Akshay Rajhans

Senior Research Scientist

MathWorks
3 Apple Hill Drive, Natick, MA 01760
✉ *Akshay.Rajhans@mathworks.com*
arajhans.github.io

Education

May 2013 **Ph.D.**, *Electrical and Computer Engineering*, Carnegie Mellon University, Pittsburgh, PA.
Thesis Title: *Multi-Model Heterogeneous Verification of Cyber-Physical Systems*
Thesis Advisor: Prof. Bruce H. Krogh.

Dec. 2007 **M.S.E.**, *Electrical Engineering*, University of Pennsylvania, Philadelphia, PA.
Thesis Title: *Development of Robust Testing Toolbox for Hybrid Systems*
Thesis Advisor: Prof. George J. Pappas.

May 2003 **B.E.**, *Electronics and Telecommunication*, University of Pune, Pune, India.

Professional Experience

Jul 16– **Senior Research Scientist**, *MathWorks*, Natick, MA.
Advanced research and technology development with a focus on *cyber-physical systems*.

Jul 13–Jul 16 **Senior Software Engineer**, *MathWorks*, Natick, MA.
Developed and maintained the subsystem and initialization semantics of Simulink.

Aug 09–Dec 09 **Intern**, *Bosch Research and Technology Center*, Pittsburgh, PA.
Developed a new approach to non-intrusive load monitoring using hybrid system state estimation. Co-inventor on **U.S. Patent # 8209062**. See the section on Patents for the citation.

Aug 05–Dec 05 **Manager**, *IBU Application Engineering*, Cummins India Limited, Pune, India.
Application engineering for electronic control of diesel engines in mining, marine, defense, rail, compressors, oil rigs, fire pumps, automotive and off-highway construction equipment.

Aug 03–Aug 05 **Operations Management Program Participant**, Cummins India Limited, Pune, India.
Research, development and application engineering of electronic controls for diesel engines and their applications.

Teaching Assistantship

At Carnegie Mellon University

Spring 2011, Spring 2010 **18-474: Embedded Control Systems**.
Set up laboratory experiments, held office hours, graded homework and mid-terms

At University of Pennsylvania

Spring 2008, Fall 2007 **MATH 114: Calculus II**.
Taught recitations, held office hours, graded homework, mid-terms and finals

Spring 2007 **ESE 210: Introduction to Dynamic Systems**.
Held office hours, graded mid-terms and finals

Fall 2006 **ESE 301: Introduction to Probability**.
Held office hours, graded mid-terms and finals

Spring 2006 **OPIM 101: Introduction to Computer as an Analysis Tool**.
Grader for final exams

Professional Service

Conference Program Committee (PC)

2017 **Special Track Chair, Cyber-Physical Systems**, *Winter Simulation Conference (WSC)*.

PC Chair, *MathWorks Research Summit*.

Demo and Poster Session Chair, *Hybrid Systems: Computation and Control (HSCC)*.

PC Member, *Summer Simulation Multi-Conference (SummerSim), International Conference on Informatics in Control, Automation and Robotics (ICINCO), Computational Intelligence Techniques for Testing and Validating Complex CPSs (CITest_CPS)*.

2016 **PC Member**, *Hybrid Systems: Computation and Control (HSCC)*.

2015 **PC Member**, *International Conference on Cyber-Physical Systems (ICCPS), Conference on Analysis and Design of Hybrid Systems (ADHS), Summer Simulation Multi-Conference (SummerSim)*.

2014 **PC Member**, *Summer Simulation Multi-Conference (SummerSim)*.

Repeatability Evaluation Committee Member, *Hybrid Systems: Computation and Control (HSCC)*.

Ad-Hoc Paper Review: Journals and Conferences

– **Reviewer**, *Technological Forecasting & Social Change*.

2017 **Reviewer**, *Tools and Algorithms for the Construction and Analysis of Systems (TACAS)*.

– **Reviewer**, *Nonlinear Analysis: Hybrid Systems*.

– **Reviewer**, *Simulation: Transactions of the Society for Modeling and Simulation International*.

2013 **Reviewer**, *American Control Conference (ACC)*.

2011 **Reviewer**, *Conference on Decision and Control (CDC)*.

2011 **Reviewer**, *Intelligent Transportation Systems Conference (ITSC)*.

2010 **Reviewer**, *Hybrid Systems: Computation and Control (HSCC)*.

2009 **Reviewer**, *American Control Conference (ACC)*.

Judge

May 2016 **Judge**, *CPS V&V Grand Prix*, Course Competition for 15-424/15-624/15-824: Foundations of Cyber-Physical Systems, Carnegie Mellon University, **Instructor**: Prof. André Platzer.

Service for Social Cause

2008-2011 **Member, Board of Directors**, Maharashtra Mandal Pittsburgh, a non-profit organization based in Pittsburgh.

Summer 2009 **Laboratory Instructor**, *Summer Engineering Experience for Girls (SEE)*, a day-long summer camp for high-school students at Carnegie Mellon University, **Instructor**: Prof. Bruno Sinopoli.

Patents

PP1. Burton Andrews, Diego Benitez, Badri Raghunathan and **Akshay Rajhans**, "*Method for Non-Intrusive Load Monitoring using a Hybrid System State Estimation Approach*", U.S. Patent # 8209062, granted on June 26, 2012. Also filed as European and International Patents # EP 2514068 A1 and # WO 2011084390 A1.

Journal Publications

J1. **Akshay Rajhans**, Ajinkya Bhave, Ivan Ruchkin, Bruce H. Krogh, David Garlan, André Platzer and Bradley Schmerl, "*Supporting Heterogeneity in Cyber-Physical System Architectures*", IEEE Transactions on Automatic Control, Special issue on Cyber-Physical Systems, Volume 59, Issue 12, Pages 3178-3193.

J2. Matthias Althoff, **Akshay Rajhans**, Bruce H. Krogh, Soner Yaldiz, Xin Li and Larry Pileggi, "*Formal Verification of Phase-Locked Loops Using Reachability Analysis and Continuization*", Communications of the ACM, Volume 56, Issue 10, Pages 97-104. ***Research Highlight for the October 2013 issue***.

J3. **Akshay Rajhans**, Shang-Wen Cheng, Bradley Schmerl, David Garlan, Bruce H. Krogh, Clarence Agbi, and

Ajinkya Bhave, "*An Architectural Approach to the Design and Analysis of Cyber-Physical Systems*", Electronic Communications of the EASST, Volume 21, 2009.

Book Chapters

B1. Yi Deng, **Akshay Rajhans**, and A. Agung Julius, "*STRONG: A Trajectory-Based Verification Toolbox for Hybrid Systems*", in Kaustubh Joshi, Markus Siegle, Mariëlle Stoelinga and Pedro R. D'Argenio, editors, Lecture Notes in Computer Science, *10th International Conference, QEST 2013, Buenos Aires, Argentina, August 27-30, 2013. Proceedings*, Volume 8054, Pages 165-168, Springer, 2013.

B2. Alexandre Donzé, Bruce H. Krogh, and **Akshay Rajhans**, "*Parameter Synthesis for Hybrid Systems with an Application to Simulink Models*", in Rupak Majumdar and Paulo Tabuada, editors, Lecture Notes in Computer Science, *Hybrid Systems: Computation and Control, 12th International Conference, HSCC 2009, San Francisco, CA, USA, April 13-15,2009. Proceedings*, Volume 5469, Pages 165-179, Springer, 2009.

Conference Papers

C1. **Akshay Rajhans** and Bruce H. Krogh, "*Compositional Heterogeneous Abstraction*", in Proceedings of the 16th ACM International Conference on Hybrid Systems: Computation and Control (HSCC), 2013.

C2. **Akshay Rajhans** and Bruce H. Krogh, "*Heterogeneous verification of cyber-physical systems using behavior relations*", in Proceedings of the 15th ACM International Conference on Hybrid Systems: Computation and Control (HSCC), 2012.

C3. **Akshay Rajhans**, Ajinkya Bhave, Sarah Loos, Bruce H. Krogh, André Platzer, and David Garlan, "*Using Parameters in Architectural Views to Support Heterogeneous Design and Verification*", in Proceedings of the 50th IEEE Conference on Decision and Control (CDC), 2011.

C4. Matthias Althoff, **Akshay Rajhans**, Bruce H. Krogh, Soner Yaldiz, Xin Li, and Larry Pileggi, "*Formal Verification of Phase-Locked Loops Using Reachability Analysis and Continuization*", in Proceedings of the IEEE/ACM International Conference on Computer-Aided Design (ICCAD), 2011. ***William J. McCalla Best Paper Award***.

C5. Ajinkya Bhave, David Garlan, Bruce H. Krogh, **Akshay Rajhans**, and Bradley Schmerl, "*Augmenting Software Architectures with Physical Components*", in Proceedings of the Embedded Real Time Software and Systems Conf. (ERTS^2), 2010.

Peer Reviewed Extended Abstracts

A1. Matthias Althoff, **Akshay Rajhans**, Bruce H. Krogh, Soner Yaldiz, Xin Li, Larry Pileggi, "*Using Continuization in Rechability Analysis for the Verification of a Phase-Locked Loop*", Frontiers in Analog Circuit (FAC) Synthesis and Verification, co-located with Computer-Aided Verification (CAV) 2011, Snowbird, UT.

A2. Ajinkya Bhave, David Garlan, Bruce H. Krogh, Sarah Loos, André Platzer, **Akshay Rajhans**, Bradley Schmerl, "*Multi-View Consistency in Architectures for Cyber-Physical Systems*", Safe and Secure Systems & Software Symposium (S5) 2011, Beavercreek, OH.

Posters

P1. Ivan Ruchkin, Stefan Mitsch, **Akshay Rajhans**, Bruce H. Krogh, David Garlan, André Platzer, Bradley Schmerl, James Kapinski, Prashant Ramachandra and Ken Butts, "*An Architectural Approach to Heterogeneous Modeling and Verification of Cyber-Physical Systems*", NSF CPS PI Meeting, Arlington, VA, October 16-18, 2013.

P2. Yi Deng, **Akshay Rajhans**, and A. Agung Julius, "*STRONG: A Trajectory-Based Verification Toolbox for Hybrid Systems*", Hybrid Systems: Computation and Control (HSCC), Philadelphia, PA, April 8-11, 2013.

P3. **Akshay Rajhans**, "*Addressing Heterogeneity in Model-Based Development of Cyber-Physical Systems*", Innovation with Impact, Carnegie Mellon University, Pittsburgh PA, April 4, 2013.

P4. **Akshay Rajhans**, "*Addressing Heterogeneity in Model-Based Development of Cyber-Physical Systems*", Google Regional PhD Summit, Google Pittsburgh, Mar 21, 2013.

P5. **Akshay Rajhans** and Bruce H. Krogh, "*Heterogeneous Verification of Cyber-Physical Systems using Behavior Semantics*", NSF CPS PI Meeting, Annapolis, MD, October 3-5, 2012.

P6. Ajinkya Bhave, Ken Butts, Derek Caveney, David Garlan, Bruce H. Krogh, Sarah Loos, André Platzer, **Akshay Rajhans**, Prashant Ramachandra, Bradley Schmerl, "*An Architecture Approach to Heterogeneous Verification of Cyber-Physical Systems*", NSF CPS PI Meeting, Annapolis, MD, August 1-2, 2011.

P7. **Akshay Rajhans**, Matthias Althoff, Bruce H. Krogh, Larry Pileggi, Xin Li, "*Investigation of Formal Verification Methods for Self-Healing Analog/RF Systems*", C2S2 Annual Review 2010, Atlanta, GA.

P8. Shang-Wen Cheng, David Garlan, Bruce H. Krogh, **Akshay Rajhans**, Bradley Schmerl and Bruno Sinopoli, "*Design and Analysis of Cyber-Physical Architectures*", CPS Forum, co-located with the CPSWeek 2009, San Francisco, CA.

Other Miscellaneous Writing

O1. **Akshay Rajhans**, "*EGO Insider's Guide*", ECE Graduate Organization (EGO), Carnegie Mellon University, 2012. Edited. Available at `http://www.ece.cmu.edu/~ego/files/insiders/guide2012.pdf`.

Invited Talks

T1. "*Recent Advancements in MathWorks Verification and Validation Tools and Techniques*", CPS V&V I&F Workshop 2016, May 2016, Carnegie Mellon University. **Host**: Prof. André Platzer.

T2. "*Robustness of Temporal Logic Specifications for Testing of Signals*", Specification and Verification Center, School of Computer Science, Carnegie Mellon University, August 2008. **Host**: Prof. Ed Clarke.

T3. "*Verification of Systems Using Robust Temporal Logic Testing*", Specification and Verification Center, School of Computer Science, Carnegie Mellon University, August 2008. **Host**: Prof. Ed Clarke.

Honors

2014 **Work featured as Research Highlight**, *Communications of the ACM magazine*.

2013 **Work featured in Innovation with Impact**, *an interdisciplinary exhibition of graduate student research and projects held annually at Carnegie Mellon University*.

2014 **William J. McCalla Best Paper Award**, *ACM/IEEE International Conference on Computer-Aided Design (ICCAD)*.

2008 **Dean's Fellowship**, *Carnegie Institute of Technology*, Carnegie Mellon University.

2005 **Ranked in top 0.48% in India**, *Common Admission Test*.
Percentile score: **99.52**

1997 **Finalist**, *National Talent Search (NTS) Scholarship, India*.

1996 **Scholarship**, *Maharashtra Talent Search (MTS)*, India.
State-level rank: **35**

1995 **Scholarship**, *Maharashtra Talent Search (MTS)*, India.
State-level rank: **15**

1991-1994 **Scholarship**, *Middle School Scholarship*, Maharashtra, India.
State-level rank: **16**

Software

Developer	Simulink, Stateflow, STRONG, AcmeStudio
User	SpaceEx, PHAVer, Breach, KeYmaera
Languages	MATLAB, C++