

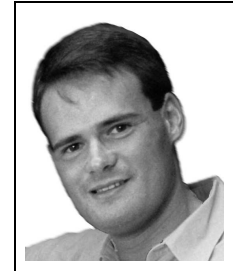
# CURRICULUM VITAE

JEAN-MATTHIEU BOURGEOT

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## PERSONAL INFORMATION

Surname, First name	Bourgeot, Jean-Matthieu
Place and date of birth	France, 15 February 1977
Marital status	Single
Nationality	French
Address	197, rue Compagnie Stéphane 38420 Le Versoud - France
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Email address	Jean-Matthieu.Bourgeot@inrialpes.fr
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Languages	French (native), English (scientific).



**Position since January 2005 :** Researcher at the GRACE Lab “Group for Research on Automatic Control Engineering”, Benevento, Italie.

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## EDUCATION

- 2001-2004** Ph.D. in Automatic Control, Grenoble National Polytechnic Institute. Dissertation: “Control of Nonsmooth Mechanical Systems”. October 27th, 2004.
- 2000-2001** **DEA** (Diplôme d’Etudes Approfondies), equivalent to a **Master thesis**, in **Automatic Control and Virtual Reality** (DEA RVMSC) at the University of Versailles Saint-Quentin en Yvelines.
- 1999-2000** **Electrical Engineer** of the ENSIEG (Leading French school in electrical engineering, part of INPG (Grenoble National Polytechnic Institute). Exchange student at Ecole Polytechnique of Montreal in electrical engineering and data processing.
- 1997-1999** Student at the Electrical Engineering School, ENSIEG - INPG, 3 years program in : **electric power, process control, signal processing, computer science**.
- 1995-1997** University level preparation in Math, Physics and Engineering Sciences for the competitive exams to entrance to French "Grandes Ecoles". Lycée Vaucanson de Grenoble

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## TEACHING AND RESEARCH EXPERIENCE

- 2001-2004** **Part-time lecturing** (monitorat). Third of the hourly volume of an assistant professor as part of the Higher Education Initiation Centre (Centre d’Initiation

à l'Enseignement Supérieur, CIES) of Grenoble - Joseph Fourier University; 64 hours of lecturing and 10 days of teacher-training per year.

- 2001-2004**     **PhD thesis in automatic control** - BIPOP project - INRIA Rhone-Alpes - Grenoble. *Subject:* Control of Nonsmooth Mechanical Systems. *Advisors:* Pr Bernard Brogliato & Pr Carlos Canudas-de-Wit.
- Spring 2001**     **Master thesis** - BIP project - INRIA Rhône-Alpes - Grenoble. *Subject:* Planification and trajectories generation for a biped in a 3D Partially Structured Environment. INRIA Rhône-Alpes. *Advisors:* Pr Bernard Espiau & Dr Nathalie Cisló.
- Spring 2000**     **Master degree** Ecole Polytechnique de Montréal - Québec. *Subject:* Design a path-tracking controller for articulated vehicles with a negative off-axle joint. *Advisors:* Pr Romano de Santis.
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## SKILLS

<b>Operating Systems</b>	Linux, Solaris, MacOS X, Windows.
<b>Programming Languages</b>	Java, C, UNIX shells.
<b>Meta Languages</b>	Maple, Matlab, Scilab, Latex, HTML

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## ACTIVITIES

### SCIENTIFIC ACTIVITIES AND SERVICE TO THE COMMUNITY

<b>Reviews</b>	Reviewer of papers submitted to the 2004 IEEE Conference on Control Application
<b>Research Groups</b>	- Participant in the European project <b>SICONOS</b> (Modelling, Simulation and Control of Nonsmooth Dynamical Systems) - Participant in the French project <b>ROBEA</b> : Commande pour la marche et la course d'un robot bipède. (Control of a biped on walking and running gaits).
<b>Educational</b>	Member of the organization staff of the "2004 Welcome seminar" for new teachers at Grenoble University (Seminar for 120 novice lecturers: discussions about educational methods and about the role of the teacher).

### EXTRA-PROFESSIONAL ACTIVITIES

<b>Main International Visits</b>	U.S.A, Canada, Mexico, Cuba.
<b>Sports</b>	Skiing, Sailing (employ as safety-staff in a nautical club during 3 summers) and Mountain-Biking.

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## RESEARCH INTEREST

<b>Nonsmooth Mechanics</b>	Unilateral Constraint, Linear Complementarity Problem, Coupling Effect, Discrete Event Systems, Impact Laws, Lyapunov Stability.
<b>Biped locomotion</b>	Biped Impact Shaping, Path-Planification. Trajectories Generation.

**General interest**

Automatic Control, Unilateral Constraint, Hybrid, Impact, Lagrangian Mechanical Systems.

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**RESEARCH ACTIVITY****TRACTOR-TRAILER PATH-TRACKING - [past work]**

My first research projects were done in the department of Electrical Engineering of the Polytechnic School of Montreal under the supervision of Pr Romano DeSantis. First, we worked on path-tracking control for a tractor-2-trailers vehicle with one coupling joint on axle and the other off axle. Results are based on exact linearization. Second, we worked on the case of a tractor-1-trailer with an off axle hitching with a positive offset (the coupling is behind the center of rotation of the tractor). Exact linearization is no longer applicable for this system and the problem is solved using Jacobian linearization.

My personal contribution to this subject:

- Controller design based on input/output linearization for the positive off axle configuration.
- Controller design based on exact linearization for the on axle configuration.
- One publication [4]

**BIPED LOCOMOTION****Planification in 3D -[past work]**

My first research on the biped locomotion was done in the BIP research project of INRIA Rhône-Alpes, during my master thesis training. I worked under the direction of Pr Bernard Espiau on two subjects. First, we worked on the generation of trajectories for the biped actuators. These automatic generations were based on the control-task approach. A primary task was defined : The static-stability of the biped, and then the redundancy of the biped (15 dof) was used to perform secondary tasks like avoiding actuator limits, obstacles or minimizing some energetic criteria.

Second, we worked on the planification for a biped in a 3D partially structured environment. The path-planning problem is seen as finding a sequence of footholds in a 3D environment, keeping robot stability, motion continuity and working within the structural constraints of the biped.

My personal contribution to this subject:

- Path-planning strategy using  $A^*$  algorithm.
- Some gaits generation using different energetic criteria.
- One publication [3]

**Double support walk - [current work]**

In the “Laboratoire d’Automatique de Grenoble” (LAG) - Control Laboratory of Grenoble - I currently studying the biped robot Rabbit. Under the supervision of Pr Carlos Canudas-de-Wit, I am working on the impact shaping of the biped during double impact. We exhibit conditions on the configuration of the robot during an impact to have a double support phase. In fact the research shows that, if the impact configuration is not properly monitored, the transition between a single support phase from one leg to the other leg can be done instantly. These conditions depend on the steps length, the inertia of the biped and its configuration.

**NON-SMOOTH TRACKING CONTROL: - [current work]**

Most of my PhD was done on the control of non-smooth systems, in the BIPOP research project of INRIA Rhône-Alpes (which is the amalgamation of the control part’s BIP project researchers with the NUMOPT project researchers).

I study, with Pr Bernard Brogliato, the tracking control of Lagrangian systems subject to frictionless unilateral constraints. The problem is to find a specific controller which can perform cyclic tasks composed of free motion and constraint phases (i.e: the tool of a manipulator arms which performs some tasks in contact with an obstacle and some free motions).

In the transition between free and constraint motion, some impact can occur and the stability analysis must incorporate the hybrid and nonsmooth dynamical feature of such systems.

The second aspect of such controller is the monitoring of the detachment phase. The transition between the constraint and the free phase is not trivial, the reaction force during this switch must be monitored to assure a well done detachment. It was shown that the design of suitable desired trajectories for transition phases, is a crucial step.

My personal contribution to this subject:

- This work provides details on the conditions of existence of controllers which guarantee stability.
- Two controller schemes based of Panden-Panja or Slotine-Li controller.
- Some possible extensions to multiple impact cases.
- Three publications [1], [2] and [5]

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## TEACHING ACTIVITY

**2001-2004**      **Part-time lecturing (monitorat), as part of the Higher Education Initiation Centre of Grenoble - U.J.F. Grenoble, France - 64 hours of lecturing and 10 days of teacher-training per year.**

Details of the teaching per year:

### 2003-2004

**Electronics**, Master's degree in Engineering (D.W. 19.5h - P.W. 24.5h)<sup>1</sup>  
**Automatic control**, Master's degree in Engineering (P.W. 21h)

### 2002-2003

**Electronics**, Master's degree in Engineering (D.W. 18h - P.W. 36h)  
**Automatic control**, Master's degree in Engineering (P.W. 42h)  
**Programming - C language**, Master's degree in Science (Course & D.W. 9h - P.W. 18h)

### 2001-2002

**Electronics**, Master's degree in Engineering (P.W. 14h)  
**Automatic control**, Master's degree in Engineering (P.W. 42h)  
**Programming - C language**, Master's degree in Science (Course & D.W. 9h - P.W. 14h)

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## PUBLICATIONS

### PAPERS

- [1] Jean-Matthieu Bourgeot and Bernard Brogliato. Tracking control of complementarity lagrangian systems. *The International Journal of Bifurcation and Chaos*, special issue on Non-smooth Dynamical Systems, 2005. *To Appear in vol. 15, no 6, June 2005.*

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<sup>1</sup>D.W. for Directed Work and P.W. for Pratical Work

## INTERNATIONAL CONFERENCES

- [2] Jean-Matthieu Bourgeot and Bernard Brogliato. Tracking control of nonsmooth complementarity lagrangian systems. In *Proceedings of the European Control Conference ECC'03*, University of Cambridge, UK, September 2003.
- [3] Jean-Matthieu Bourgeot, Nathalie Cislo, and Bernard Espiau. Path-planning and tracking in a 3d complex environment for an anthropomorphic biped robot. In *Proc. of the 2002 IEEE Intl. Conf. on Intelligent Robots & Systems*, volume 3, pages 2509–2514, EPFL, Lausanne, Suisse, October 2002.
- [4] Romano M. DeSantis, Jean Mathieu Bourgeot, Jean Noel Todeschi, and Richard Hurteau. Path-tracking for tractor-trailers with hitching of both the on-axle and the off-axle kind. In *Proceedings of the 17th IEEE International Symposium on Intelligent Control*, pages 206–211, Vancouver, Canada, October 2002.
- [5] Jean-Matthieu Bourgeot and Bernard Brogliato. Tracking control of rigid manipulators subject to unilateral constraints. In *Proc. of 6th ASME Conf. on Engineering Systems Design and Analysis*, Istanbul, Turkey, July 2002.

## ORAL COMMUNICATIONS, POSTERS AND FRENCH CONGRESS

- [6] Jean-Matthieu Bourgeot. Détermination de la configuration pre-impact du bipède pour obtenir un double support, et introduction d'un modèle d'impact tenant compte de l'élasticité du système. *Présentation projet ROBEA : Commande pour la marche et la course d'un robot bipède*, CNRS, Paris, France, 12 Mars 2004.
- [7] Jean-Matthieu Bourgeot. A tracking control scheme for complementarity lagrangian systems. Poster presented at Siconos General Meeting, Barcelona, Spain, November 10-11, 2003.
- [8] Jean-Matthieu Bourgeot. A tracking control scheme for complementarity lagrangian systems. Poster presented at WorkShop on Free Boundary Problems, St-Etienne, France, September 4-6, 2003.
- [9] Jean-Matthieu Bourgeot. Poursuite de trajectoires pour des systèmes soumis à des contraintes unilatérales et applications sur les robots bipèdes. *Présentation projet ROBEA : Commande pour la marche et la course d'un robot bipède*, LRV, Versailles, France, 10 juillet 2003.
- [10] Jean-Matthieu Bourgeot and Bernard Brogliato. Poursuite de trajectoires dans les systèmes lagrangiens de complémentarité. In Presses Universitaires de Valenciennes, editor, *Actes des JDA 2003, Journées Doctorales d'Automatique*, pages 371–376, Valenciennes, France, June 2003.
- [11] Jean-Matthieu Bourgeot and Bernard Brogliato. Poursuite de trajectoire pour des systèmes mécaniques lagrangiens soumis à des contraintes unilatérales. In *17<sup>èmes</sup> Journées des Jeunes Chercheurs en Robotique*, pages 20–26, LRV, Versailles, April 2003.

## RESEARCH REPORTS

- [12] Jean-Matthieu Bourgeot and Bernard Brogliato Robustness analysis of Passivity-based Controllers for Complementarity Lagrangian Systems. *Inria Research Reports Nr. 5385*, November 2004 <http://www.inria.fr/rrrt/rr-5385.html>.
- [13] Jean-Matthieu Bourgeot and Bernard Brogliato Tracking Control of Complementarity Lagrangian Systems. Complementarity Lagrangian Systems. *Inria Research Reports Nr. 5384*, November 2004 <http://www.inria.fr/rrrt/rr-5384.html>.