Matthew M. Peet, curriculum vitae

CONTACT INFORMATION	Matthew M. Peet National Institute for Research in Computer Science and Control (INRIA) Domaine de Voluceau, BP 105 78153 Le Chesnay Cedex France	*Voice:* +33 1 39 63 53 81 *Mobile:* +33 6 87 26 46 77 *Fax:* +33 1 39 63 57 86 *E-mail:* matthew.peet@inria.fr *WWW:* www-rocq.inria.fr/~peet

NATIONALITY United States Citizen

RESEARCH AREA Computational Nonlinear Control

RESEARCH INTERESTS

I work on a theory of the use of computation in problems of analysis and control of dynamic systems. I develop optimization-based tools for the analysis and control of nonlinear ordinary-, delay- and partial-differential equations. I have experience in analysis of models in networking with hybrid, nonlinear and decentralized dynamics, sparse interconnection and delayed feedback. I have also worked on analysis of nonlinear delay- and partial-differential models of tumour growth with emphasis on therapy. I am currently using semidefinite programming for model analysis of the *blast crisis* in Chronic Myelogenous Leukemia. I am also developing some Matlab® toolboxes for system analysis based on "sum-of-squares" techniques for polynomial optimization.

EDUCATION

Stanford University, Stanford, California USA

Ph.D., Aeronautics and Astronautics, March, 2006

- Dissertation Topic: "Stability and Control of Functional Differential Equations"
- Thesis Advisor: Sanjay Lall
- Thesis Committee: Geir Dullerud, Stephen Rock, Günter Niemeyer

Stanford University, Stanford, California USA

M.S., Aeronautics and Astronautics, June, 2001

University of Texas at Austin, Austin, Texas USA

B.S., Aerospace Engineering, December, 1999
B.S., Physics, December, 1999

RESEARCH EXPERIENCE

National Institute for Research   **2007 - present**
in Computer Science and Control (INRIA), Rocquencourt, France
Nonlinear Analysis for Biology and Geophysical flows (BANG)   ARC ModLMC
Postdoctoral Researcher
The ARC ModLMC is a collaboration of researchers at INRIA, INSERM, CNRS, and the universities of Lyon and Bordeaux, including hematologists and applied mathematicians, in order to develop and analyze new models of cancer-related diseases and in particular Chronic Myelogenous Leukemia(CML). My main subject of research is the development and analysis of models for the occurrence of the *blast crisis*, by which CML becomes AML (Acute Myelogenous Leukemia). I view the blast crisis as a loss of stability of the underlying nonlinear delay-differential model. From this perspective therapeutic treatment and prognosis can be studied using algorithmic approaches to stability analysis of differential equations. I am working with clinical practitioners and specialists in modeling to develop data-driven models which can be analyzed computationally in order to predict patient response.

National Institute for Research   **2006 - 2007**
in Computer Science and Control (INRIA), Rocquencourt, France
SIgnals and SYstems in PHysiology & Engineering (SISYPHE)
Postdoctoral Research Fellow
During my first postdoc at INRIA, I worked on the use of optimization algorithms for analysis of systems with nonlinearity and delay. I have written several papers on the parametrization of Lyapunov functions for both delay-differential and ordinary differential equations. The most important of these results is a converse Lyapunov theorem which shows that stable systems have polynomial Lyapunov functions and that these polynomials admit an a-priori upper bound on the degree. I have also worked on the use of sum-of-squares programming to analyze linear systems in the complex plane.

Networked Systems and Controls Laboratory, Stanford, California   **2002 - 2006**
Stanford University   Advisor: Sanjay Lall
Research Assistant
My doctoral research focused on the ability of communication systems to handle nonlinearity and delay. In my work on optimization-based control of networks, I studied the proposed FAST TCP using a hybrid, nonlinear, time-delayed model of the Internet. Using a technique known as analysis via Integral Quadratic Constraints (IQC), I was able to prove convergence of the protocol, giving necessary and sufficient conditions for stabiltiy. Additionally, during this period, I begin my work on numerical algorithms for stability analysis of nonlinear systems with delay using semidefinite programming. Implementations of these algorithms are now available online.

SuperNova Acceleration Probe (SNAP) project, Berkeley, California   **2000 - 2001**
Lawrence Berkeley National Laboratory
Research Assistant
I worked on developing a lunar gravity-assist trajectory for the Supernova/Acceleration Probe (SNAP). I developed a prototype algorithm for the construction of lunar gravity assist trajectories for the purpose of evaluation of cost and feasibility.

Gravity Probe B, Stanford, California   **2000 - 2001**
Stanford University
Research Assistant
I performed analysis of the orbital configuration of the GPS satellite constellation to determine optimal antenna design and orientation. Presented results to engineers and to the 2001 GPS III conference in Phoenix.

Johnston Space Center, Clear Lake, Texas   **1998 - 1999**
Lockheed Martin Space Operations Corp.   Flight Dynamics Planning and Analysis Group
Applications Engineer
Developed flight dynamics software for the International Space Station. Programmed orbital dynamics simulators using ADA and MatrixX. Improved graphical interfaces using GPip and PVWave. Participated in design review and inspection process. Worked on testing and implementation of software.

Applied Research Laboratories, Austin, Texas   **1997 - 1998**
Department of Defense
Undergraduate Researcher

Fusion Research Center, Austin, Texas   **1996 - 1997**
University of Texas at Austin
Undergraduate Researcher

PROFESSIONAL
REFERENCES

Dr. Sanjay Lall
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Stanford University
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for Scientific Research(CNRS)
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Dr. Pierre-Alexandre Bliman
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Computer Science and Control(INRIA)
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Department of Engineering Science
University of Oxford
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OX1 3PJ, United Kingdom
Voice: +44-1865-283063
E-mail: antonis@eng.ox.ac.uk
WWW: users.ox.ac.uk/ engs0587/

SOFTWARE

SOSCode, S. Lall, M. Peet, and T. Wang. A self-contained Matlab toolbox for the efficient construction of sum-of-squares programming problems.

DelayTools/Linear, M. Peet. A set of Matlab functions and files for the analysis on n-dimensional linear systems with m discrete delays. Separate files handle the deterministic and generalized uncertainty cases separately. Available for download from: `http://www-rocq.inria.fr/~peet/software`

DelayTools/Nonlinear, M. Peet. A set of Matlab functions and files for the analysis on n-dimensional nonlinear polynomial systems with m discrete delays. Separate files handle the deterministic and generalized uncertainty cases separately. Available for download from:
`http://www-rocq.inria.fr/~peet/software`

DelayTools/Complex, M. Peet. A number of matlab toolbox functions for analysis of transfer functions in the frequency domain using SOS and positivstellensatz techniques. Scripts test quasi-ploynomial transfer functions for both delay-independant and delay-dependant H_∞ stabiltiy and delay-independent exponential stability. The delay-dependent test is based on the paper by Zhang et al. Available for download from: `http://www-rocq.inria.fr/~peet/software`

PROFESSIONAL
ACTIVITIES

- Reviewer: IEEE Transactions on Automatic Control (9), IEEE Transactions on Circuits and Systems - I (1), Automatica (4), Linear Algebra and Its Applications (1), IEEE/CSS Conference on Decision and Control (10), American Control Conference (1), IFAC Workshop on Time-Delay Systems (2), IFAC World Congress (1).
- International Program Committee: Seventh International Conference on Mathematical Problems in Engineering, Aerospace and Sciences. Genoa, Italy, 2008;
- Organizer and Chair: Invited Session on "Computational Methods for Nonlinear and Time-Delay Systems" at Seventh International Conference on Mathematical Problems in Engineering, Aerospace and Sciences. Genoa, Italy, 2008;
- Co-Chair, "Time Delay Uncertain Systems", at the 45th IEEE Conference on Decision and Control, 2006.
- Evaluation Panel: National Research Foundation (South Africa)
- Member: IEEE, AIAA, SIAM, SMAI

TECHNICAL SKILLS
AND EXPERIENCE

- Mathematical Programming Languages: Matlab, Mathematica
- Optimization Software and Parsers: SeDuMi, LMILab, YALMIP, SOSTOOLS, SOSCODE
- Programming Languages: C, Ada, Fortran
- Physical Modeling Tools: AutoCad, NASTRAN
- Mission Planning and Analysis Software: STK, Princeton Satellite Toolbox
- Operating Systems: Windows, Red Hat Linux.
- Foreign Language Experience: Russian, French, German
- Licensed Radio Operator - Call Sign: KG6ASN, License: L00221152

GRANTS

- Projet **Para-SDP** (co-PI),*Parameter-dependent semidefinite programming in robust control. Application to analysis of dynamical system interaction networks.* Sources: FAPESP, INRIA

AWARDS AND
HONORS

- INRIA Postdoctoral Research Fellow, 2006
- Best Paper in Session, CDC, 2006
- Boeing Graduate Research Fellow, 2000
- Graduated with Honors - University of Texas at Austin, 1999

- ΣΓΤ Aerospace Engineering Honors Society, 1996
- Friends of Alec Merit Scholar, 1995
- Dedman Merit Scholar, 1995
- National Merit Scholar, 1995

JOURNAL
PUBLICATIONS

M. M. Peet, P. Kim, S.-I. Niculescu, A. Papachristodoulou and D. Levy *Model Analysis of Chronic Myelogenous Leukemia with Treatment Options: Sensitivity to System Parameters and Delay.* Invited Paper for the Special Issue on Mathematical Modelling of Natural Phenomena.

M. M. Peet. *Exponentially Stable Nonlinear Systems have Polynomial Lyapunov Functions on Bounded Regions.* Submitted June 29, 2007 (Revised Feb 27, 2008) to IEEE Transactions on Automatic Control.

M. M. Peet, A. Papachristodoulou and S. Lall. *Positive Forms and Stability of Linear Time-Delay Systems.* Submitted Oct 31, 2007 (Revised Jan 29, 2008) to the SIAM Journal on Control and Optimization.

A. Papachristodoulou, M Peet and S. Lall *Stability Analysis of Nonlinear Time-Delay Systems.* Submitted July 1, 2007 (Revised March 21, 2008) to IEEE Transactions on Automatic Control.

M. Peet and S. Lall. *Global Stability Analysis of a Nonlinear Model of Internet Congestion Control with Delay.* IEEE Transactions on Automatic Control. Vol. 52, No. 3, March 2007.

BOOK CHAPTERS

M. M. Peet, C. Bonnet, and H. Ozbay. *SOS Methods for Stability Analysis of Neutral Differential Systems.* To Appear in Springer Lecture Notes in Control and Information Science.

A. Papachristodoulou and M. Peet. *SOS Methods for Nonlinear Delayed Models in Biology and Networking.* To Appear in Springer Lecture Notes in Control and Information Science.

PEER-REVIEWED
CONFERENCE
PROCEEDINGS

M. M. Peet, S.-I. Niculescu, P. Kim, and D. Levy *Analysis of Models of Chronic Myelogenous Leukemia with Treatment Options using Computation: Sensitivity to Uncertainty and Delay* Submitted to the 47th IEEE Conference on Decision and Control, Cancun, Mexico. December 9-11, 2008.

M. M. Peet and A. Papachristodoulou *Using Polynomial Semi-Separable Kernels to Construct Infinite-Dimensional Lyapunov Functions.* Invited Session on Infinite-Dimensional Systems, 47th IEEE Conference on Decision and Control, Cancun, Mexico. December 9-11, 2008.

M. M. Peet, H. Özbay and C. Bonnet *SOS Methods for Delay-Dependent Stability of Neutral Differential Systems.* Mathematical Theory of Networks and Systems, Blacksburg, VA. July 28 - Aug. 1, 2008.

M. M. Peet and P.-A. Bliman. *The Weierstrass Approximation Theorem on Linear Varieties: Polynomial Lyapunov Functionals for Delayed Systems.* Mathematical Theory of Networks and Systems, Blacksburg, VA. July 28 - Aug. 1, 2008.

A. Papachristodoulou and M. M. Peet. *Global Stability Analysis of Primal Internet Congestion Control Schemes with Heterogeneous Delays.* IFAC World Congress, Seoul, Korea. July 6 - 11, 2008.

M. M. Peet and P.-A. Bliman. *Polynomial Lyapunov Functions for Exponential Stability of Nonlinear Systems on Bounded Regions.* IFAC World Congress, Seoul, Korea. July 6 - 11, 2008.

A. Papachristodoulou, M. M. Peet and S.-I. Niculescu. *Stability Analysis of Linear Systems with Time-Varying Delays: Delay Uncertainty and Quenching.* 46th IEEE Conference on Decision and Control, New Orleans, LA. December 12-14, 2007. pp. 2117-2122

M. M. Peet and A. Papachristodoulou. *Positivity of Kernel Functions for Systems with Communication Delay.* 46th IEEE Conference on Decision and Control, New Orleans, LA. December 12-14, 2007. pp. 2815-2820

M. M. Peet. *Exponentially Stable Nonlinear Systems have Polynomial Lyapunov Functions on Bounded Regions.* 45th Annual Allerton Conference on Communication, Control and Computing. Monticello, IL. Sept. 26-28, 2007.

C. Bonnet and M. M. Peet. *Using the Positivstellensatz for Stability Analysis of Neutral Delay Systems in the Frequency Domain.* 7th IFAC Workshop on Time-Delay Systems. Nantes, France. Sept. 17-19, 2007.

M. M. Peet and P.-A. Bliman. *An Extension of the Weierstrass Theorem to Linear Varieties: Application to Delayed Systems.* 7th IFAC Workshop on Time-Delay Systems. Nantes, France. Sept. 17-19, 2007.

M. M. Peet and C. Bonnet. *Stability and Computation of Roots in Delayed Systems of Neutral Type.* IFAC Workshop on Control of Distributed Parameter Systems. Namur, Belgium. June 22-27, 2007.

M. M. Peet. *On Positive Quadratic Forms and Stability of Linear Systems.* Conférence de la SMAI sur l'optimisation et la décision. April, 2007.

M. Peet, A. Papachristodoulou and S. Lall. *Positive Forms and Stability of Linear Time-Delay Systems.* Proceedings of the 45th IEEE Conference on Decision and Control, pp. 187-193 December 2006. **(Best Paper in Session)**

A. Papachristodoulou and M. M. Peet. *On the Analysis of Systems Described by Classes of Partial Differential Equations.* Proceedings of the 45th IEEE Conference on Decision and Control, pp. 747-752, December 2006.

A. Papachristodoulou, M. Peet and S. Lall. *Constructing Lyapunov-Krasovskii Functionals for Linear Time Delay Systems.* Proceedings of the American Control Conference, pp. 2845-2850, June 2005.

M. Peet and S. Lall. *On Global Stability of Internet Congestion Control.* Proceedings of the 43rd IEEE Conference on Decision and Control, pp. 1035-1041, December 2004.

M. Peet and S. Lall. *Constructing Lyapunov Functions for Delay-Differential Equations using Semidefinite Programming.* Proceedings of the 6th IFAC Symposium on Nonlinear Control Systems (NOLCOS), pp. 381-381, August 2004.

INVITED SEMINARS AND CONFERENCE PRESENTATIONS	IFAC World Congress. Pre-conference Workshop: WS7, Seoul, South Korea. July, 2008.

IFAC World Congress. Present Paper: MoB02.2, Seoul, South Korea. July, 2008.

IFAC World Congress. Present Paper: MoC14.5, Seoul, South Korea. July, 2008.

European Conference on Mathematical and Theoretical Biology. Edinburgh, U.K., June 29th - July 4th, 2008.

ICNPAA 2008: Mathematical Problems in Engineering, Aerospace and Science. Genoa, Italy. June, 2008.

LAAS, Groupe de Travail EDP - GDR MACS. Toulouse, France. June, 2008.

State University of Campinas, School of Electrical and Computer Engineering. Campinas, Brasil. June, 2008.

Katholieke Universiteit Leuven, Department of Electrical Engineering, OPTEC Group. Leuven, Belgium. May, 2008.

Illinois Institute of Technology. Department of Mechanical, Materials, and Aerospace Engineering. Chicago, IL. March, 2008.

Workshop on Haematopoiesis and its Disorders. Modelling, Experimental and Clinical Approaches. Paris, France, March 20-21, 2008.

IEEE Conference on Decision and Control. Present Paper: WePI27.12, December 2007.

IEEE Conference on Decision and Control. Present Paper: ThPI23.18, December 2007.

45th Annual Allerton Conference on Communication, Control and Computing. Monticello, IL. Sept. 26-28, 2007.

7th IFAC Workshop on Time-Delay Systems. Present Paper 55. Nantes, France. Sept. 17-19, 2007.

7th IFAC Workshop on Time-Delay Systems. Present Paper 67. Nantes, France. Sept. 17-19, 2007.

IFAC Workshop on Control of Distributed Parameter Systems. Namur, Belgium. June 22-27, 2007.

Conférence de la SMAI sur l'optimisation et la décision. April, 2007.

State University of Campinas, School of Electrical and Computer Engineering. Campinas, Brasil. March, 2007.

Réunion EDP-MOSAR Paris. March, 2007.

IEEE Conference on Decision and Control. Present Paper: WeA06.1, December 2006.

IEEE Conference on Decision and Control. Present Paper: WeA06.4, December 2006.

INRIA - Rocquencourt. Rocquencourt, France. November 2006.

American Control Conference. Present Paper: ThB18.6, June 2005.

Seagull Technology. May, 2005.

Stanford Aerospace Affiliates. April, 2005.

IEEE Conference on Decision and Control. Present Paper: TuC03.6, December 2004.

IFAC Symposium on Nonlinear Control Systems(NOLCOS). August 2004.

Stanford Aerospace Affiliates. April, 2004.

GPS III Conference. June, 2001.