

CURRICULUM VITÆ

Dr. Mathieu Desroches

November 2011

Contents

1	Contact Details	3
1.1	Personal Information	3
1.2	Current Appointment	3
1.3	Previous Appointments	3
2	Education	3
2.1	Higher Education	3
2.2	Training Courses	5
3	Research	5
3.1	Ph.D. (6 May 2009)	5
3.2	Research Interests	5
3.3	Research Visits	5
4	Publications	6
4.1	Preprints	6
4.2	Peer-reviewed journal articles	6
4.3	Conference Proceedings	7
4.4	Work in Progress	7
5	Talks	9
5.1	Invited Presentations	9
5.2	Contributed Talks and Posters	11
6	Grants and Awards	11
7	Other academic activities	12
7.1	Conference and seminar organisation	12
7.2	Dynamical Systems community	12
7.3	Reviewing activities	12
7.4	Professional memberships	12
8	Teaching Experience	12
9	Languages and Computer skills	13
10	Referees	13

1 Contact Details

1.1 Personal Information

✉ [SISYPHE project team](#)
INRIA Paris-Rocquencourt Centre
Domaine de Voluceau
BP 105
78153 Le Chesnay Cedex
France

☎ +33 (0)1 39 63 55 58

📶 +44 (0)781185 6160

✉ mathieu.desroches@inria.fr

🌐 <http://seis.bris.ac.uk/~enzmfd>

🌍 French Nationality

1.2 Current Appointment

Since November 2011, I am a **Junior Permanent Researcher** (*Chargé de Recherche de Classe 2*) at [INRIA](#), in the [Paris-Rocquencourt centre](#) (France). I am working in the [SISYPHE](#) research team.

I am also a **Visiting Fellow** in the [Applied Nonlinear Mathematics](#) research group of the Engineering Mathematics department at the University of Bristol (UK).

1.3 Previous Appointments

A. Chérioux Highschool, Vitry-sur-Seine, France.

Mathematics Teacher

Sept 2004 - April 2006.

2 Education

2.1 Higher Education

[University of Bristol](#), Department of Engineering Mathematics, Bristol, UK.

PhD. in Applied Mathematics

April 2006 - February 2009.

- Thesis : “Numerical Continuation Methods for Slow-Fast Dynamical Systems”
- Supervisors : [Dr. Hinke M. Osinga](#) and [Prof. Bernd Krauskopf](#), Bristol Centre for Applied Non-linear Mathematics, Department of Engineering Mathematics, University of Bristol, Bristol, UK.

[Université D. Diderot](#), Équipe d'Analyse Algébrique, Paris, France.

DEA (Masters Degree) in Pure Mathematics

Sept 2004.

- Graduated with honours.
- Course work in Riemannian Geometry, Symplectic Geometry, Dynamical Systems and Hamiltonian Dynamics.
- Thesis : “The Birkhoff-Smale Theorem ; Examples in Hamiltonian Dynamics”
- Supervisor : Associate Professor Jacques Féjóz, Institut de Mathématiques de Jussieu (UMR 7586 du CNRS), équipe d’Analyse Algébrique, University P. & M. Curie, Paris, France.

Université P. & M. Curie, Équipe d’Analyse Fonctionnelle, Paris, France.

External ‘Agrégation’ (competitive examination) in Mathematics

June 2003.

DEA (Masters Degree) in Functional Analysis

June 2001.

- Course work in Descriptive Set Theory and Geometry of Banach Spaces.
- Thesis : “A study of the paper *Smooth norms on certain $C(K)$ spaces* by Petr Hájek (*Proc. Amer. Math. Soc.* **131**(7): 2049–2051, 2003)”
- Supervisor : Professor Gilles Godefroy, Institut de Mathématiques de Jussieu (UMR 7586 du CNRS), équipe d’Analyse Fonctionnelle, University P. & M. Curie, Paris, France.

Maîtrise (fourth year diploma) in Pure Mathematics

June 2000.

- Graduated with first class honours.
- Course work in Lie Groups and Algebras, Real and Applied Analysis, Model Theory.

Licence (third year diploma) in Applied Mathematics

June 1999.

- Graduated with first class honours.
- Course work in Matrix Analysis, Lebesgue Integration Theory, Differential Equations, Topology and Functional Analysis, Calculus and Complex Analysis.

A. Schweitzer Highschool, Le Raincy, France.

Classes Préparatoires Scientifiques

1996-1998.

(Scientific Preparatory Classes)

A. Boulloche Highschool, Livry-Gargan, France.

Baccalauréat (série Scientifique, option Mathématiques)

June 1996.

- graduated with Honours

2.2 Training Courses

Centre de Recherches Mathématiques, Université de Montréal, Canada.

Minicourse on Advanced Algorithms and Numerical Software for the Bifurcation Analysis of Dynamical Systems
30 June - 1 July,
2007.

Department of Applied Mathematics, University of Twente, The Netherlands.

Multiscale Modeling and Singular Perturbations

7-11 Jan 2008.

3 Research

3.1 Ph.D. (6 May 2009)

My PhD research dealt with the numerical study of global manifolds in slow-fast dynamical systems. This includes numerical computations of slow manifolds and canard orbits, bifurcation analysis of singularly perturbed systems, with a view towards applications, e.g., in biology, chemistry, or neuroscience.

- **Thesis** : *Numerical Continuation Methods for Slow-Fast Dynamical Systems*.
- **Supervisors** : Dr. Hinke M. Osinga and Prof. Bernd Krauskopf
(University of Bristol, Bristol, UK).
- **Examiners** : Prof. Alan R. Champneys (University of Bristol, Bristol, UK) and
Prof. Tasso J. Kaper (Boston University, Boston, USA)

3.2 Research Interests

My research is focused on geometric singular perturbation theory and the canard phenomenon in the context of both smooth and non-smooth (Filippov, piecewise-linear) dynamical systems. I am looking at the robustness of slow-fast phenomena in general, and canard behaviours in particular. I am also interested further developing numerical continuation methods adapted to the study of multiple time scale dynamics and to the computation of challenging dynamical objects (invariant manifolds, isolas, complex i.e. multi-mode oscillations).

3.3 Research Visits

Center for Applied Mathematics, Cornell University, USA.

(invited by Prof. John Guckenheimer)

January - March, 2009.

27 October - 7 November, 2009.

Centre de Recerca Matemàtica, Barcelona, Spain.

(invited by Dr. Antoni Guillamon)

3-15 May, 2009.

Laboratoire J.-L. Lions, Université P. & M. Curie, France.

(invited by Prof. Jean-Pierre Francoise)

11-18 Feb, 2010.

I.N.R.I.A., Centre de Paris - Rocquencourt, Équipe SISYPHE-REGATE, France.

(invited by Dr. Frédérique Clément)

4-11 May, 2010.

Center for Biodynamics, Boston University, USA.

(invited by Prof. Tasso J. Kaper)

3-10 Oct, 2010.

Department of Mathematics, Hasselt University, Belgium.

(invited by Dr. Peter De Maesschalck)

12-18 Dec, 2010.

4 Publications

4.1 Preprints

- [Pr1] J. Burke, **M. Desroches**, A. M. Barry, T. J. Kaper and M. A. Kramer, *A showcase of torus canards in neuronal bursters*, submitted for publication, July 2011.
- [Pr2] D. Avitabile, **M. Desroches** and S. Rodrigues, *Boundary-value formulations for the numerical continuation of isolas of equilibria*, submitted for publication, July 2011.
- [Pr3] D. Linaro, A. R. Champneys, **M. Desroches** and M. Storace, *Spike-adding and codimension-two bifurcations in the Hindmarsh-Rose burster*, submitted for publication, September 2011.
- [Pr4] **M. Desroches**, J. Burke, T. J. Kaper and M. A. Kramer, *Canards of mixed type: new dynamics in a neural burster*, submitted for publication, September 2011.
- [Pr5] **M. Desroches**, M. Krupa and S. Rodrigues, *Canards, inflection and excitability threshold in neuronal models*, submitted for publication, September 2011.

4.2 Peer-reviewed journal articles

- [8] **M. Desroches**, J. Guckenheimer, B. Krauskopf, C. Kuehn, H. M. Osinga and M. Wechselberger *Mixed-mode oscillations with multiple time scales* ([preprint](#))
SIAM Review **52**(2), 2012. [14 citations]
- [7] **M. Desroches** and M. R. Jeffrey
Canard and curvature : the “smallness of ε ” in slow-fast dynamics ([preprint](#))
Proceedings of the Royal Society A **467**(2132): 2404, 2011. [3 citations]
- [6] **M. Desroches** and M. R. Jeffrey
Canard and curvature : nonsmooth approximation by pinching ([preprint](#))
Nonlinearity **24**(5): 1655-1682, 2011. [5 citations]

- [5] J. Rankin, **M. Desroches**, B. Krauskopf and M. Lowenberg
Canard cycles in aircraft ground dynamics ([preprint](#))
 Nonlinear Dynamics (Online First), 2011.
- [4] **M. Desroches**, B. Krauskopf, and H. M. Osinga
Numerical continuation of canard orbits in slow-fast dynamical systems ([preprint](#))
 Nonlinearity **23**(3): 739–765, 2010. [10 citations]
- [3] **M. Desroches**, B. Krauskopf, and H. M. Osinga
The geometry of mixed-mode oscillations in the Olsen model for P.-O. reaction ([preprint](#))
 Discrete and Continuous Dynamical Systems Series S **2**(4): 807–827, 2009. [4 citations]
- [2] **M. Desroches**, B. Krauskopf, and H. M. Osinga
The geometry of slow manifolds near a folded node ([preprint](#))
 SIAM Journal of Applied Dynamical Systems **7**(4): 1131–1162, 2008. [17 citations]
- [1] **M. Desroches**, B. Krauskopf, and H. M. Osinga
Mixed-mode oscillations and slow manifolds in the self-coupled FitzHugh-Nagumo system ([preprint](#))
 Chaos **18**(1): 015107, 2008. [20 citations]

4.3 Conference Proceedings

- [Proc1] D. Avitabile, **M. Desroches** and S. Rodrigues, *Numerical continuation of isolas of equilibria*.
 7th European Nonlinear Oscillations Conference (E.N.O.C.) Rome (Italy), July 2011.
- [Proc2] P. Thota and **M. Desroches**, *Numerical continuation of canard-like orbits in piecewise-linear systems*.
 7th European Nonlinear Oscillations Conference (E.N.O.C.) Rome (Italy), July 2011.

4.4 Work in Progress

- J. M. Cortes, **M. Desroches** and S. Rodrigues, *Shil'nikov chaos in a synaptic model for working memory*, in preparation, 2011.
- P. De Maesschalck and **M. Desroches**, *Numerical continuation techniques for planar slow-fast systems*, in preparation, 2011.
- F. Clément, **M. Desroches** J.-P. Françoise, M. Krupa and A. Vidal, *Multiscale analysis of mixed-mode oscillations in a phantom bursting model*, in preparation, 2011.

5 Talks

5.1 Invited Presentations

- 2011**
- **30 March** - *Numerical Continuation: Theory and Applications*. - Invited seminar talk, séminaire CalSim, Institut du Calcul et de la Simulation, Université Pierre et Marie Curie - Paris 6, Paris (France).
 - **13 May** - *Méthodes de continuation numérique pour les perturbations singulières - application à certaines dynamiques neuronales..* - Invited seminar talk, séminaire MODEMIC, I.N.R.I.A., Centre de Sophia-Antipolis, Montpellier (France).
 - **22 May** - *Canard à l'orange: a new recipe for multiple time scales*. - Invited talk in the mini-symposium *Multiple Time Scales Dynamics: from Theory to Biological Applications*, SIAM Conference on Application of Dynamical Systems, Snowbird (USA).
Co-organiser of this mini-symposium with Mike R. Jeffrey and Serafim Rodrigues.
 - **29 June** - *Numerical Continuation: Theory, Implementation and Recent Advances*. - Invited seminar talk, Department of Computer Science and Artificial Intelligence, Universidad de Granada, Granada (Spain).
 - **25 July** - *Numerical continuation of canard-like orbits in piecewise-linear systems*. - Invited talk in the mini-symposium *Computational Methods, 7th European Nonlinear Oscillations Conference (ENOC)*, Rome (Italy).
 - **26 July** - *Numerical continuation of isolas of equilibria*. - Invited talk in the mini-symposium *Computational Methods, 7th European Nonlinear Oscillations Conference (ENOC)*, Rome (Italy).
 - **17 August** - *Computation of invariant manifolds in slow-fast systems with mixed-mode oscillations..* - Invited seminar talk, Department of Mathematics, Nonlinear Analysis and Dynamics seminar, Technical University of Denmark, Copenhagen (Denmark).
 - **15 September** - *Canards and Inflection*. - Invited presentation, *Mathematical neuroendocrinology week*, Regate research group, INRIA, Paris-Rocquencourt centre (France).
- 2010**
- **7 January** - *Calcul numérique de variétés lentes dans les systèmes lents-rapides présentant des oscillations*. - Invited seminar talk, Séminaire d'Analyse et Applications, Université d'Évry Val d'Essonne, Evry (France).
 - **15 February** - *Systèmes dynamiques lents-rapides en 2 et 3 dimensions: résultats théoriques et défis numériques*. - Invited seminar talk, Séminaire SISYPHE, I.N.R.I.A., Centre de Paris-Rocquencourt (France).
 - **17 February** - *Systèmes dynamiques lents-rapides en 2 et 3 dimensions: résultats théoriques et défis numériques*. - Invited seminar talk, Séminaire NeuroMathComp, I.N.R.I.A., Centre de Sophia-Antipolis (France).
 - **7 April** - *Computing 2D manifolds in slow-fast systems: a boundary value approach with an application to reaction dynamics*. - Invited talk in the special session *Dynamical Systems, Joint British Mathematics Colloquium & British Applied Mathematics Colloquium*, University of Edinburgh (UK).
 - **4 June** - *Numerical continuation of isolas*. - Invited talk in the mini-symposium *Recent Advances on Isolats and Invariant Manifolds: Numerics and Applications*, SIAM Meeting DSPDEs'10, Barcelona (Spain).
Co-organiser of this mini-symposium with Daniele Avitabile and Serafim Rodrigues

- o; **9 September** - *Canard à l'orange: a new recipe for multiple time scales.* - Invited talk in the mini-symposium [Multiple Time Scale Behaviour, Dynamics Days Europe 2010](#), Bristol (UK).
Co-organiser of this mini-symposium with Mike Jeffrey
- o **4 October** - *Canards and inflection.* - Invited seminar talk, [Department of Mathematics, Dynamical Systems Seminar, Boston University](#), Boston (USA).
- o **7 December** - *Canards and inflection.* - Invited presentation, Workshop *Analyse Non-linéaire et Applications aux Rythmes du vivant (A.N.A.R.)*, Université de La Rochelle, La Rochelle (France).
- o **13 December** - *Numerical Continuation in Slow-Fast Systems.* - Invited seminar talk, [Department of Mathematics, Dynamical Systems Seminar, Hasselt University](#), Hasselt (Belgium).

2009

- o **6 February** - *Numerical computation of slow manifolds and canards near a folded node.* - Invited seminar talk, [Department of Mathematics, Dynamic Seminar, Cornell University](#), Ithaca (USA).
- o **12 February** - *Numerical computation of slow manifolds and canards near a folded node.* - Invited seminar talk, [Department of Mathematics, Cicada Seminar, The University of Manchester](#), Manchester (UK).
- o **19 February** - *Detection and continuation of canard orbits.* - Invited presentation, [Mini-Workshop on Slow-Fast Dynamics and Applications, University of Bristol](#), Bristol (UK).
- o **20 March** - *Detection and continuation of canard orbits.* - Invited presentation, [McGill University](#), Montréal (Canada).
- o **23 March** - *Numerical computation of slow manifolds and canards near a folded node.* - Invited seminar talk, [Department of Mathematics, Dynamical Systems Seminar, Boston University](#), Boston (USA).
- o **16 April** - *Numerical continuation methods for slow-fast dynamical systems.* - Invited seminar talk, [Department of Mathematics, Nonlinear dynamics and complex systems seminar, Technical University of Denmark](#), Copenhagen (Denmark).
- o **20 May** - *Computation of global manifolds in slow-fast systems with mixed-mode oscillations.* - Invited talk in the mini-symposium [Slow-fast Systems and Mixed-Mode Oscillations, SIAM Conference on Application of Dynamical Systems, Snowbird](#) (USA).
Co-organiser of this mini-symposium with Hinke M. Osinga.
- o **21 October** - *Computation of global manifolds in slow-fast systems with mixed-mode oscillations.* - Invited seminar talk, [School of Mathematical Sciences, Theoretical Mechanics Seminar, The University of Nottingham](#), Nottingham (UK).
- o **2 December** - *Slow-fast systems and “canards” : from the theory to a numerical duck hunt!* - Invited seminar talk, [Department of Mathematics, Dynamics Seminar, University of Portsmouth](#), Portsmouth (UK).

2008

- o **29 May** - *Calcul numérique de variétés lentes et de canards près d'une pseudo-singularité de type noeud.* - Invited seminar talk, [Séminaire: Dynamique globale des systèmes différentiels, Université P. & M. Curie - Paris VI](#), France.
- o **11 July** - *Slow manifolds, mixed-mode oscillations and canards in the self-coupled FitzHugh-Nagumo system.* - Invited talk in the mini-symposium [Systems with Multiple Time Scales: Computations and Applications, 2008 SIAM annual meeting](#), San Diego (USA).

- **14 July** - *Numerical computation of slow manifolds and canards near a folded node.* - Invited seminar talk, Department of Mathematics, Mathematical Biology group, University of Pittsburgh, Pittsburgh (USA).

5.2 Contributed Talks and Posters

- **15 May 2009** - *Numerical computation of slow manifolds and canard orbits near a folded node - Application to neuronal dynamics.* - **Deterministic and Stochastic Modeling in Computational Neuroscience and Other Biological Topics**, Centre de Recerca Matemàtica, Barcelona, Spain.
- **31 March 2008** - *Slow manifolds, mixed-mode oscillations and canards near a folded node.* - **50th British Applied Mathematics Colloquium**, University of Manchester, UK.
- **23 April 2007** - *The geometry of slow manifolds near a folded node.* - **International Conference "Dynamics in Perturbations"** on the occasion of Freddy Dumortier's 60th birthday, Hasselt University, Belgium.
- **18 April 2007** - *Computing canards.* - **49th British Applied Mathematics Colloquium**, University of Bristol, UK.

Poster

Computing slow manifolds and canards in the self-coupled FitzHugh-Nagumo system.

Presented at :

ECMTB08, University of Edinburgh, UK

Workshop in Nonlinear Neurodynamics, University of Exeter

July 2008.

September 2008.

6 Grants and Awards

- **'Agrégation' Scholarship** given by the French Ministry of Education **2002-2003.**
- **Prize** awarded by the UK and Republic of Ireland section of SIAM together with the University of Manchester for **one of the best presentations by a PhD student at the British Applied Mathematics Colloquium 2008,** **April 2008.**
- **Postdoctoral Fellowship (Empower)** awarded for two years by the Irish Research Council for Science, Engineering & Technology (IRCSET) **July 2009.**
Offer declined since I accepted the position in Bristol.
- **Visiting grant** "Research in Pair" awarded by the Centre International de Rencontres Mathématiques (C.I.R.M.) (Luminy, France) for a project together with Serafim Rodrigues **28 Feb - 12 Mar 2011.**
- **Postdoctoral Fellowship** awarded for three years by the Mathematical Biosciences Institute (MBI) **February 2011.**
Offer declined since I accepted the permanent position at the INRIA.

7 Other academic activities

7.1 Conference and seminar organisation

- **Organiser of Mini-Symposia** at the following past and forthcoming international conferences
 - [SIAM Conference on Applications of Dynamical Systems](#), Snowbird (USA), 17–21 May 2009.
 - SIAM meeting Emerging Topics on Dynamical Systems and Partial Differential Equations, Barcelona (Spain), 31 May – 4 June 2010.
 - XXXth Dynamics Days Europe, Bristol, 6–10 September 2010.
 - [SIAM Conference on Applications of Dynamical Systems](#), Snowbird (USA), 22–26 May 2011.
- **Organiser of the Applied Nonlinear Mathematics Seminar, University of Bristol, Dept. of Eng. Mathematics**

September 2009 - June 2011.

7.2 Dynamical Systems community

Section chief editor, DSWeb Media Gallery

January 2010 - present

7.3 Reviewing activities

- Physica D
- International Journal of Nonlinear Mechanics
- Nonlinear Dynamics
- Philosophical Transactions of the Royal Society, Series A
- Journal of Mathematical Neuroscience

7.4 Professional memberships

- Society for Industrial and Applied Mathematics (SIAM)
- Société Mathématique de France (SMF)

8 Teaching Experience

University of Bristol, Department of Engineering Mathematics, UK.

Taught various tutorials, example classes and computer labs

2006-2009.

- Engineering Mathematics (tutorials)
- Mathematics with Maple (computer labs)

- Data Analysis with Matlab (computer labs)
- Discrete Mathematics (example classes)

Supervised a third-year project on “Periodic solutions of the van der Pol equation”	Autumn 2009.
Supervised a third-year project on “Bursting oscillations in the Hindmarsh-Rose system”	Autumn 2010.
Supervised a third-year project on “Mathematical models for neuronal activity”	Winter 2011.
Supervised a third-year project on “The dynamics of single and double pendula ”	Winter 2011.
Supervised a third-year project on “Mathematical models for interacting species”	Winter 2011.

9 Languages and Computer skills

FRENCH :	mother tongue
ENGLISH :	fluent
GERMAN :	working knowledge
PROGRAMMING LANGUAGES :	C/C++, python
OPERATING SYSTEMS :	linux, unix, windows
SCIENTIFIC SOFTWARES :	Maple, Matlab
NUMERICAL BIFURCATION SOFTWARES :	Auto, XppAUT, Cl_MatCont, Neuron

10 Referees

Professor Alan R. Champneys

Address: Department of Engineering Mathematics
University of Bristol
Queen’s Building, University Walk
Bristol BS8 1TR, UK.

Tel: +44-(0)117 33-15643

E-mail: a.r.champneys@bristol.ac.uk

Professor Eusebius J. Doedel

Address: Computational Mathematics and Visualization Laboratory
Concordia University
EV 3285, Sir George Williams Campus
1455 De Maisonneuve Boulevard West
Montreal, Quebec, Canada, H3G 1M8.

Tel: +001-514 848 2424 3048

E-mail: doedel@cse.concordia.ca

Professeur Jean-Pierre François

Address: Laboratoire Jacques-Louis Lions (LJLL)
Université Pierre et Marie Curie - Paris 6 (UPMC)
4 Place Jussieu
75005 Paris, France.
Tel: +33-(0) 44 27 85 61
E-mail: jpf@math.jussieu.fr

Professor John Guckenheimer

Address: Mathematics Department
Cornell University
565 Malott Hall
Ithaca, NY 14853-2401, USA.
Tel: +001-607 255-8290
E-mail: jmg16@cornell.edu

Professor Tasso J. Kaper

Address: Department of Mathematics and Statistics
Boston University
111 Cummington Street
Boston, MA 02215, USA.
Tel: +001-617 353-9552
E-mail: tasso@math.bu.edu

Professor Bernd Krauskopf

Address: Department of Engineering Mathematics
University of Bristol
Queen's Building, University Walk
Bristol BS8 1TR, UK.
Tel: +44-(0)117 33-15625
E-mail: b.krauskopf@bristol.ac.uk

Professor Jonathan E. Rubin

Address: Department of Mathematics
University of Pittsburgh
301 Thackeray Hall
Pittsburgh, PA 15260, USA.
Tel: +001-412 624-6157
E-mail: jonrubin@pitt.edu

Doctor Martin Wechselberger

Address: School of Mathematics and Statistics
University of Sydney
NSW, 2006, Australia
Tel: +61-2-9351 3860
E-mail: wm@maths.usyd.au