# GORAN FREHSE

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## APPOINTMENTS

***Assistant Professor (Maître de conférences)*** at VERIMAG, Grenoble, France in the Hybrid Systems group of Dr. Oded Maler, since 2006 (unlimited appointment)

***Post-Doctoral Research Associate*** at VERIMAG, Grenoble, France (advisor: Dr. Oded Maler), 2005-2006

## EDUCATION

Radboud University, Nijmegen, The Netherlands, 2005
Ph.D. in Computer Science, October 10, 2005
Thesis Title: *Compositional Verification of Hybrid Automata using Simulation Relations*

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| Supervision: | Prof.dr. Frits W. Vaandrager<br>Prof. Dr.-Ing. Sebastian Engell |
| Reading Committee : | Prof. Dr. Thomas A. Henzinger,<br>Prof. Dr. Kim G. Larsen,<br>Prof. Dr. Bruce H. Krogh |
| Judgement : | « excellent work » |
| Defense Committee: | Prof. Dr. Kim G. Larsen<br>Prof. Dr. Bruce H. Krogh<br>Prof.dr. Ed Brinksma<br>Prof.dr.ir. Jan Friso Groote<br>Dr. Jozef Hooman<br>Prof. Dr. Markus Mueller-Olm |

Carnegie Mellon University, Pittsburgh, PA, USA, 2003-2005
Doctoral Research: Analysis of Hybrid Systems and Mixed-Signal Circuits

Dortmund University, Dortmund, Germany, 2000-2003
Doctoral Research: Formal Verification of Hybrid Systems

Karlsruhe University, Karlsruhe, Germany, 1993-1999
Diploma in Electrical Engineering, 1999, Grade: very good
Thesis Title: *Process Control of a Class of Hybrid Systems based on Net-State-Models*

Institut National des Sciences Appliquées (INSA), Lyon, France, 1996-1997
Projet de Fin d'Etudes (master's thesis), 1997, Grade: excellent
Thesis Title: *Control of a MIG welding post using Fuzzy Logic*

Tehachapi High School, Tehachapi, California, 1989-1990
High School Diploma, GPA 4.45
Bank of America Award in the Field of Mathematics

## Research Experience

***Post-Doctoral Research:*** VERIMAG, Grenoble, France (advisor: Dr. Oded Maler), 2005-2006

- Verification of switched flow networks

***Doctoral Research:*** Process Control Laboratory, Department of Biochemical and Chemical Engineering, Dortmund University, 2000-2003 (research advisor: Prof. Dr.-Ing. Sebastian Engell), and Department of Electrical and Computer Engineering, Carnegie Mellon University, 2003-2005 (research advisor: Prof. Bruce Krogh)

- PHAVer, a tool for verifying safety of hybrid automata via reachability analysis and compositional reasoning by computing simulation relations; currently the most powerful one for several benchmarks.
- Framework for compositional reasoning for hybrid automata, including a novel assume/guarantee rule; first algorithmic application of compositional reasoning in the field of hybrid systems
- Verification of analog and mixed-signal circuits

***Undergraduate Research:***

Control Systems Laboratory, Department of Electrical Engineering, Karlsruhe University, 1999

- Fast reachability analysis and control of Piecewise Linear Systems based on their left eigenvector structure

ABB Research Center, Baden, Switzerland, 1999

- Optimal control of a gas compressor field

## Research Interests

- Formal methods
- Verification of analog and mixed-signal circuits
- Compositional and assume-guarantee reasoning for discrete and hybrid systems
- Optimal control

## Teaching Experience

**Assistant Professor,** Computer Science and Applied Mathematics (UFR IMA), Joseph Fourier University (UJF), Grenoble

- Language and Computer Architecture (4h/week, 1 semester), 2006
- Introduction to Data Bases (2h/week, 1 semester), 2006
- Data Base Administration (2h/week, 1 semester), 2007
- Compilation for Embedded Systems (2h/week, 1 semester), 2007
- Testing (4h/week, 2 weeks), 2007

**Teaching Assistant,** Process Control Laboratory, Dortmund University

- Systems Analysis (2h/week, 1 semester), 2000
- Optimal control (2h/week, 1 semester), 2001
- Modeling of Dynamic Systems (2h/week, 1 semester), 2002
- Applied Control Theory (2h/week, 1 semester), 2003

- Student Lab (10h/week, 6 semesters), 2000-2003

**Teaching Assistant,** Control Systems Laboratory, Karlsruhe University

- Student lab (20h/week, 2 semesters), 1999

**Teaching Assistant,** Institute of Theoretical Mechanics, Karlsruhe University

- Theoretical Mechanics (2h/week, 1 semester), 1995

## LANGUAGES

- German: native
- English: fluent, US Honors English Award, 1990
- French: fluent, Diplôme d'études en langue française, 1er degré
- Spanish: intermediate

## PUBLICATIONS

### Thesis:

Goran Frehse. Compositional Verification of Hybrid Systems using Simulation Relations. PhD thesis, Radboud Universiteit Nijmegen, October 10, 2005. pdf on A4, pdf on letter

### Conference Proceedings:

Goran Frehse. On Timed Simulation Relations for Hybrid Systems and Compositionality. In *FORMATS 2006: 4th Int. Conf. Formal Modelling and Analysis of Timed Systems, Paris, France, Sept. 25-27*, 2006.

E. Asarin, T. Dang, G. Frehse, A. Girard, C. Le Guernic, O. Maler. Recent Progress in Continuous and Hybrid Reachability Analysis. In *CACSD 2006: Proc. IEEE Int. Symp. Computer-Aided Control Systems Design, Technische Universitet Munchen, Munich, Germany, October 4-6*, 2006

Goran Frehse, Bruce H. Krogh, Rob A. Rutenbar. Verifying Analog Oscillator Circuits Using Forward/Backward Abstraction Refinement. In *DATE 2006: Design, Automation and Test in Europe, Munich, Germany, March 6-10*, 2006. pdf

Goran Frehse. PHAVer: Algorithmic Verification of Hybrid Systems past HyTech. In Manfred Morari and Lothar Thiele, editors, *Hybrid Systems: Computation and Control (HSCC'05),* volume 3414 of *Lecture Notes in Computer Science*, pages 258-273, Springer-Verlag, 2005. (revised) pdf, BibTeX (DBLP)

Goran Frehse, Zhi Han, Bruce Krogh. Assume-Guarantee Reasoning for Hybrid I/O-Automata by Over-Approximation of Continuous Interaction. In *CDC 2004: IEEE Conf. Decision and Control, Atlantis, Bahamas, December 14-17*, 2004. pdf

Goran Frehse. Compositional Verification of Hybrid Systems with Discrete Interaction using Simulation Relations. In *CACSD 2004: IEEE Conf. Computer Aided Control Systems Design, Taipei, Taiwan, September 1-4*, 2004. pdf

Goran Frehse, Olaf Stursberg, Sebastian Engell, Ralf Huuck, and Ben Lukoschus. Modular analysis of discrete controllers for distributed hybrid systems. In *b'02: The XV. IFAC World Congress, Barcelona, Spain, July 21-26, 2002*, 2002.

Goran F. Frehse, Olaf Stursberg, Sebastian Engell, Ralf Huuck and Ben Lukoschus. Verification of hybrid controlled processing systems based on decomposition and deduction. In *ISIC 2001: 2001 IEEE International Symposium on Intelligent Control, Mexico City, Mexico, September 5-7, 2001*, pages 150-155. IEEE Control Systems Society, IEEE Press, 2001.

G. Nenninger, G. Frehse and V. Krebs. Hybrid Regions of Attraction of Piecewise Affine Hybrid Systems. In *Proc. Automation des Processus Mixtes (ADPM 2000), Dortmund*, 2000.

G. Frehse and A. Paice. Optimal Control of a Gas Compressor Field. In *Proc. 14th Int. Symposium Mathematical Theory of Networks and Systems (MTNS 2000), Perpignan*, 2000.

### Workshops and Nonpublic Conferences:

Goran Frehse, Bruce H. Krogh, Rob A. Rutenbar. Verification of Hybrid Systems Using Iterative Refinement. In *Semiconductor Research Corporation TECHCON 2005, Portland, USA, October 24-26*, 2005. (Best paper in session award, out of 8 papers)

Goran Frehse, Bruce H. Krogh, Rob A. Rutenbar, Oded Maler. Time Domain Verification of Oscillator Circuit Properties. In *Workshop on Formal Verification of Analog Circuits, Edinburgh, Scotland, April 2-10*, 2005.

Goran Frehse. Solving simulation relations of timed automata for the design and verification of timed discrete controllers. In *RT-TOOLS 2002: Second Workshop on Real-Time Tools, Copenhagen, Denmark, August 1, 2002*, 2002.

Goran Frehse. Integrated algorithmic and deductive verification of distributed control systems for hybrid processes. In *MOVEP'02: Summer School on Modelling and Verification of Parallel Processes, Nantes, France, June 19-23, 2002*, 2002.

**Books and Book Articles:**

Sebastian Engell, Goran Frehse and Eckehard Schnieder (Eds), Modelling, Analysis and Design of Hybrid Systems, volume 279 of *Lecture Notes in Control and Information Sciences*. Springer-Verlag, 2002.

Ralf Huuck, Ben Lukoschus, Goran Frehse and Sebastian Engell. Compositional verification of continuous-discrete systems. In Sebastian Engell, Goran Frehse and Eckehard Schnieder, editors, *Modelling, Analysis and Design of Hybrid Systems*, volume 279 of *Lecture Notes in Control and Information Sciences*, pages 225-244. Springer-Verlag, 2002.

Gero Nenninger, Goran Frehse and Volker Krebs. Reachability Analysis and Control of a Special Class of Hybrid Systems. In Sebastian Engell, Goran Frehse and Eckehard Schnieder, editors, *Modelling, Analysis and Design of Hybrid Systems*, volume 279 of *Lecture Notes in Control and Information Sciences*, pages 173-192. Springer-Verlag, 2002.

## PRESENTATIONS

07 Feb. 2007 *PHAVer: Sound Reachability Analysis for Hybrid Systems*
Invited Talk, Distributed Systems and Semantics Unit, Department of Computer Science, Aalborg University, Denmark

18 Dec. 2006 *PHAVer: Reachability Analysis for Linear Hybrid Systems and Beyond*
Invited Talk, AVACS seminar, University of Freiburg, Germany

31 Aug. 2006 *PHAVer: Recent developments and applications*
Workshop Talk, CORTOS Workshop (satellite event of CONCUR'06), Paris

29 Jun. 2006 *Reachability Analysis of Hybrid Systems with PHAVer*
Invited Talk, Computer Science Seminar, Université Libre de Bruxelles, Belgium

29 Nov. 2005 *Forward/Backward Abstraction Refinement with PHAVer*
Invited Talk, Thrust in Reliable Software Research Group, Ecole Polytechnique de Lausanne, Switzerland

21 Oct. 2005 *Simulation Relations and Compositionality in Hybrid Systems Verification*
Invited Talk, Theory of Distributed Systems Group, Computer Science and Artificial Intelligence Laboratory, Massachusetts Institute of Technology, Boston, USA

19 Oct. 2005 *Verification of Hybrid Systems Using Forward/Backward Abstraction Refinement*
Invited Talk, Center for Information and Systems Engineering, Boston University, USA

29 Sep. 2005 *Algorithmic Compositional Verification of Hybrid Systems*
Invited Talk, Department of Computer and Information Sciences, University of Pennsylvania, Philadelphia, USA

26 Aug. 2003 *Verification of Linear Hybrid Automata using Simulation Relations*
Invited Talk, Specification and Verification Center, Carnegie Mellon University, Pittsburgh, USA

20 Nov. 2001 *Modular Analysis of Hybrid Automata based on Abstraction*
Invited Talk, Distributed Systems and Semantics Unit, Department of Computer Science, Aalborg University, Denmark

## PROFESSIONAL ACTIVITIES

### Program Committee Member

*FORMATS 2007: 5th Int. Conf. Formal Modelling and Analysis of Timed Systems*

### Research Visits

2007 Aalborg University, 1 week
Prof. Kim G. Larsen

2006 Saarbruecken University and Freiburg University, 1 week
Prof. Andreas Podelski

2005 Ecole Polytechnique de Lausanne, 1 week
Prof. Thomas A. Henzinger

2004 Radboud University Nijmegen, 2 weeks
Prof. Frits W. Vaandrager

2003 Aalborg University, 1 week
Prof. Kim G. Larsen

2002 Aalborg University, 7 weeks
Prof. Kim G. Larsen

### Reviewer for Journals

Logical Methods in Computer Science, 2006
IEEE Transactions on CAD of Integrated Circuits and Systems, 2006
Foundations and Trends in Electronic Design Automation, 2006
Mathematics and Computers in Simulation, 2005
SIAM Journal On Control and Optimization, 2005
ACM Transactions on Embedded Computing Systems, 2005
IEEE Transactions on Automatic Control, 2005

### Reviewer for Conferences

IEEE Conference on Decision and Control, 2006
Hybrid Systems: Computation and Control, 2006
Computer Aided Verification, 2005
IEEE Conference on Decision and Control and European Control Conference (CDC/ECC), 2005
IEEE Conference on Decision and Control, 2004

### Session Co-Chair

IEEE International Symposium on Computer Aided Control Systems Design (CACSD), Taipei, Taiwan, 2005 (Co-Chair)