
JYOTIRMOY V. DESHMUKH

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SUMMARY

The theoretical and practical development of cyberphysical systems is a crucial step in building efficient human societies of the future. The need of the hour is to meld the rigor provided by formal methods in computer science with mathematical and practical aspects of control theory while exploiting the recent developments in data-driven learning and reasoning techniques. My research lies at the convergence of these fields, and intends to serve as a bridge between academic innovation and industrial adoption.

EDUCATION

Ph.D. in Electrical and Computer Engineering (August 2010).
The University of Texas at Austin. Advisor: Dr. E. Allen Emerson
Dissertation: *Verification of Sequential and Concurrent Libraries*

Bachelor of Engineering in Electronics (August 2000).
Veermata Jijabai Technological Institute, University of Mumbai, India.
Undergraduate Project: Design and implementation of a 16-bit RISC microprocessor.
First Rank, First Class with Distinction.

EMPLOYMENT

APR 2012 TO CURRENT	Principal Engineer (Research) Toyota Technical Center, Gardena, CA, Division of Toyota Engineering and Manufacturing North America, Inc.
AUG 2010 TO APR 2012	Postdoctoral Research Fellow, Mentor: Dr. Rajeev Alur Department of Computer and Information Sciences, University of Pennsylvania. Topics: Theory of streaming transducers, Protocol synthesis, Robustness analysis
MAY 2008 TO AUG 2008	Research Intern Rigorous Software Engineering, Microsoft Research India. Topic: Analysis and Synthesis of Concurrent Software.
SEP 2007 TO DEC 2007	Research Consultant NEC Labs America. Topic: Deadlock Analysis for Java libraries.
MAY 2007 TO SEP 2007	Research Intern NEC Labs America. Topics: Static deadlock detection for Java programs with wait-notify synchronization.
AUG 2000 TO DEC 2001	Software and Circuit Designer Texas Instruments, India. Topics: Crosstalk, parasitics and timing analysis at the deep sub-micron level.

ACADEMIC EMPLOYMENT

- Teaching Assistant, Engineering Programming Languages (C++) [Fall 2006, 2008, 2009]
 - Teaching Assistant, Concurrent and Distributed Programming [Spring 2007, 2008, 2009]
 - Teaching Assistant, Generic Programming and the STL [Summer 2009]
 - Research Assistant, Model Checking and Software Verification [Fall 2002-Spring 2006]
 - Research Assistant, Distributed Systems [Fall 2010, Summer 2010].
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PUBLICATIONS

Journal Publications

- **J. V. Deshmukh**, R. Majumdar, V. Prabhu, *Quantifying Conformance Using the Skorokhod Metric*, accepted for publication in the international journal on Formal Methods in System Design.
 - J. Kapinski, **J. V. Deshmukh**, X. Jin, H. Ito, K. Butts, *Simulation-based Approaches for the Verification of Embedded Control Systems*, accepted for publication in the December 2016 issue of IEEE Control Systems magazine.
 - X. Jin, **J. V. Deshmukh**, A. Donzé, S.A. Seshia, *Mining Requirements from Closed-loop Control Models*, IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems, Special Section on Automotive Embedded Systems and Software, 2015.
 - N. Aréchiga, J. Kapinski, **J. V. Deshmukh**, B. Krogh and A. Platzer, *Numerically-aided Deductive Safety Proof for a Powertrain Control System*, Electronic Notes in Theoretical Computer Science, 317(C), 2015.
 - **J. V. Deshmukh**, G. Ramalingam, V. P. Ranganathan, and K. Vaswani, *Logical Concurrency Control from Sequential Proofs*, Logical Methods in Computer Science 7(3):10, 2011.
 - **J. V. Deshmukh**, E. Allen Emerson, S. Sankaranarayanan, *Symbolic Modular Deadlock Analysis*, Journal of Automated Software Engineering, 18(3-4), 2011.
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Peer-Reviewed Conference Publications

- A. Balkan, P. Tabuada, **J. V. Deshmukh**, X. Jin, J. Kapinski, *Underminer: A Framework for Automatically Identifying Non-Convergent Behaviors in Black Box System Models*, accepted for publication at the International Conference on Embedded Software, 2016, **EMSOT 2016 Best Paper Award**.
- A. Zutshi, S. Sankaranarayanan, **J. V. Deshmukh**, X. Jin, *Symbolic-Numeric Reachability Analysis of Closed-Loop Control Software*, In Proc. of the 19th ACM International Conference on Hybrid Systems: Computation and Control, 2016. **Recipient of the Best Student Paper Award**.
- J. Kapinski, X. Jin, **J. V. Deshmukh**, A. Donzé, T. Yamaguchi, H. Ito, T. Kaga, S. Kobuna, S.A. Seshia, *ST-Lib: A Library for Specifying and Classifying Model Behaviors*, SAE Technical Paper, presented at the SAE World Congress 2016.
- **J. V. Deshmukh**, A. Donzé, S. Ghosh, X. Jin, G. Juniwal, S. A. Seshia, *Robust Online Monitoring of Signal Temporal Logic*. In Proc. of the 6th International Conference on Runtime Verification, 2015. **RV 2015 Best Paper Award**.
- **J. V. Deshmukh**, X. Jin, J. Kapinski, O. Maler, *Stochastic Local Search for Falsification of Hybrid Systems*, In Proc. of the 13th International Symposium on Automated Technology for Verification and Analysis, 2015.
- J. Kapinski, **J. V. Deshmukh**, X. Jin, H. Ito, K. Butts, *Simulation-guided approaches for Verification of Automotive Powertrain Control Systems*, In Proc. of the American Control Conference, 2015.
- A. Donzé, X. Jin, **J. V. Deshmukh**, S. A. Seshia, *Automotive systems requirement mining using Breach*, In Proc. of the American Control Conference, 2015.
- J. V. Deshmukh, G. E. Fainekos, J. Kapinski, S. Sankaranarayanan, A. Zutshi, X. Jin, *Beyond single shooting: Iterative approaches to falsification*, In Proc. of the American Control Conference, 2015.
- N. Arechiga, J. Kapinski, **J. V. Deshmukh**, A. Platzer, B. H. Krogh, *Forward invariant cuts to simplify proofs of safety*, In Proc. of International Conference on Embedded Software, 2015.
- **J. V. Deshmukh**, Rupak Majumdar, Vinayak S. Prabhu, *Quantifying Conformance Using the Skorokhod Metric*, In Proc. of the 27th International Conference on Computer-Aided Verification, 2015.
- T. Dreossi, T. Dang, A. Donzé, J. Kapinski, X. Jin, **J.V. Deshmukh**, *Efficient Guiding Strategies for Testing of Temporal Properties of Hybrid Systems*, In Proc. of the 7th NASA Formal Methods Symposium, 2015.
- **J. V. Deshmukh**, H. Ito, X. Jin, J. Kapinski, K. Butts, J. Gerhard, B. Samadi, K. Walker, Y. Xie, *Piecewise-Affine*

- Approximations for a Powertrain Control Verification Benchmark*, In Proc. of the 2nd Workshop on Applied Verification for Continuous and Hybrid Systems 2015.
- A. Balkan, **J. V. Deshmukh**, J. Kapinski, P. Tabuada, *Simulation-guided Contraction Analysis*, In Proc. of the 1st Indian Control Conference 2015. **Recipient of the Best Student Paper Award.**
 - A. Zutshi, S. Sankaranarayanan and J. Kapinski, *Multiple Shooting, CEGAR-based Falsification for Hybrid Systems*, In Proc. of the 14th International Conference on Embedded Software, 2014. **EMSOFT 2014 Best Paper Award.**
 - X. Jin, **J. V. Deshmukh**, J. Kapinski, K. Butts, K. Ueda, *Benchmarks for Model Transformations and Conformance Checking*, In Proc. of 1st Workshop on Applied Verification for Continuous and Hybrid Systems 2014.
 - X. Jin, **J.V. Deshmukh**, J. Kapinski, K. Butts and K. Ueda, *Powertrain Control Verification Benchmark*, In Proc. of 17th ACM/IEEE International Conference on Hybrid Systems: Computation and Control, 2014.
 - J. Kapinski, **J. V. Deshmukh**, S. Sankaranarayanan, and N. Aréçhiga Simulation-guided Lyapunov Analysis for Hybrid Dynamical Systems, In Proc. of 17th ACM/IEEE International Conference on Hybrid Systems: Computation and Control, 2014.
 - J. Kapinski, **J. V. Deshmukh**, *Discovering Forward Invariant Sets for Nonlinear Dynamical Systems*, In: Interdisciplinary Topics in Applied Mathematics, Modeling and Computational Science, Springer Proceedings in Mathematics and Statistics, 117, eds. M. Cojocar, I.S. Kotsireas, R. N. Makarov, R. Melnik, H. Shodiev, 2015.
 - X. Jin, **J. V. Deshmukh**, J. Kapinski, K. Ueda, K. Butts, *Challenges of Applying Formal Methods to Automotive Control Systems*, In NSF National Workshop on Transportation Cyber-Physical Systems 2014.
 - A. Zutshi, S. Sankaranarayanan, **J. V. Deshmukh**, J. Kapinski, *A Trajectory Splicing Approach to Concretizing Counterexamples for Hybrid Systems*, In Proc. of 52nd IEEE Conference on Decision and Control, 2013.
 - R. Samanta, **J. V. Deshmukh**, S. Chaudhuri, *Robustness Analysis of String Transducers*, In Proc. of the 11th International Symposium on Automated Technology for Verification and Analysis, 2013.
 - R. Alur, L. D'antoni, **J. V. Deshmukh**, M. Raghothaman, Y. Yuan, *Regular cost functions, Cost Register Automata and Generalized Min-cost Problems*, **Invited Paper** at the 28th annual ACM/IEEE Symposium on Logic in Computer Science, 2013.
 - X. Jin, A. Donzé, **J. V. Deshmukh**, and S. A. Seshia, *Mining Requirements from Closed-Loop Control Models*, In Proc. of the 16th ACM/IEEE International Conference on Hybrid Systems: Computation and Control, 2013.
 - R. Alur, **J. V. Deshmukh**, S. Mador-Haim, M. Martin, A. Raghavan, and A. Udupa, *TRANSIT: Specifying Protocols with Concolic Snippets*, In Proc. of the 34th annual ACM SIGPLAN conference on Programming Language Design and Implementation, 2013.
 - R. Samanta, **J. V. Deshmukh**, S. Chaudhuri, *Robustness Analysis for Networked Processes*, In Proc. of the 14th International Conference on Verification, Model Checking, and Abstract Interpretation, 2013.
 - R. Alur, **J. V. Deshmukh**, *Nondeterministic Streaming String Transducers*, **Invited Paper** at the 38th International Colloquium on Automata, Languages and Programming, 2011.
 - **J. V. Deshmukh**, G. Ramalingam, V. P. Ranganathan, K. Vaswani, *Logical Concurrency Control from Sequential Proofs*. In Proc. of the 19th European Symposium on Programming, 2010. **ETAPS 2010 Best Paper Award.**
 - **J. V. Deshmukh**, E. A. Emerson, S. Sankaranarayanan, *Symbolic Deadlock Analysis for Concurrent Libraries and their Clients*, In Proc. of the 24th IEEE/ACM conference on Automated Software Engineering, 2009. **ACM SIGSOFT Distinguished Paper Award.**
 - **J. V. Deshmukh**, E. A. Emerson, *Verification of Recursive Method on Tree-like Data Structures*. In Proc. of the 9th conference on Formal Methods in Computer-Aided Design, 2009.
 - R. Samanta, **J. V. Deshmukh**, E. A. Emerson, *Automatic Generation of Local Repairs in Boolean Programs*, In Proc. of the 8th conference on Formal Methods in Computer-Aided Design, 2008.
 - **J. V. Deshmukh**, E. A. Emerson, P. Gupta, *Automatic Verification of Parameterized Data Structures*, In Proc. of the 12th International Conference on Tools and Algorithms for the Construction and Analysis of Systems, 2006.

Publications under review

- **J. V. Deshmukh**, A. Donz , S. Ghosh, X. Jin, G. Juniwal, S. Seshia, *Robust Online Monitoring of Signal Temporal Logic*.
- M. Vazquez-Chanlatte, **J. V. Deshmukh**, X. Jin, S. Seshia. *Learning Auditable Features from Signals using Unsupervised Temporal Projection*.
- L. V. Nguyen, J. Kapinski, X. Jin, **J. V. Deshmukh**, K. Butts, T. T. Johnson, *Abnormal Data Classification Using Time-Frequency Temporal Logic*.
- **J. V. Deshmukh**, X. Jin, R. Majumdar, V. Prabhu, *Parameter Localization for Debugging and Performance Optimization in Control Software*.

HONORS

- EMSOFT 2016 Best Paper Award.
- RV 2015 Best Paper Award.
- EMSOFT 2014 Best Paper Award.
- Co-author on paper receiving HSCC 2016 Best Student Paper Award.
- Co-author on paper receiving ICC 2015 Best Student Paper Award.
- 2010 CCC-CRA *Computing Innovation Fellow*, fellowship granted jointly by Computing Research Association (CRA) and Computing Community Consortium (CCC) with support from NSF.
- ETAPS 2010 Best Paper Award.
- ACM SIGSOFT Distinguished Paper Award (2009).
- Professional Development Award, Graduate School, Univ. of Texas at Austin, 2008.
- First Rank in Bachelor of Engineering in Electronics, First class with Distinction.
- 2nd rank, IIT Mathematics Olympiad, India, 1999.

INVITED SEMINARS AND TALKS

- *Requirements-based Testing for Embedded Control Systems*, **Invited Tutorial**, *International conference on Embedded Software, 2016*.
- *Formal methods for cyber-physical systems in the automotive domain*, **Keynote Address**, 6th International Workshop on Cyber Physical Systems.
- *Formal methods for automotive control software*, **Invited Speaker**, *International Workshop on Cross-layer Resiliency, UC Irvine, 2016*.
- *Formal Methods for Automotive Control Software*, **Invited Speaker**, 1st International Workshop on Verification and Validation of Cyber-Physical Systems, June 2016.
- *Formal Methods for Automotive Control Software*, Cyber-physical Systems Seminar, Univ. of Southern California, May 2016.
- *Bridging the Gap between Research and Practice: Formal Methods in the Automotive Domain*, Univ. of California Berkeley, DREAM Seminar, October 2015.
- *Making formal methods work in industrial practice*, Univ. of California Davis, Hyundai Center of Excellence Distinguished Lecture Series, October 2015.
- *Formal Methods for Powertrain Control Software*, RiSE Seminar, IST Austria, September 2015.
- *Bridging the gap between research and practice: Formal methods in the automotive domain*, Univ. of Salzburg, September 2015.
- *Will future cars have formally verified powertrain control software?* **Keynote Address**, 18th International Conference on Hybrid Systems: Computation and Control, April 2015.
- *How can CPS education provide what the industry needs?* CPS-Ed 2014, Cyber-physical Systems Education Workshop at UC Berkeley (jointly organized with KTH Royal Institute of Technology, Sweden).
- *Making formal methods work in industrial practice*. PRECISE seminar, Univ. of Pennsylvania, Oct. 2014.
- *Simulation-Guided Formal Analysis*, Dagstuhl Seminar on Hybrid Systems, March 2014.
- *Bridging the gap between Industrial-scale control systems and formal methods*. (December 2013), Seminars at the Northeastern University, Massachusetts Institute of Technology.
- *How can we formally reason about industrial-scale control systems?* Center for Information & Systems Engineering Colloquium at the Boston University, December 2013.
- *How do we bridge the gap between formal methods and industrial-scale control systems?* Computer Science Colloquium, University of Colorado, September 2013.

- *Mining Requirements from Closed-loop Control Systems* (April 2013). Talk at LIX, Ecole Polytechnique, France and ETH Zurich.
- *Requirement Mining for Control Systems*, **Invited Speaker** at the LCCC Workshop on Formal Verification of Embedded Control Systems, Lund University, Sweden, April 2013.
- *Dagstuhl Seminar on Program Synthesis*, Wadern, Germany, April 2012.

PATENTS GRANTED

- **J. V. Deshmukh**, X. Jin, A. Donzé, S. A. Seshia, *Systems and methods for mining temporal requirements from block diagram models of control systems*, U.S. Patent 9081900 B2, filed 10/15/2012, and issued 7/14/2015.
- J. Kapinski, **J. V. Deshmukh**, *Systems and methods for evaluating stability of software code for control systems*, U.S. Patent 9195222 B2, filed 2/6/2013, and issued 11/24/2015.

PATENTS FILED

- A. Balkan, **J. V. Deshmukh**, J. Kapinski, *Simulation-guided incremental stability analysis*, U.S. Patent Application number 14/462,218, filed 02/18/2016.
 - G. Ramalingam, S. Rajamani, V.-P. Ranganath, K. Vaswani, **J. V. Deshmukh**, *Identifying concurrency control from a sequential proof*, U.S. Patent Application Number 12/345,857, filed 12/30/2008.
 - J. Kapinski, **J. V. Deshmukh**, X. Jin, T. Dang, T. Dreossi, *Coverage guided technique for bug finding in control systems and software*, U.S. Patent Application Number: 14/847,221.
- A. Balkan, P. Tabuada, **J. V. Deshmukh**, J. Kapinski, X. Jin, *Systems and methods for evaluating testing convergence of closed-loop control systems*, U.S. Patent Application Number 15/093975, filed 4/8/2016.

PROFESSIONAL ACTIVITIES

- Program Committee member:
 - ACM Int. Conf. on Hybrid Systems: Computation and Control (HSCC) 2014, 2015, 2016, 2017.
 - ACM SIGBED International Conference on Embedded Software (EMSOFT) 2016.
 - Runtime Verification (RV) 2016.
 - Monitoring and Testing of Cyber-Physical Systems (MTCPS@CPSWeek) 2016.
 - Applied Research on Verification for Continuous and Hybrid Systems (ARCH@CPSWeek) 2014, 15, 16.
 - International Conference on Cyber-Physical Systems (ICCPs) 2015.
 - Numerical Software Verification (NSV) 2014.
 - Numerical Software Verification Workshop 2013 (co-organizer and PC chair).
- Conceived and organized *Toyota Summit for Industrial Cyber-physical systems*.
- Member of the Industrial Advisory Board for the Center for Embedded Systems (An NSF Industry/University Cooperative Research Center).
- Member of the Industrial Advisory Board for NSF Frontiers of Cyber-Physical Systems Project on Correct-by-Design Control Software Synthesis for Highly Dynamic Systems.
- Member of NSF panel for Software and Hardware Foundations.
- Reviewer for NSF PIRE program.
- Technical Advisor for the 15th International Workshop on Discrete Event Systems (WODES 2018).
- Expert Review Panel: 28th IEEE/ACM International Conference on Automated Software Engineering (ASE 2013).
- External Reviewer (Journals): IEEE Transactions in Automatic Control, IEEE Transactions in Software Engineering, Formal Methods in System Design, Journal of Discrete Event Dynamical Systems, Journal of the Franklin Institute, Int. Journal for Software Tools for Technology Transfer.
- External Reviewer (Conferences): VLSI 03; VDAT 04; FSTTCS 04; CAV 04,05; VMCAI 05; ATVA 07, SPIN 08, TACAS 08, ISSTA 08, SoCP 08, SPIN 09, FSEN 09, TPDS 09, OPODIS 09, ICSE 10, ICDCS 10, IJCAI 11, CAV 13, ASE 13, FMCAD 13, CDC 13.
- Ph.D. committee membership:
 - Ayca Balkan (Univ. of California Los Angeles, advisor: Paulo Tabuada).
 - Aditya Zutshi (Univ. of Colorado Boulder, advisor: Sriram Sankaranarayanan).

- Thomas Ferrère (Université Grenoble Alpes, advisor: Oded Maler).
- Internship mentor/supervisor for:
 - Nikos Aréchiga (Carnegie Mellon) [Now: Toyota Information Technology Center, Mountain View]
 - Ayca Balkan (Univ. of California Los Angeles)
 - Tommaso Dreossi (Verimag/University of Udine, Italy/University Joseph Fourier France)
 - Chuchu Fan (Univ. of Illinois Urbana-Champaign)
 - Xiaoqing Jin (Univ. of California Riverside) [Now: Toyota Technical Center, Gardena]
 - Luan Ngyuven (Univ. of Texas at Arlington)
 - Marcell Vazquez-Chanlatte (Univ. of California Berkeley)
 - Aditya Zutshi (Univ. of Colorado Boulder)
- Member of Association for Computing Machinery (ACM), Member of IEEE.

EXTRACURRICULAR ACTIVITIES

- Volunteer Support for the SAE/AWIM STEM Education initiative at the 186th street elementary school, Gardena, CA, 2012, 2013.

PERSONAL INFORMATION

- Date of Birth: March 1, 1979.
- Citizen of India, Immigration status in the US: Green Card.
- Married with one child.

REFERENCES

Rajeev Alur
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University of Pennsylvania
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