

Grégory BATT

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RESEARCH INTERESTS

Development of mathematical methods and computer tools for the analysis of synthetic biological systems

keywords: hybrid systems, formal verification, synthetic biology, genetic regulatory networks

CURRENT POSITION

Research scientist (CR1) in the Institut National de Recherche en Informatique et en Automatique.

EDUCATION

- 2006 **PhD in computer science** at the Université Joseph Fourier (Grenoble, France)
- 2002 *DEA Informatique: Systèmes et Communication* at the Université Joseph Fourier
- 2001 *Licence of the Magistère d'Informatique et Modélisation* at the Ecole Normale Supérieure de Lyon (France)
- 2000 **Maîtrise of the Magistère de Biologie Moléculaire et Cellulaire** at the Ecole Normale Supérieure de Lyon.
ERASMUS student at Uppsala University (Sweden)
- 1999 *Licence of the Magistère de Biologie Moléculaire et Cellulaire* at the Ecole Normale Supérieure de Lyon
- 1998 General scientific preparation (*BioMathSup* and *BioMathSpé*) for the *Grandes Ecoles* at the Lycée Pierre de Fermat in Toulouse (France). Admitted to the Institut National Agronomique de Paris-Grignon and to the Ecole Normale Supérieure de Lyon

RESEARCH EXPERIENCE

- since 10/2007 **Research scientist** at INRIA in the Contraintes research group (tenured position; hired CR2; promoted CR1 in 10/2009)
- 01/2006 - 09/2007 **Postdoctoral researcher:** *Timed abstractions of continuous dynamical systems with applications to gene network analysis* at Institut National Polytechnique de Grenoble in the Verimag research center (France)
- 12/2005 - 12/2006 **Postdoctoral researcher:** *Rational design of synthetic gene networks using formal analysis of hybrid systems* in Center for Information and Systems Engineering and Center for BioDynamics at Boston University
- 09/2002 - 11/2005 **PhD student:** *Validation of qualitative models of genetic regulatory networks: a method based on formal verification techniques* in the HELIX research group at INRIA Rhône-Alpes (France), under supervision of Hidde de Jong
- 01/2002 - 08/2002 **Lab training period** (computer science, *DEA*): *Validation of genetic regulatory network models*, in the HELIX research group at INRIA Rhône-Alpes, under supervision of Hidde de Jong
- 06/2001 - 08/2001 **Lab training period** (computer science, *Licence*): *Representation of protein/protein interactions in qualitative models of genetic regulatory networks*, in the HELIX research group at INRIA Rhône-Alpes, under supervision of Hidde de Jong
- 06/1999 - 08/1999 **Lab training period** (biology, *Licence*): *Discovering interactions between cytoskeletal proteins using double hybrid techniques*, in the Pharmacologie et Dynamique du Cytosquelette Microtubulaire research group at the Institut de Pharmacologie et de Biologie Structurale (Toulouse, France), under supervision of Laurent Mazzolini

TEACHING EXPERIENCE

- 09/2008 - 01/2009 Computational methods for systems and synthetic biology (12h) in Master Parisien de Recherche en Informatique of Paris 7 Univ., Ecoles Normales Supérieures of Paris and Cachan and Ecole Polytechnique (lecture)
- 09/2002 - 08/2005 Teaching assistant in computer science at the Université Joseph Fourier (3*64h):
- introduction to programming in *Licence Sciences et Technologies* (lecture and lab)
- modeling and simulation of genetic regulatory networks in *Master Sciences, Technologies et Santé* (lab)

SKILLS

Computer science: hybrid systems, model checking, bioinformatics, graph theory, algorithms, programming, operating systems, architecture, software engineering, synchronous languages for reactive systems, operational research, artificial neural networks, data and knowledge bases, distributed systems, human-computer interaction, probability theory.

Biology:

- theoretical: molecular biology, cellular biology and cancer, genetics, immunology, biochemistry, bioinformatics, plant biology, integrated physiology, development and evolution,
- practical: enzymology, chromatography, cloning, fusion proteins, immunolabeling, *in situ* hybridization, genetics in *Drosophila*, yeast, and *E. coli*, sequencing, double hybrid, electronic microscopy.

Languages: English: fluent; German and Swedish: notions.

PUBLICATIONS

Note: Impact Factors (IF) and Acceptance Rates (AR) are given when available.

Journal articles

- A. Rizk, **G. Batt**, F. Fages and S. Soliman (2009), A general computational method for robustness analysis with applications to synthetic gene networks, *Bioinformatics*, ISMB09/ECCB09 Special Issue, 25(12):i169-i178. (IF: 5.04; AR: 18%)
- **G. Batt**, C. Belta and R. Weiss (2008), Temporal logic analysis of gene networks under parameter uncertainty, joint special issue on Systems Biology of *IEEE Transactions on Circuits and Systems* and *IEEE Transactions on Automatic Control*, 53:215-229. (IF: 2.77/1.139, 2006)
- **G. Batt**, H. de Jong, M. Page and J. Geiselmann (2008), Symbolic reachability analysis of genetic regulatory networks using qualitative abstractions, *Automatica*, 44(4):982-989. (IF: 2.27, 2006)
- **G. Batt**, B. Yordanov, C. Belta and R. Weiss (2007), Robustness analysis and tuning of synthetic gene networks, *Bioinformatics*, 23(18):2415-2422. (IF: 4.89, 2006)
- **G. Batt**, D. Ropers, H. de Jong, J. Geiselmann, R. Mateescu, M. Page and D. Schneider (2005), Validation of qualitative models of genetic regulatory networks by model checking: Analysis of the nutritional stress response in *Escherichia coli*, *Bioinformatics*, 21(Suppl 1):i19-i28. (IF: 6.02, 2005)
- H. de Jong, J. Geiselmann, **G. Batt**, C. Hernandez and M. Page (2004), Qualitative simulation of the initiation of sporulation in *Bacillus subtilis*, *Bulletin of Mathematical Biology*, 66(2):261-300. (IF: 1.48, 2004)

Book chapters

- **G. Batt**, R. Casey, H. de Jong, J. Geiselmann, J.-L. Gouzé, M. Page, D. Ropers, T. Sari and D. Schneider (2005), Qualitative analysis of the dynamics of genetic regulatory networks using piecewise-linear models, in E. Pecou, S. Martinez and A. Maass, eds., *Mathematical and Computational Methods in Biology*. Hermann, 206-239.

International peer-reviewed conferences

- A. Rizk, **G. Batt**, F. Fages and S. Soliman (2008), On a continuous degree of satisfaction of temporal logic formulae with applications to systems biology, in M. Heiner and A.M. Uhrmacher, eds., *Sixth International Conference on Computational Methods in Systems Biology, CMSB'08*, Lecture Notes in Computer Science 5307, Springer-Verlag, 251-268. (AR: 33%)
- O. Maler and **G. Batt** (2008), Approximating continuous systems by timed automata, in J. Fisher, ed., *First International Workshop on Formal Methods in Systems Biology, FMSB'08*,

Lecture Notes in Computer Science 5054, Springer-Verlag, pp. 77-89.

- **G. Batt**, R. Ben Salah and O. Maler (2008), On timed models of gene networks, in J.-F. Raskin and P.S. Thiagarajan, eds., *Fifth International Conference on Formal Modeling and Analysis of Timed Systems (FORMATS'07)*, Lecture Notes in Computer Science, Springer-Verlag. (AR: 45%)
- **G. Batt**, C. Belta and R. Weiss (2007), Model checking genetic regulatory networks with parameter uncertainty, in A. Bemporad, A. Bicchi and G. Buttazzo, eds., *Tenth International Workshop on Hybrid Systems: Computation and Control (HSCC'07)*, Lecture Notes in Computer Science 4416, Springer-Verlag, pp. 61-75. (AR: 25%)
- **G. Batt**, C. Belta and R. Weiss (2007), Model checking liveness properties of genetic regulatory networks, in O. Grumberg and M. Huth, eds., *Thirteenth International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS'07)*, Lecture Notes in Computer Science 4424, Springer-Verlag, pp. 323-338. (AR: 26%)
- B. Yordanov, **G. Batt** and C. Belta (2007), Model checking discrete-time piecewise affine systems: application to gene networks, in M. Athans, ed., *European Control Conference (ECC'07)*, Kos, Greece.
- **G. Batt**, C. Belta and R. Weiss (2006), Robustness analysis and tuning of synthetic gene networks with parameter uncertainties, in *Cold Spring Harbor conference on Engineering Principles in Biological Systems*, 62, Cold Spring Harbor, NY, USA. (AR: < 35%)
- **G. Batt**, D. Ropers, H. de Jong, J. Geiselmann, R. Mateescu, M. Page and D. Schneider (2005), Analysis and verification of qualitative models of genetic regulatory networks: A model-checking approach, in L.P. Kaelbling and A. Saffiotti, eds., *Nineteenth International Joint Conference on Artificial Intelligence (IJCAI'05)*, Edinburgh, Scotland, 370-375. (AR: 18%)
- **G. Batt**, D. Ropers, H. de Jong, J. Geiselmann, M. Page and D. Schneider (2004), Qualitative analysis and verification of hybrid models of genetic regulatory networks: Nutritional stress response in *Escherichia coli*, in M. Morari and L. Thiele, eds., *Eighth International Workshop on Hybrid Systems: Computation and Control (HSCC'05)*, Lecture Notes in Computer Science 3414, Springer-Verlag, 134-150. (AR: 44%)
- **G. Batt**, D. Bergamini, H. de Jong, H. Garavel and R. Mateescu (2004), Model checking genetic regulatory networks using GNA and CADP, in S. Graf and L. Mounier, eds., *Eleventh International SPIN Workshop on Model Checking Software (SPIN'04)*, Lecture Notes in Computer Science 2989, Springer-Verlag, 158-163. (AR: 40%)

International workshops and national journals and conferences (peer-reviewed)

- **G. Batt**, H. de Jong, J. Geiselmann, J.-L. Gouzé, M. Page, D. Ropers, T. Sari and D. Schneider (2007), Analyse qualitative de la dynamique de réseaux de régulation génique par des modèles linéaires par morceaux, *Technique et sciences informatiques*, numéro spécial Post-génomique, 26(1-2):11-45.
- **G. Batt**, B. Yordanov, C. Belta and R. Weiss (2007) Robustness analysis and tuning of synthetic gene networks, in C. Brun and G. Didier, eds., *Working Notes of the Journées Ouvertes Biologie, Informatique et Mathématiques (JOBIM'07)*, Marseille, France.
- **G. Batt**, D. Ropers, H. de Jong, J. Geiselmann, R. Mateescu, M. Page and D. Schneider (2005), Analysis and verification of qualitative models of genetic regulatory networks: A model-checking

approach, in F. Hofbaur, B. Rinner and F. Wotawa, eds., *Working Notes of the Nineteenth International Workshop on Qualitative Reasoning (QR'05)*, Graz, Austria.

- **G. Batt**, D. Ropers, H. de Jong, J. Geiselmann, R. Mateescu, M. Page and D. Schneider (2005), Validation of qualitative models of genetic regulatory networks by model checking: Analysis of the nutritional stress response in *Escherichia coli*, in G. Perrière, A. Guénoche and C. Geourjon, eds., *Working Notes of the Journées Ouvertes Biologie, Informatique et Mathématiques (JOBIM'05)*, 471-482, Lyon, France.
- **G. Batt**, H. de Jong, J. Geiselmann and M. Page (2003), Analysis of genetic regulatory networks: A model-checking approach, in B. Bredeweg and P. Salles, eds., *Working Notes of the Seventeenth International Workshop on Qualitative Reasoning (QR'03)*, 31-38, Brasilia, Brazil.
- **G. Batt**, H. de Jong, J. Geiselmann and M. Page (2003), Analysis of genetic regulatory networks: A model-checking approach, in M. Benerecetti and C. Pecheur, eds., *Working Notes of the Second International Workshop on Model Checking and Artificial Intelligence (MoChArt'03)*, 51-58, Acapulco, Mexico.

PhD thesis

- **G. Batt** (2006). Validation de modèles qualitatifs de réseaux de régulation génique : une méthode basée sur des techniques de vérification formelle, Université Joseph Fourier.

Research reports

- **G. Batt** and C. Belta (2006), Model checking genetic regulatory networks with applications to synthetic biology, Technical Report 2006-IR-0030, CISE Boston University.
- **G. Batt**, H. de Jong, J. Geiselmann, M. Page, D. Ropers and D. Schneider (2004), Symbolic reachability analysis of genetic regulatory networks using qualitative abstraction, Technical Report RR-5362, INRIA Rhône-Alpes.
- **G. Batt** (2002). Représentation des interactions protéine/protéine dans la cadre d'une méthode de modélisation de réseaux géniques, Technical Report RR-4382, INRIA Rhône-Alpes.

TOOLS

- **RoVerGeNe**, version **3.0**, for the robust verification of gene networks. Joint work with C. Belta (Boston University).
- **Genetic Network Analyzer**, version **6.0**, for the verification of dynamical properties of genetic regulatory networks. Joint work with H. de Jong and M. Page (INRIA Rhône-Alpes).

INVITED TALKS (SELECTED)

- Parameter search for robust dynamical properties with applications to synthetic biology, in *séminaire d'informatique de l'ENS Lyon*, Sept. 2009, Lyon, France
- A general computational method for robustness analysis with applications to synthetic gene networks, in *Modelling and Analysis of Cell Behaviour*, Sept. 2009, Warwick, UK.
- A general computational method for robustness analysis with applications to synthetic gene networks, in *Hybrid Systems Approaches to Computational Biology (HSCB'09)*, Apr. 2009, San

Francisco, USA.

- Quantitative robustness estimate of gene network properties, in *Workshop on discrete models of biological networks : from structure to dynamics*, Nov. 2008, Marseille, France.
- Quantitative robustness estimate of gene network properties, in *Workshop on bioinformatical modeling in biology and medicine*, Oct. 2008, Nice, France.
- Robustness analysis and tuning of synthetic gene networks, in *First French Workshop on Synthetic Biology*, March 2008, Paris, France.
- Robustness analysis and tuning of synthetic gene networks, in *Towards Systems Biology Workshop*, October 2007, Grenoble, France.
- Automatic tuning of synthetic gene networks, in *Workshop on Hybrid Systems Biology of Conference on Decision and Control, CDC'06*, December 2006, San Diego, CA, USA. (Presented by C. Belta)
- Validation of genetic regulatory network models, in *Workshop on Hybrid Systems Biology of Conference on Decision and Control, CDC'06*, December 2006, San Diego, CA, USA.
- Combining discrete abstraction and model checking for the analysis of partially-known models of natural and synthetic gene networks, in *MIT Bioinformatics Seminar*, October 2006, Cambridge, MA, USA.
- Formal verification of hybrid models of genetic regulatory networks, in *Dagstuhl Seminar on Verification and Simulation of Dynamic Systems*, May 2006, Schloss Dagstuhl, Germany.
- Validation of qualitative models of genetic regulatory networks by model checking: Analysis of the nutritional stress response in *E. coli*, in *Workshop on Computation of Biochemical Pathways and Genetic Networks*, September 2005, Heidelberg, Germany.
- Validation of qualitative models of genetic regulatory networks by model checking: Analysis of the nutritional stress response in *E. coli*, in *Workshop on Dynamical Modeling and Analysis of Biological Regulatory Networks*, May 2005, Marseille, France.
- Qualitative modeling and simulation of genetic regulatory networks, in *Minisymposium on Cell Biology with Control and System Theory of Conference on Mathematical Theory of Networks and Systems (MTNS'04)*, July 2004, Leuven, Belgium.

CONFERENCE PRESENTATIONS (SELECTED)

- Robustness analysis and tuning of synthetic gene networks, in *Journées Ouvertes Biologie Informatique et Mathématiques (JOBIM'07)*, July 2007, Marseille, France
- Model checking genetic regulatory networks with parameter uncertainty, in *Tenth International Workshop on Hybrid Systems: Computation and Control (HSCC'07)*, April 2007, Pisa, Italy.
- Model checking liveness properties of genetic regulatory networks, in *Thirteenth International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS'07)*, March 2007, Braga, Portugal.
- Robustness analysis and tuning of synthetic gene networks with parameter uncertainties, in *Cold Spring Harbor conference on Engineering Principles in Biological Systems*, December 2006, Cold Spring Harbor, NY, USA.
- Analysis and verification of qualitative models of genetic regulatory networks: A model-checking

approach, in *Nineteenth International Joint Conference on Artificial Intelligence (IJCAI'05)*, August 2005, Edinburgh, UK.

- Validation of qualitative models of genetic regulatory networks by model checking: Analysis of the nutritional stress response in *E. coli*, in *Journées Ouvertes Biologie, Informatique et Mathématiques (JOBIM'05)*, July 2005, Lyon, France
- Validation of qualitative models of genetic regulatory networks by model checking: Analysis of the nutritional stress response in *E. coli*, in *Thirteenth International Conference on Intelligent Systems for Molecular Biology (ISMB'05)*, June 2005, Detroit, MI, USA.
- Qualitative analysis and verification of hybrid models of genetic regulatory networks: Nutritional stress response in *E. coli*, in *Eighth International Workshop on Hybrid Systems : Computation and Control (HSCC'05)*, March 2005, Zurich, Switzerland.
- Model checking genetic regulatory networks using GNA and CADP, in *International SPIN Workshop on Model Checking of Software (SPIN'04)*, April 2004, Barcelona, Spain.
- Formal validation of models of genetic regulatory networks, in *Modeling and Simulation of Biological Regulatory Processes*, a satellite meeting of *European Conference on Computational Biology (ECCB'03)*, October 2003, Paris, France.
- Analysis of genetic regulatory networks: A model-checking approach, in *International Workshop on Qualitative Reasoning (QR'03)*, August 2003, Brasilia, Brazil.
- Analysis of genetic regulatory networks: A model-checking approach, in *Model Checking and Artificial Intelligence (MoChArt'03)*, August 2003, Acapulco, Mexico.

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