

## Ashish Tiwari

333 Ravenswood Ave (650) 859-4774 (voice), (650) 859-2844 (fax)  
SRI International tiwari@csl.sri.com  
Menlo Park, CA 94025 <http://www.csl.sri.com/users/tiwari/>

### Education

May 1995	Bachelor of Technology	Computer Science
	Indian Institute of Technology-Kanpur	GPA : 3.92/4.0
Aug 2000	Doctor of Philosophy, PhD	Computer Science
	State University of New York, Stony Brook	GPA : 4.0/4.0

### Experience

**Senior Computer Scientist** : SRI International, 2012–present.

**Computer Scientist** : SRI International, 2000–2012.

**Research Assistant** : Department of Computer Science, State University of New York at Stony Brook, 1996–2000.

**Summer Intern** : SRI International, Menlo Park, CA (1999); Bellcore, Piscataway, NJ (1998); Bharath Earth Movers Limited, Bangalore, India (1994); Aeronautical Development Agency, Bangalore, India (1993).

**Teaching Assistant** : Department of Computer Science, State University of New York at Stony Brook, 1995–1996.

### Personal

Born June 6, 1973, India. Currently a citizen of the United States.

### Honors and Awards

1. National Science Foundation (NSF) awards funding the research proposals “Symbolic techniques for analysis of hybrid systems” (2003), “Little engines of proof” (2003), “Invariants for continuous and hybrid dynamical systems” (2007), “SMT-aware real constraint solving” (2009), and “Bounded verification and bounded synthesis” (2010).
2. National Aeronautics and Space Administration (NASA) awards funding the research proposal “Using symbolic constraint solving techniques for analyzing stability properties of adaptive control systems” (2007).
3. Certificate of merit for academic excellence in the core curriculum at the Indian Institute of Technology for the years 1991, 1992 and 1993.
4. Certificate of merit for being among the top 0.1% of successful candidates of All India Senior School Certificate Examination 1991 in Mathematics and Chemistry.

### Professional Activities

- Program Chair for 23rd International Conference on Rewriting Techniques and Applications, RTA 2012.
- Program co-chair for 9th International Workshop on Hybrid Systems: Computation and Control, HSCC 2006.
- Conference Chair for 17th International Conference on Rewriting Techniques and Applications, RTA 2006.
- Program co-chair for the first workshop on “Automated Deduction: Decidability, Complexity, and Tractability”, ADDCT 2007 held in conjunction with CADE-21, 2007.

- Member of the program committee for
  - IEEE International Conference on Logic in Computer Science, LICS 2008;
  - International Joint Conference on Automated Reasoning, IJCAR 2008 and IJCAR 2010;
  - EACSL Annual Conference on Computer Science and Logic, CSL 2007;
  - International Conference on Algebraic Biology, AB 2007 and AB 2008;
  - International Conference on Computer-Aided Verification, CAV 2007 and CAV 2011;
  - International Conference on Foundations of Software Technology and Theoretical Computer Science, FST&TCS 2006, FST&TCS 2007 and FST&TCS 2011;
  - International Workshop on Hybrid Systems: Computation and Control, HSCC 2003, HSCC 2005, HSCC 2009, HSCC 2011, and HSCC 2012;
  - International Conference on Rewriting Techniques and Applications, RTA 2003, RTA 2004, RTA 2006 and RTA 2009;
  - Pragmatics of Decision Procedures in Automated Reasoning, PDPAR 2003 and PDPAR 2006; and Satisfiability Modulo Theories, SMT 2007
  - International Conference on Logic for Programming, Artificial Intelligence, and Reasoning, LPAR 2005;
  - International Joint Conference on Automated Reasoning, IJCAR 2004;
  - International Conference on Automated Deduction, CADE 2005;
  - International Workshop on Frontiers of Combining Systems, FroCoS 2005.
- Reviewed papers for SIAM Journal of Computing, Journal of Automated Reasoning (JAR), Transactions on Computational Logic (TOCL), Intl. Conf. on Automated Deduction (CADE), Intl. Conf. on Computer-aided Verification (CAV), Intl. Formal Methods Europe Symposium (FME), Intl. Conf. on Foundations of Software Technology and Theoretical Computer Science (FST&TCS), Intl. Symposium on Formal Techniques in Real-Time and Fault Tolerant Systems (FTRTFT), Intl. Workshop on Frontiers of Combining Systems (FroCoS), Intl. Workshop on Hybrid Systems: Computation and Control (HSCC), Intl. Colloquium on Automata, Languages and Programming (ICALP), IEEE Symposium on Logic in Computer Science (LICS), Intl. Conference on Logic for Programming and Automated Reasoning (LPAR), Intl. Workshop on Pragmatics of Decision Procedures in Automated Reasoning (PDPAR), Intl. Conf. on Rewriting Techniques and Applications (RTA), Conf. on Tools and algorithms for the Construction and Analysis of Systems (TACAS), and Intl. Conf. on Theorem Proving in Higher Order Logics (TPHOLs).
- Invited speaker at the 21st International Conference on Automated Deduction, CADE 2007 and 26th Annual IEEE Symposium on Logic in Computer Science, 2011.
- Presented a Tutorial titled “On Shostak’s Combination of Decision Procedures” at the 18th International Conference on Automated Deduction, CADE’02.

### Publications

- [AT06] A. Abate and A. Tiwari. Box invariance of Hybrid and Switched systems. In *2nd IFAC Conference on Analysis and Design of Hybrid Systems*, pp. 359–364, 2006.
- [Aba07] A. Abate, Y. Bai, N. Sznajder, C. Talcott, and A. Tiwari. Quantitative and probabilistic modeling in pathway logic. In *IEEE Conf. BIBE07*, pages 922–929, 2007.

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- [ATS07] A. Abate, A. Tiwari, and S. Sastry. Box invariance for biologically-inspired dynamical systems. In *Proc. 46th IEEE Conf. on Decision and Control, CDC*, pages 5162–5167, 2007.
- [ATS09] A. Abate, A. Tiwari, and S. Sastry. Box invariance in biologically-inspired dynamical systems. *Automatica*, 45(7):1601–1610, July 2009.
- [AOT00] R. K. Ahuja, J. B. Orlin, and A. Tiwari. A greedy genetic algorithm for the quadratic assignment problem. *Computers and Operations Research*, 27(10):917–934, September 2000. Preliminary version appeared as a working paper, Sloan School of Management, WP#3826-95, June 1995.
- [Ben00] S. Bensalem, et.al. An overview of SAL. In B.L. De Vito, editor, *Langley Workshop on Formal Methods, LFMW 2000*, 2000.
- [BRIT99] L. Bachmair, C.R. Ramakrishnan, I.V.Ramakrishnan, and A. Tiwari. Normalization via rewrite closures. In P. Narendran and M. Rusinowitch, editors, *Rewriting Techniques and Applications, RTA 1999*, volume 1631 of *Lecture Notes in Computer Science*, pages 190–204, Trento, Italy, July 1999. Springer-Verlag.
- [BRTV00] L. Bachmair, I.V. Ramakrishnan, A. Tiwari, and L. Vigneron. Congruence closure modulo Associativity-Commutativity. In H. Kirchner and C. Ringesisen, editors, *Frontiers of Combining Systems, Third International Workshop, FroCoS 2000*, volume 1794 of *Lecture Notes in Artificial Intelligence*, pages 245–259, Nancy, France, March 2000. Springer-Verlag.
- [BT97] L. Bachmair and A. Tiwari. D-bases for polynomial ideals over commutative noetherian rings. In H. Comon, editor, *Rewriting Techniques and Applications, RTA 1997*, volume 1103 of *Lecture Notes in Computer Science*, pages 113–127, Sitges, Spain, July 1997. Springer-Verlag.
- [BT00] L. Bachmair and A. Tiwari. Abstract congruence closure and specializations. In D. McAllester, editor, *Conference on Automated Deduction, CADE 2000*, volume 1831 of *Lecture Notes in Artificial Intelligence*, pages 64–78, Pittsburgh, PA, June 2000. Springer-Verlag.
- [BTV03] L. Bachmair, A. Tiwari, and L. Vigneron. Abstract congruence closure. *J. of Automated Reasoning*, 31(2):129–168, 2003.
- [BRT02] N. Berregeb, R. Robbana, and A. Tiwari. Towards automated proofs of observational properties. *Discrete Mathematics and Theoretical Computer Science*, 6(2):143–162, 2004.
- [deM04] L. de Moura, S. Owre, H. Rueß, J. Rushby, N. Shankar, M. Sorea, and A. Tiwari. SAL 2. In R. Alur and D. Peled, editors, *Computer-Aided Verification, CAV*, volume 3114 of *LNCS*, pages 496–500. Springer, July 2004.
- [DT13] P. S. Duggirala and A. Tiwari. Safety verification for linear systems. In *ACM/IEEE Intl. Conf. on Embedded Software, EMSOFT 2013*.
- [Eke13] S. Eker, M. Krummenacker, A. Shearer, I. Keseler, C. Talcott, A. Tiwari and P. Karp. Computing minimal nutrient sets from metabolic networks via linear constraint solving. *BioMed Central BMC Bioinformatics* 14:114, 2013.
- [GT14] A. Gascon and A. Tiwari. A Synthesized Algorithm for Interactive Consistency. In *NASA Formal Methods, NFM 2014*.
- [GNT02] G. Godoy, R. Nieuwenhuis, and A. Tiwari. Classes of Term Rewrite Systems with Polynomial Confluence Problems. *ACM Transactions on Computational Logic (TOCL)*, 5(2):321–331, April 2004.
- [GT04] G. Godoy and A. Tiwari. Deciding Fundamental Properties of Right-(Ground or Variable) Rewrite Systems by Rewrite Closure. In D. Basin and M. Rusinowitch, editors, *Intl. Joint Conf. on Automated Deduction, IJCAR*, volume 3097 of *LNAI*, pages 91–106, Springer, 2004.

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- [GT05a] G. Godoy and A. Tiwari. Confluence of shallow right-linear rewrite systems. In *Annual EACSL Conference on Computer Science Logic, CSL 2005*.
- [GT05b] G. Godoy and A. Tiwari. Termination of Rewrite Systems with Shallow Right-Linear, Collapsing, and Right-Ground Rules. In *Intl. Conf. on Automated Deduction, CADE 2005*.
- [GTV03] G. Godoy, A. Tiwari, and R. Verma. On the confluence of linear shallow term rewrite systems. In H. Alt and M. Habib, editors, *20th Intl. Symposium on Theoretical Aspects of Computer Science STACS 2003*, volume 2607 of *Lecture Notes in Computer Science*, pages 85–96. Springer, February 2003.
- [GTV04a] G. Godoy, A. Tiwari, and R. Verma. Characterizing confluence by rewrite closure and right ground term rewrite systems. *Applicable Algebra in Engineering, Communication and Computing, AAEC*. 15(1):13–36, Springer, Jun 2004.
- [GTV04b] G. Godoy, A. Tiwari, and R. Verma. Deciding confluence of certain term rewriting systems in polynomial time. *Annals of Pure and Applied Logic*. 130(1-3):33–59, Elsevier, Dec 2004.
- [GMT08] S. Gulwani, W. McClosekey, and A. Tiwari. Lifting abstract interpreters to quantified abstract domains. In *Proc. 35th Symp. on Principles of Programming Languages, POPL*, pages 235–246, 2008.
- [GTN04] S. Gulwani, A. Tiwari, and G. Necula. Join algorithms for the theory of uninterpreted functions. In K. Lodaya and M. Mahajan, editors, *Foundations of Software Technology and Theoretical Computer Science, FSTTCS 2004*. volume 3328 of *LNCS*, pages 311–323. Springer, 2004.
- [GT06a] S. Gulwani and A. Tiwari. Assertion checking over combined abstraction of linear arithmetic and uninterpreted functions. In *European Symposium on Programming, ESOP 2006*.
- [GT06b] S. Gulwani and A. Tiwari. Combining abstract interpreters. In *ACM SIGPLAN Conf. on Programming Language Design and Implementation, PLDI 2006*.
- [GT07a] S. Gulwani and A. Tiwari. Assertion checking unified. In *Proc. Verification, Model Checking and Abstract Interpretation, VMCAI 2007*.
- [GT07b] S. Gulwani and A. Tiwari. Computing procedure summaries for interprocedural analysis. In *European Symposium on Programming, ESOP 2007*.
- [GT07c] S. Gulwani and A. Tiwari. Static analysis of heap manipulating low-level software. In *Intl. Conf. on Computer-Aided Verification, CAV 2007*.
- [GT08] S. Gulwani and A. Tiwari. Constraint-based approach for analysis of hybrid systems. In *Proc. 20th Intl. Conf. on Computer Aided Verification, CAV 2008*, volume 5123 of *LNCS*, pages 190–203. Springer, 2008. July 7-14, 2008, Princeton, NJ.
- [GKT11] S. Gulwani, V. Korthikanti and A. Tiwari. Synthesizing geometry constructions. In *ACM SIGPLAN Conf. on Programming Language Design and Implementation, PLDI 2011*.
- [1] bb S. Gulwani, S. Jha, A. Tiwari and R. Venkatesan. Synthesis of loop-free programs. In *ACM SIGPLAN Conf. on Programming Language Design and Implementation, PLDI 2011*.
- [2] Susmit Jha, Sanjit A. Seshia, and Ashish Tiwari. Synthesis of optimal switching logic for hybrid systems. In *Proc. ACM 11th Intl. Conf. on Embedded Software, EMSOFT*, pages 107–116, 2011.
- [KTK07] R. Kumar, A. Tiwari, and B. Krogh. EOLC: Efficiently modeling inconsistency for commonsense reasoning. In *Intl. Workshop on Multi-Valued Logic Programming and Applications, MVLPA 2006*.

- [LT14] J. Leike and A. Tiwari. Synthesis for polynomial lasso programs. In *Proc. VMCAI*, LNCS 8318, pages 454–472, 2014.
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- [MCTT13] S. Mover, A. Cimatti, A. Tiwari, and S. Tonetta. Time-aware relational abstraction for hybrid systems. In *EMSOFT*, 2013.
- [RT05] E. Rodriguez-Carbonell and A. Tiwari. Generating polynomial invariants for hybrid systems. In *Hybrid Systems: Computation and Control*, HSCC 2005.
- [ST11a] S. Sankaranarayanan and A. Tiwari. Relational abstractions for continuous and hybrid systems. In *Proc. 23rd Intl. Conf. on Computer Aided Verification, CAV*, volume 6806 of *LNCS*, pages 686–702. Springer, 2011.
- [ST11b] T. Sturm and A. Tiwari. Verification and synthesis using real quantifier elimination. In *Intl. Symposium on Symbolic and Algebraic Computation*, ISSAC 2011.
- [TGT09] A. Taly, S. Gulwani, and A. Tiwari. Synthesizing switching logic using constraint solving. In *Proc. 10th Intl. Conf. on Verification, Model Checking and Abstract Interpretation, VMCAI*, volume 5403 of *LNCS*, pages 305–319. Springer, 2009.
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- [Tiw03a] A. Tiwari. Abstraction based theorem proving: An example from the theory of reals. In C. Tinelli and S. Ranise, editors, *Proceedings of the CADE-19 Workshop on Pragmatics of Decision Procedures in Automated Deduction, PDPAR 2003*, pages 40–52. INRIA, Nancy, France, 2003.
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- [Tiw04] A. Tiwari. Termination of linear programs. In R. Alur and D. Peled, editors, *Computer-Aided Verification, CAV*, volume 3114 of *LNCS*, pages 70–82. Springer, July 2004.
- [Tiw05] A. Tiwari. An algebraic approach to the satisfiability of nonlinear constraints. In *Annual EACSL Conference on Computer Science Logic, CSL* 2005.
- [Tiw08] A. Tiwari. Generating box invariants. In *HSCC*, LNCS 4981, pages 658–661. Springer, 2008.
- [Tiw11] A. Tiwari. Compositionally analyzing a proportional-integral controller, 2011. Submitted. Under review.
- [Tiw12] A. Tiwari. Hybridsal relational abstracter. In *Proc. CAV*, volume 7358 of *LNCS*, 2012. <http://www.csl.sri.com/~tiwari/relational-abstraction/>.
- [Tiw14] A. Tiwari, B. Dutertre, D. Jovanovic, T. de Candia, P. Lincoln, J. Rushby, D. Sadigh, and S. Seshia. Safety Envelope for Security. In *ACM Intl. Conf. on High Confidence Networked Systems, HiCoNS* 2014.
- [TG07] A. Tiwari and S. Gulwani. Logical interpretation: Static program analysis using theorem proving. In *Intl. Conf. on Automated Deduction, CADE* 2007.
- [TK02] A. Tiwari and G. Khanna. Series of abstractions for hybrid automata. In C. J. Tomlin and M. R. Greenstreet, editors, *Hybrid Systems: Computation and Control, HSCC 2002*, volume 2289 of *LNCS*, pages 465–478, 2002.
- [TK04] A. Tiwari and G. Khanna. Nonlinear systems: Approximating reach sets. In R. Alur and G. Pappas, editors, *Hybrid Systems: Computation and Control, HSCC 2004*, volume 2993 of *LNCS*, pages 600–614, 2004.
- [TRSS01] A. Tiwari, H. Rueß, H. Saïdi, and N. Shankar. A technique for invariant generation. In Tiziana Margaria and Wang Yi, editors, *TACAS 2001 - Tools and Algorithms for the Construction and Analysis of Systems*, volume 2031 of *LNCS*, pages 113–127, Genova, Italy, April 2001. Springer-Verlag.
- [TSR03] A. Tiwari, N. Shankar, and J. Rushby. Invisible formal methods for embedded control systems. *Proceedings of the IEEE*, 91(1):29–39, January 2003.
- [TTKPL07] A. Tiwari, C. Talcott, M. Knapp, P. Lincoln, and K. Laderoute. Analyzing pathways using SAT-based approaches. In *Proc. Conf. on Algebraic Biology, AB* 2007.
- [ZST12] A. Zutshi, S. Sankaranarayanan, and A. Tiwari. Timed relational abstractions for sampled data control systems. In *Proc. CAV*, volume 7358 of *LNCS*, pages 343–361, 2012.

**Dissertation**

Title : Decision Procedures in Automated Deduction  
Advisor : Prof. Leo Bachmair (State University of New York at Stony Brook)