

Curriculum Vitae of Rodolphe Sepulchre – April 2008

1. Personal data

(Professional address)	(Private address)
Institut Montefiore, B28	
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E-mail : r.sepulchre@ulg.ac.be	
Belgian, born on April 2, 1967	
Married, three children	

2. Professional experience

2005- present	Professeur ordinaire, Dept. of Electrical Engineering and Computer Science Université de Liège, Belgium
2001- present	Professeur invité, Dept. of Mathematical Engineering Université catholique de Louvain, Belgium
2002-2003	Visiting fellow, Dept. Mechanical and Aerospace Eng. Princeton University.
2000 - 2003	Professeur, Systems and Control Université de Liège, Belgium.
1997 - 2000	Chargé de cours, Systems and Control Université de Liège, Belgium.
1995 - 1997	FNRS Research Associate Université catholique de Louvain, Belgium.
1994 - 1996	Postgraduate research fellow University of California, Santa Barbara.

3. Education

- 1994 Ph.D. degree, Applied Science.
CESAME, Université catholique de Louvain
- 1990 Engineering degree in Applied Mathematics.
Université catholique de Louvain
Honours : la plus grande distinction
- 1990 Baccalauréat spécial en philosophie (one-year graduate degree).
Université catholique de Louvain

4. Research activities

The five following selected publications provide a representative sample of my research activity.

1. R. Sepulchre, D. Paley, N. Leonard. *Stabilization of planar collective motion. With all-to-all communication*, IEEE Transactions on Automatic Control, Vol. 52, No 5, pp. 811–824, 2007. *With limited communication*, IEEE Transactions on Automatic Control, Vol. 53, No 3, pp. 706-719, 2008.
These two papers study connections between phase models of coupled oscillators and mechanical models of groups of self-propelled particles. These connections are exploited in the analysis and design of feedback control laws for the individuals that stabilize collective motions for the group. The papers result from a research project initiated during my sabbatical year at Princeton University, 2002-2003. It led to a number of other publications with the same coauthors and to an ongoing research on consensus problems on manifolds
2. P.-A. Absil, R. E. Mahony, R. Sepulchre. *Optimization algorithms on matrix manifolds*, Princeton University Press, 224 pages, 2008.
This monograph summarizes research over the past ten years on efficient optimization algorithms developed on manifolds. It is an outgrowth of the PhD thesis of my former student Absil and a state of the art account of a flourishing research area that has gained significant momentum in the recent years in several branches of computational engineering.
3. R. Sepulchre. *Oscillators as systems and synchrony as a design prin-*

cipte, in “Current trends in nonlinear systems and control, L. Menini, L. Zaccarian, C. T. Abdallah (eds.)” Springer-Verlag, 2005.

The paper presents an expository survey of my ongoing research on a system theory for oscillators. Oscillators are regarded as open systems that can be interconnected to robustly stabilize ensemble phenomena characterized by a certain level of synchrony. The first part of the paper provides examples of design (stabilization) problems in which synchrony plays an important role. The second part of the paper shows that dissipativity theory provides an interconnection theory for oscillators. This research has led to several papers coauthored with PhD students, in particular Ronsse (rhythmic robotics) and Stan (dissipativity theory for oscillators).

4. R. Sepulchre. *Slow peaking and low-gain designs for global stabilization of nonlinear systems*, IEEE Transactions on Automatic Control, Vol. 45, No 3, pp. 453-461, 2000.

This paper exhibits a dynamical phenomenon induced by low-gain designs which are commonly used in the control of nonlinear systems. The understanding of this phenomenon is used to solve a particular nonlinear stabilization problem that has been open since the early nineties.

5. R. Sepulchre, M. Jankovic and P.V. Kokotovic. *Constructive Nonlinear Control*. Springer-Verlag, Series in Communications and Control Engineering, 313 pages, 1997.

This 310 pages monograph is the result of my postdoctoral stay at the University of California, Santa Barbara. The monograph presents new design procedures for the global stabilization of systems characterized by triangular properties of their state space models. These methods make it possible to exploit in a constructive manner fundamental connections previously established between stability, passivity, and optimality.

5. Teaching activities

Regular teaching assignment :

1. SYST002 Modélisation et analyse des systèmes (2nd year, 200 students).
2. SYST003 Analyse des systèmes et introduction à leur synthèse (4th

- year, 80 students).
3. SYST017 Systèmes non-linéaires (5th year, 20 students).
 4. INMA2361 Systèmes dynamiques non linéaires (course taught at UCL)
 5. GBIO 011 Modélisation des systèmes biologiques.

6. Conference activities

6.1. Organization of conferences and workshops

Grenoble '08	<i>Optimization on manifolds</i> (International summer school). Organisation : R. Sepulchre and P.-A. Absil. September 2008.
New-Orleans '07	<i>Optimization on manifolds</i> (pre-conference tutorial workshop). Organisation : P.-A. Absil, K. Hüper, R. Sepulchre . 46th IEEE Conference on Decision and control, New Orleans, December 2007. (25 participants)
Louvain-La-Neuve '04	<i>8th Workshop on dynamics and computation</i> , July 15, 2004 (20 participants). Organized with V. Blondel (UCL) , P. Van Dooren(UCL).
Leuven '03	<i>7th Workshop on dynamics and computation</i> , October 27-28, 2003 (100 participants). Organized with V. Blondel (UCL) , P. Deleenheer (Rutgers U., USA).
Brussels '02	<i>6th Workshop on dynamics and computation</i> , July 1-2, 2002 (60 participants). Organized with V. Blondel (UCL) , P. Rouchon (Ecole des Mines de Paris).
Brussels '01	<i>Workshop on dynamics and verification</i> , July 16-17, 2001. (50 participants). Organized with V. Blondel (UCL) , B. Boigelot (ULg), and J-F Raskin (ULB).
Brussels '00	<i>Workshop on the dynamics of neurons and vision</i> , September 4-5, 2000. (50 participants). Organized with V. Blondel (UCL) and Ph. Lefevre (UCL).
Liège '99	<i>Workshop on the dynamics of switching</i> , Université de Liège, August 30, 1999 (30 participants). Organized with V. Blondel.
Liège '98	<i>Workshop on the dynamics of computing</i> , Université de Liège, July 13, 1998 (25 participants). Organized with V. Blondel.

- Brussels '97 *Applied problems in nonlinear control*. Organized with L. Praly (France), and K. Astrom (Sweden). Brussels, June 30, 1997.
- San Diego '97 *Constructive Nonlinear Control* (one-day tutorial workshop). Organisation : P. Kokotovic, R. Freeman, M. Jankovic, M. Kstric, R. Sepulchre, A. Teel. 36th IEEE Conference on Decision and control, San Diego, December 1997. (55 participants)
- Phoenix '99 *Constructive Nonlinear Control* (one-day tutorial workshop). Organisation : P. Kokotovic, R. Freeman, M. Jankovic, M. Kstric, R. Sepulchre, A. Teel. 38th IEEE Conference on Decision and control, Phoenix, December 1999. (40 participants)

6.2. Selected invited lectures (since 2004)

Oscillators as systems and synchrony as a design principle, plenary lecture at annual study day of the Interuniversity Attraction Pole V/22 in Systems and Control, Ghent, June 2004.

A dissipativity approach to the design of stable oscillations, ACTRA workshop to honor the 70th birthday of P. Kokotovic, Rome, June 2004.

Dynamics and control of bounce juggling, semi-plenary lecture, 16th International Symposium on Mathematical Theory of Networks and Systems, Leuven, July 2004.

Oscillators as systems and synchrony as a design principle, plenary lecture, first Control Training Site workshop, Coimbra (Portugal), July 2004.

Dynamics and control of bounce juggling, semi-plenary lecture, 6th IFAC Symposium on Nonlinear Control Systems, Stuttgart, September 2004.

Control and coordination as interconnection, 6th MOVE0P Winter school, Brussels, December 2004.

Group coordination and cooperative control of steered particles in the plane, Trömso international workshop on coordination and control, June 2006.

Coordinated control and collective optimization, Cambridge University, June 2006.

Coordinated control and collective optimization, HYCON-CTS international

workshop, Paris, July 2006.

Optimization on manifolds and data processing, Principal Manifolds Workshop, Leicester, August 2006.

Consensus optimization on manifolds, plenary lecture at annual study day of the Interuniversity Attraction Pole V/22 in Systems and Control, Leuven, October 2006.

Consensus optimization on manifolds, Center Wiskunde and Informatica Amsterdam, November 2006.

A systems view on biochemical oscillators, Vrije Universiteit Amsterdam, November 2006.

Consensus optimization on manifolds, University of California Santa Barbara, December 2006.

Consensus on manifolds, SynCOnNet International Workshop Leuven, July 2007.

Consensus on manifolds, a series of two lectures at the Summer school on Optimization and Control with Applications in Modern Technologies, Thurnau, Germany, July 2007.

A systems view on biochemical oscillators, Workshop on control theory for Systems Biology, Groningen, November 2007.

Consensus, coordination, and synchronization, a series of five lectures at the Indian Institute of Technology, Bombay, India, January 2008.

Consensus, coordination, and synchronization, plenary lecture at Dynamic Days 2008, Delft, The Netherlands, August 2008.

7. Research supervision

7.1. Doctoral theses

F. Grogard, “Control of constrained systems : closed-loop, open-loop, and hybrid solutions.” October 2001, Université catholique de Louvain (co-promotor). Now researcher at INRIA, Sophia-Antipolis (France).

W. Michiels, “stability and stabilization of time-delay systems”, May 2002, Katholieke Universiteit Leuven (co-promotor). Now researcher at KUL, Belgium.

PA. Absil, “Invariant Subspace Computation : A Geometric Approach.” February 2003, Université de Liège. Now professor at UCL, Belgium.

G. Stan, “Global analysis and synthesis of oscillations : a dissipativity approach,” January 2005, Université de Liège. Now researcher at Cambridge, UK.

M. Gérard, “Dynamics and control of juggling,” February 2005, Université de Liège. Now at KPNG Consulting, Luxembourg.

R. Ronsse, “Rhythmic movements control : Parallels between human behavior and robotics,” May 2007. Now researcher at KUL, Belgium.

Ch. Germy, “Modelling and control of stick-slip oscillations in drilling systems ,” in progress (started October 1, 2003).

A. Sarlette, “Coordination and control”, in progress (started October 1, 2005).

M. Journée, “Optimization-based matrix algorithms for large-scale gene expression data mining”, in progress (started October 1, 2005).

M. Bonjean, “Modelling of spindle oscillations in deep sleep” (started October 1, 2005, co-supervised by P. Maquet).

A. Mauroy, “Synchronization and clustering in networks of integrate-and-fire oscillators” (started October 1, 2007).

G. Meyer, “Matrix algorithms for genome-scale discrete data mining” (started October 1, 2007).

7.2. Postdoctoral researchers

Pierre Ansay (Ph.D. 1999, University of Liège). January 2000- December 2001. First Europe project with Usinor/Cockerill-Sambre and the Royal Institute of Technology de Stockholm.

Jose De Dona (Ph.D. 2000, Newcastle University, Australia). January 2000-June 2000 (TMR European network on nonlinear control methods).

Javier Moreno (Ph.D. 2002, CICESE, Mexico). April 2004-April 2005. Antiwindup control of electromechanical systems.

Dong-Eui Chang (Ph.D. 2002, Caltech, USA). October 2004-August 2005. Hamiltonian systems with impacts.

Luca Scardovi (Ph.D. 2005, University of Genoa, Italy). September 2005-September 2006. Consensus and collective motion.

Emre Tuna (Ph.D. 2005, University of California, Santa Barbara, USA). October 2006-October 2007, consensus and synchronization.

Silvère Bonnabel (Ph.D. 2007, Ecole des Mines de Paris, France). October 2007-October 2008, coordination on Lie Groups, symmetry-preserving algorithms.

Denis Efimov (Ph.D. 2001, St Petersburg State Electrical Engineering University). - December 2008-December 2009, oscillators and entrainment.

8. Other scientific activities

8.1. Editorial tasks

Associate Editor of Journal of Nonlinear Science (since 2008).

Associate Editor of SIAM Journal of Control and Optimization (since 2007).

Associate Editor for Systems and Control Letters (since 2007).

Associate Editor for the journal Automatica (Elsevier) (July 1999-July 2002).

Associate Editor for the journal Mathematics for Control, Signals, and Systems (since January 1999).

Co-editor with E. Sontag (Rutgers University) of the electronic newsletter *Nonlinear Control Abstracts* (1998-2003).

8.2. Participation in theses committees (outside Ulg, since 2004)

G. Moorren, “Advanced signal processing applied to in-vivo spectroscopy and heart rate variability”, Katholieke Universiteit Leuven, 2004.

A. Pavlov, “The output regulation problem : a convergent dynamics approach”, Eindhoven University, 2004.

J.-M. Bourgeot, “Contribution à la commande de systèmes mécaniques non-réguliers”, INRIA Grenoble, 2004.

E. Witrant, “Stabilisation des systèmes commandés par réseaux”, Institut National Polytechnique de Grenoble, 2005.

J. Theys, “Joint Spectral Radius : theory and approximations”, Université catholique de Louvain, 2005.

W. De Clerq, “Advanced preprocessing techniques and nonlinear signal analysis applied to scalp electroencephalograms for the prediction of epileptic seizures”, Katholieke Universiteit Leuven, 2005.

J.M. Papy, “Subspace-based exponential data fitting using linear and multi-linear algebra”, Katholieke Universiteit Leuven, 2005.

M. Mirrahimi, “Dynamique et contrôle des systèmes quantiques”, Ecole Nationale Supérieure des Mines de Paris, 2005 (rapporteur).

K. Yacoubi, “Stabilisation des systèmes linéaires avec commande bornée et retardée”, Université Paris-Sud, 2005.

V. Andrieu, “Bouclage de sortie et observateur”, Ecole Nationale Supérieure des Mines de Paris, 2005 (rapporteur).

T. Laudadio, “Subspace-based quantification of magnetic resonance spectroscopic data using biochemical prior knowledge”, Katholieke Universiteit Leuven, 2005.

A. Chaillet, “On stability and robustness of nonlinear systems – Applications to cascaded systems”, LSS Supelec, France, 2006.

J. Rogge, “Dynamic behavior of oscillator networks”, Ghent University, 2006.

L. Sinègre, “ Etude des instabilités dans les puits activés par gas-lift”, Ecole

Nationale Supérieure des Mines de Paris, France, 2006.

S. Bonnabel, “Observateurs asymptotiques et symétries : théorie et exemples”, Ecole Nationale Supérieure des Mines de Paris, France, 2007.

F. De Smet, “Clustering behaviors in systems of coupled of oscillators and networks of mutually attracting agents”, Ghent University, 2007.

O. White, “The role of gravity in dexterous manipulation”, Université catholique de Louvain, 2007.

J. Hendrickx, “Graphs and Networks for the Analysis of Autonomous Agent Systems”, Université catholique de Louvain, 2008.

8.3. Scientific affiliations

Member of the administrative council of the European Union Control Association (1999-2001).

Vice-chair of IEEE Technical Committee on Nonlinear Systems.
Member of IFAC Technical Committee on Nonlinear Systems.

8.4. Funding and participation to research networks (not including university projects)

Partner of Interuniversity Attraction Pole VI/4 “Dynamical systems, control and optimization”

(Jan 2007 - Dec. 2011)

Nonlinear Control Network TMR # ERB FMRXCT-970137

(Dec. 97- Dec. 01)

Advanced Transmission and Oil System Concepts G4RD-CT-2000-00391

(Jan. 2001 - Jan 2004)

Control Training Site Multi-partner Marie Curie training site
(Jan. 2002 - Dec. 2006)
Partner of Interuniversity Attraction Pole V/22 “Dynamical systems and control : computation, identification, and modelling”
(Jan 2002 - Dec. 2006)
Member of HCYON network of excellence “Hybrid control : taming heterogeneity and complexity of networked embedded systems ”
(Sept 2004- Sept 2008)
FIRST Europe project CATODS “Control of Axial and Torsional Oscillations in Drilling Systems” (Promotor)
(Sept 2004 - Sept 2006).

8.5. Awards and fellowships

Erasmus 1990	Study fellowship for exchange between European universities (three months at the Ecole des Mines de Paris, 1990)
IBRA Prize 1991	Belgium Prize for the best graduate thesis in Automatic Control
BAEF 1994-1995	Post-doctoral Fellowship (Belgian American Educational Foundation)
NATO 1994-1995	Post-doctoral Fellowship (NATO)

8.6. Other activities

Consultant for Ion Beam Applications (1999-2000) and for Schneider Electric, Paris (2001-).