(6):1361-70, 2008

International Conference Publications and Abstracts (peer-reviewed)

14. S. Bastide, N. Vignais, F. Geffard, and B. Berret, Analysis of human-exoskeleton interactions: an elbow flexion/extension case study, ***Computer Methods in Biomechanics and Biomedical Engineering***, 20 (sup1), 9-10, 2017

13. J. Gaveau, B. Berret and C. Papaxanthis, Optimal adaptation of human movement to the gravity field, ***Medecine sciences: M/S***, 33 (8-9), 704-706, 2017

12. A. Supiot, B. Berret, N. Roche and D. Pradon, Impact de la normalisation temporelle du signal EMG sur l'extraction des synergies musculaires durant la marche, ***Neurophysiologie Clinique/Clinical Neurophysiology*** 46 (4), 281, 2017

11. M. Benchiheub, B. Berret, and A. Braffort. Collecting and Analysing a Motion-Capture Corpus of French Sign Language, Proceedings of the 7th Workshop on the Representation and Processing of Sign Languages: Corpus Mining, ***10th edition of the Language Resources and Evaluation Conference (LREC)***, 2016

10. A. Braffort, M. Benchiheub, and B. Berret, APLUS: A 3D Corpus of French Sign Language, ***Proceedings of the 17th International ACM SIGACCESS Conference on Computers & Accessibility (ASSETS)***, 381-382, 2015

9. V.H. Vu, B. Isableu, and B. Berret, Velocity-dependent tuning of motor strategy during 3D arm movement and its relationship to composite cost functions, ***33rd International Conference on Sport Biomechanics (ISBS)***, sciencesconf.org:isbs2015:58612, 2015

8. B. Berret, I Yung, and F. Nori, Open-loop stochastic optimal control of a passive noise-rejection variable stiffness actuator: application to unstable tasks, ***IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)***, 2013

7. B. Berret, G. Sandini, and F. Nori, Design principles for muscle-like variable impedance actuators with noise rejection property via co-contraction, ***IEEE-RAS International Conference on Humanoid Robots (HUMANOIDS)***, 2012

6. L. Fiorio, A. Parmiggiani, B. Berret, G. Sandini, and F. Nori, pnrVSA: human-like actuator with non-linear springs in agonist-antagonist configuration, I***EEE-RAS International Conference on Humanoid Robots (HUMANOIDS)***, 2012

5. L. Patanè, A. Sciutti, B. Berret, V. Squeri, L. Masia, G. Sandini, and F. Nori, Modeling Kinematic Forward Model Adaptation by Modular Decomposition, ***Fourth IEEE RAS/EMBS International Conference on Biomedical Robotics and Biomechatronics (BIOROB)***, 2012

4. F. Nori, B. Berret, L.Fiorio, A.Parmiggiani, and G.Sandini, Control of a single degree of freedom noise-rejecting variable impedance, ***Proceedings of the 10th international IFAC symposium on Robot Control (SYROCO)***, 2012

3. B. Berret, S. Ivaldi, F. Nori, and G. Sandini, Stochastic optimal control with variable impedance manipulators in presence of uncertainties and delayed feedback, ***IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)***, 2011

2. B. Berret, F. Jean, and J.P. Gauthier, A biomechanical theory of inactivation, ***Computer Methods in Biomechanics and Biomedical Engineering***, 12(1):41-42, 2009

1. B. Berret, J-P. Gauthier, and V. Zakalyukin, Nonholonomic Interpolation: a general methodology for motion planning in robotics, ***17th International Symposium on Mathematical Theory of Networks and Systems***, 2006

N.B.: posters and abstracts are not included for simplicity.

Book chapters (peer-reviewed)

3. L. Fiorio, F. Romano, A. Parmiggiani, B. Berret, G. Metta, and F. Nori, Design and Control of a passive noise rejecting Variable Stiffness Actuator, ***Biomechanics of Anthropomorphic Systems Springer STAR Series***, 2018

2. B. Berret, I. Delis, J. Gaveau, and F. Jean, Optimality and modularity in human movement: from optimal control to muscle synergies, ***Biomechanics of Anthropomorphic Systems Springer STAR Series***, 2018

1. F. Jean and B. Berret, On the duration of human movement: from self-paced to slow/fast reaches up to Fitts's law, ***Springer Star Series « Geometric and Numerical Foundations of Movements »,*** 2017

Patent

Application	Filing Date	Publication	Publication Date	Title	Inventors
PCT/IB2013 /056834	August 23, 2013	WO 2014/033603	February 28, 2014	Variable-Stiffness Actuator With Passive Disturbance Rejection	Francesco NORI, Bastien BERRET, Luca FIORIO, Alberto PARMIGGIANI, Giulio SANDINI

Patent's description: This patent describes a novel type of Variable Stiffness Actuator (VSA) for actuating a robot joint. The actuator possesses a fundamental feature, nominally the ability to augment passive disturbance rejection. In this context, the adjective passive refers to the fact rejection is not obtained with active control loops but derive from the intrinsic (i.e. passive) properties of the system. The set of actuators possessing this feature will be nominated "noise rejecting passive VSA" (nrpVSA). At first, in order for the patent to include multiple design solutions, we mathematically characterize a wide set of nrpVSA actuators, by pointing out different mechanical configurations leading to the desired joint-level noise rejection capability. Then, among multiple design solutions, one specific design is chosen and characterized. The proposed design is based on an agonist-antagonist configuration of two electric motors. Stiffness regulation is obtained by non-linear springs, which can be stiffened up via motors co-activation. Feedback-free joint-level noise rejection is finally the result of increasing the stiffness of all the elastic elements that connect the joint to the world frame. A proof-of-concept example shows how the proposed actuator deals with instabilities and disturbances exploiting co-activation and without resorting to position feedback.

See also: `https://encrypted.google.com/patents/EP2890527A1?cl=tr`

Five most relevant publications

#**1** Title	Why don't we move slower? The value of time in the neural control of action
Authors	B. Berret and F. Jean
Reference	The Journal of Neuroscience, 36(4):1056-1070, 2016
Abstract	To want something now rather than later is a common attitude that reflects the brain's tendency to value the passage of time. Because the time taken to accomplish an action inevitably delays task achievement and reward acquisition, this idea was ported to neural movement control within the "cost of time" theory. This theory provides a normative framework to account for the underpinnings of movement time formation within the brain and the origin of a self-selected pace in human and animal motion. Then, how does the brain exactly value time in the control of action? To tackle this issue, we used an inverse optimal control approach and developed a general methodology allowing to squarely sample infinitesimal values of the time cost from experimental motion data. The cost of time underlying saccades was found to have a concave growth, thereby confirming previous results on hyperbolic reward discounting, yet without making any prior assumption about this hypothetical nature. For self-paced reaching, however, movement time was primarily valued according to a striking sigmoidal shape; its rate of change consistently presented a steep rise before a maximum was reached and a slower decay was observed. Theoretical properties of uniqueness and robustness of the inferred time cost were established for the class of problems under investigation, thus reinforcing the significance of the present findings. These results may offer a unique opportunity to uncover how the brain values the passage of time in healthy and pathological motor control and shed new light on the processes underlying action invigoration.

#**2** Title	The Inactivation Principle: Mathematical Solutions minimizing the Absolute Work and Biological Implications for the Planning of Arm movements
Authors	B. Berret, C. Darlot, F. Jean, T. Pozzo, C. Papaxanthis, and J-P. Gauthier
Reference	PLoS Comput Biol, 4(10):e1000194, 2008
Abstract	An important question in the literature focusing on motor control is to determine which laws drive biological limb movements. This question has prompted numerous investigations analyzing arm movements in both humans and monkeys. Many theories assume that among all possible movements the one actually performed satisfies an optimality criterion. In the framework of optimal control theory, a first approach is to choose a cost function and test whether the proposed model fits with experimental data. A second approach (generally considered as the more difficult) is to infer the cost function from behavioral data. The cost proposed here includes a term called the absolute work of forces, reflecting the mechanical energy expenditure. Contrary to most investigations studying optimality principles of arm movements, this model has the particularity of using a cost function that is not smooth. First, a mathematical theory related to both direct and inverse optimal control approaches is presented. The first theoretical result is the Inactivation Principle, according to which minimizing a term similar to the absolute work implies simultaneous inactivation of agonistic and antagonistic muscles acting on a single joint, near the time of peak velocity. The second theoretical result is that, conversely, the presence of non-smoothness in the cost function is a necessary condition for the existence of such inactivation. Second, during an experimental study, participants were asked to perform fast vertical arm movements with one, two, and three degrees of freedom. Observed trajectories, velocity profiles, and final postures were accurately simulated by the model. In accordance, electromyographic signals showed brief simultaneous inactivation of opposing muscles during movements. Thus, assuming that human movements are optimal with respect to a certain integral cost, the minimization of an absolute-work-like cost is supported by experimental observations. Such types of optimality criteria may be applied to a large range of biological movements.

#3 Title	Modular control of pointing beyond arm's length
Authors	B. Berret, F. Bonnetblanc, C. Papaxanthis, and T. Pozzo
Reference	Journal of Neuroscience, 29(1) :191-205, 2009
Abstract	Hand reaching and bipedal equilibrium are two important functions of the human motor behavior. However, how the brain plans goal-oriented actions combining target reaching with equilibrium regulation is not yet clearly understood. An important question is whether postural control and reaching are integrated in one single module or controlled separately. Here, we show that postural control and reaching motor commands are processed by means of a modular and flexible organization. Principal component and correlation analyses between pairs of angles were used to extract global and local coupling during a whole-body pointing beyond arm's length. A low-dimensional organization of the redundant kinematic chain allowing simultaneous target reaching and regulation of the center of mass (CoM) displacement in extrinsic space emerged from the first analysis. In follow-up experiments, both the CoM and finger trajectories were constrained by asking participants to reach from a reduced base of support with or without knee flexion, or by moving the endpoint along a predefined trajectory (straight or semicircular trajectories). Whereas joint covaried during free conditions and under equilibrium restrictions, it was decomposed in two task-dependent and task-independent modules, corresponding to a dissociation of arm versus legs, trunk, and head coordination, respectively, under imposed finger path conditions. A numerical simulation supported the idea that both postural and focal subtasks are basically integrated into the same motor command and that the CNS is able to combine or to separate the movement into autonomous functional synergies according to the task requirements.

#4 Title	Evidence for Composite Cost Functions in Arm Movement Planning: An Inverse Optimal Control Approach
Authors	B. Berret, E. Chiovetto, F. Nori, and T. Pozzo
Reference	PLoS Comput Biol, 7(10):e1002183, 2011
Abstract	An important issue in motor control is understanding the basic principles underlying the accomplishment of natural movements. According to optimal control theory, the problem can be stated in these terms: what cost function do we optimize to coordinate the many more degrees of freedom than necessary to fulfill a specific motor goal? This question has not received a final answer yet, since what is optimized partly depends on the requirements of the task. Many cost functions were proposed in the past, and most of them were found to be in agreement with experimental data. Therefore, the actual principles on which the brain relies to achieve a certain motor behavior are still unclear. Existing results might suggest that movements are not the results of the minimization of single but rather of composite cost functions. In order to better clarify this last point, we consider an innovative experimental paradigm characterized by arm reaching with target redundancy. Within this framework, we make use of an inverse optimal control technique to automatically infer the (combination of) optimality criteria that best fit the experimental data. Results show that the subjects exhibited a consistent behavior during each experimental condition, even though the target point was not prescribed in advance. Inverse and direct optimal control together reveal that the average arm trajectories were best replicated when optimizing the combination of two cost functions, nominally a mix between the absolute work of torques and the integrated squared joint acceleration. Our results thus support the cost combination hypothesis and demonstrate that the recorded movements were closely linked to the combination of two complementary functions related to mechanical energy expenditure and joint-level smoothness.

#**5** Title	A unifying model of concurrent spatial and temporal modularity in muscle activity
Authors	I. Delis, S. Panzeri, T. Pozzo, and B. Berret
Reference	Journal of Neurophysiology, 111(3):675-693, 2014
Abstract	Modularity in the central nervous system (CNS), i.e. the brain capability to generate a wide repertoire of movements by combining a small number of building blocks ("modules"), is thought to underlie the control of movement. Numerous studies reported evidence for such a modular organization by identifying invariant muscle activation patterns across various tasks. However, previous studies relied on decompositions differing in both the nature and dimensionality of the identified modules. Here, we derive a single framework that encompasses all influential models of muscle activation modularity. We introduce a new model (named space-by-time decomposition) that factorizes muscle activations into concurrent spatial and temporal modules. To infer these modules, we develop an algorithm, referred to as sample-based non-negative matrix tri-factorization (sNM3F). We test the space-by-time de- composition on a comprehensive electromyographic dataset recorded during execution of arm pointing movements and show that it provides a low-dimensional yet accurate, highly flexible and task-relevant representation of muscle patterns. The extracted modules have a well- characterized functional meaning and implement an efficient trade-off between replication of the original muscle patterns and task discriminability. Furthermore, they are compatible with the modules extracted from existing models such as synchronous synergies and temporal primitives, and generalize time-varying synergies. Our results indicate the effectiveness of a simultaneous but separate condensation of spatial and temporal dimensions of muscle patterns. The space-by-time decomposition accommodates a unified view of the hierarchical mapping from task parameters to coordinated muscle activations, which could be employed as a reference framework for studying compositional motor control.