

Curriculum Vitae

Rupak Majumdar

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Research Interests

Formal verification: Algorithmic issues in the verification and control of reactive, probabilistic, and real-time systems.

Software verification, program analysis, and testing.

Theoretical foundations: Logic, automata theory, and game theoretic methods in formal verification.

Hardware logic synthesis.

Education

May 1998 B.Tech in Computer Science,
Indian Institute of Technology, Kanpur
September 2003 Ph.D. in Computer Science,
Department of Computer Science,
University of California, Berkeley, CA 94720
(Graduate Advisor: Thomas A. Henzinger)

Employment

July, 2008 onwards Associate Professor,
Department of Computer Science,
University of California, Los Angeles, CA 90095
2004-2008 Assistant Professor,
Department of Computer Science,
University of California, Los Angeles, CA 90095

Awards and Honors

1. EAPLS Best Paper award at the European Theory and Practice of Software (ETAPS) conference, 2009.

2. NSF CAREER Award, 2006.
3. Nominated for ACM Distinguished Dissertation Award, UC Berkeley, 2004.
4. Leon O. Chua Award for Research in Nonlinear Science, Department of EECS, University of California, Berkeley, 2002.
5. Best paper award, 12th International Conference on Concurrency Theory (CONCUR), 2001.
6. Microsoft Research Fellowship, Microsoft Corp, 2001.
7. UC Regent's Fellowship, University of California, Berkeley, 1998.
8. President's Gold Medal, Indian Institute of Technology, Kanpur, 1998.

Grants

1. National Science Foundation ITR: Event driven software quality. PI: Jens Palsberg, co-PIs: Eddie Kohler, Rupak Majumdar, Todd Millstein. 2004–2008.
2. National Science Foundation: CAREER: Modular verification of software. 2006–2011.
3. National Science Foundation: CPA: Software verification for hardware models. 2007–2010.
4. National Science Foundation: EHS: Directed real-time testing. 2007–2010.
5. DARPA: CSSG: Systematic testing of safety-critical systems. 2009-2011.
6. National Science Foundation: SHF: Closing the gap in controller synthesis. 2009-2011.
7. Industrial gifts from Intel, Microsoft, and Altera.

Software

1. Splat: Directed dynamic test case generator (<http://www.cs.ucla.edu/~rupak/splat.html>)
2. BLAST: Software model checker (<http://www.cs.ucla.edu/~rupak/blast>)
3. jMocha: Compositional model checker (<http://www.eecs.berkeley.edu/~mocha>)
4. The Vampire Proof-generating Theorem Prover (<http://www.cs.ucla.edu/~rupak/vampire>)

Invited Talks

- “Nash equilibria in stochastic games,” Workshop on Games in Design and Verification, 2004.
- “Software verification with Blast,” MOVEP: Modeling and Verifying Parallel Processes, Summer School, Brussels, 2004.
- “Counterexample-guided planning,” Dagstuhl Workshop on Synthesis and Planning, 2005.
- “Software verification with Blast,” SPIN Workshop on Software Model Checking, 2005.
- “Joining dataflow with predicates,” Summer Research Institute, EPFL, Lausanne, Switzerland, 2006.
- “The Next Challenges in Software Verification,” Stanford University Programming Languages Seminar, 2006. Also at Intel Strategic CAD Labs, 2006.
- “Proofs and counterexamples,” Workshop on Satisfiability modulo Theories, Berlin, 2007.
- “Structural Invariants,” Summer Research Institute, EPFL, Lausanne, Switzerland, 2007.
- “The Analysis of Asynchronous Programs,” Departmental Colloquium, University of Iowa, 2007.
- “The Analysis of Asynchronous Programs,” Distinguished Lecture, Max Planck Institute for Software Systems, Germany, 2008.

Publications

Edited Books and Proceedings

- [1] Klaus Havelund, Rupak Majumdar, and Jens Palsberg. Model Checking Software: 15th International SPIN Workshop Proceedings. Lecture Notes in Computer Science 5156, Springer, 2008.
- [2] Rupak Majumdar and Paulo Tabuada. Hybrid Systems: Computation and Control, 12th International Conference. Lecture Notes in Computer Science 5469, Springer, 2009.

Refereed Journal Publications

- [1] T.A. Henzinger, R. Majumdar, and J.-F. Raskin. A classification of symbolic transition systems. In *ACM Transactions on Computational Logic*, 6(1):1–32, 2005.
- [2] L. de Alfaro and R. Majumdar. Quantitative Solution of Concurrent Games. In *Journal of Computer and Systems Sciences*, 68, pages 374–397, 2004.
- [3] K. Chatterjee, D. Ma, R. Majumdar, T. Zhao, T.A. Henzinger and J. Palsberg. Stack size analysis for interrupt-driven programs. In *Information and Computation*, 194(2): 144–174. 2004.
- [4] J.L. Wong, R. Majumdar, and M. Potkonjak. Watermarking of SAT using combinatorial isolation lemmas. In *IEEE Transactions on Computer-Aided Design of Integrated Circuits*, 2004.
- [5] T.A. Henzinger, O. Kupferman, and R. Majumdar. On the complexity of the universal and existential μ -calculus. In *Theoretical Computer Science*, 2006.
- [6] L. de Alfaro, M. Faella, T.A. Henzinger, R. Majumdar, and M. Stoelinga. Model checking discounted temporal properties. In *Theoretical Computer Science*, 2006.
- [7] K. Chatterjee, R. Majumdar, and T.A. Henzinger. Stochastic limit-average games are in EXPTIME. In *International Journal of Game Theory*, to appear.
- [8] D. Beyer, T.A. Henzinger, R. Jhala, and R. Majumdar. Software engineering with Blast. In *Software Tools for Technology Transfer*, 2007.
- [9] L. de Alfaro, R. Majumdar, V. Raman, and M. Stoelinga. Game relations and metrics. In *Logical Methods in Computer Science*, 2008.
- [10] Y. Hu, V. Shih, R. Majumdar, and L. He. Efficient SAT-Based Boolean Matching for Heterogeneous FPGA Technology Mapping. *IEEE Transactions on Computer-Aided Design of Integrated Circuits*, 27(10): 1751–1760, 2008.
- [11] R. Jhala and R. Majumdar. Software model checking. *ACM Computing Surveys*, 2009.

Refereed Conference Publications

- [1] R. Majumdar and R.K. Shyamasundar. Design of controllers for linear hybrid systems, In *ASIAN 96: Concurrency and Parallelism, Programming, Networking, and Security: Second Asian Computing Science Conference*, Lecture Notes in Computer Science, vol 1179, pages 309–320, Springer-Verlag, 1996.

- [2] T.A. Henzinger, B. Horowitz, and R. Majumdar. Rectangular hybrid games. In *CONCUR 99: Concurrency Theory*, Lecture Notes in Computer Science, vol 1664, pages 320–335, Springer-Verlag, 1999.
- [3] T.A. Henzinger, B. Horowitz, R. Majumdar, and H. Wong-Toi. Beyond HyTech: Hybrid Systems Analysis using interval numerical methods. In *HSCC 00: Hybrid Systems: Computation and Control*, Lecture Notes in Computer Science, vol 1790, pages 130–144, Springer-Verlag, 2000. (Preliminary results appeared in *Hybrid Systems and AI: Modeling Analysis and Control of Discrete + Continuous Systems*, AAI 99 Spring Symposium Series, 1999).
- [4] T.A. Henzinger and R. Majumdar. Symbolic model checking for rectangular hybrid systems. In *TACAS 00: Tools and Algorithms for the Construction and Analysis of Systems*, Lecture Notes in Computer Science, vol 1785, pages 142–156, Springer-Verlag, 2000.
- [5] T.A. Henzinger, R. Majumdar, F. Y.-C. Mang, and J.-F. Raskin. Abstract interpretation of game properties. In *SAS 00: Static Analysis Symposium*, Lecture Notes in Computer Science, vol 1824, pages 220–239, Springer-Verlag, 2000.
- [6] R. Alur, L. de Alfaro, R. Grosu, T.A. Henzinger, M. Kang, R. Majumdar, F. Mang, C. Meyer-Kirsch, and B.Y. Wang. jMocha: a model-checking tool that exploits design structure. Proceedings of the 23rd Annual IEEE/ACM International Conference on Software Engineering (ICSE 01), ACM Press, pages 64–72, 2001.
- [7] L. de Alfaro and R. Majumdar. Quantitative solution of concurrent games. In *Proceedings on 33rd Annual ACM Symposium on Theory of Computing (STOC '01)*, ACM Press, pages 675–683, 2001.
- [8] R. Majumdar and J.L. Wong. Watermarking of SAT using combinatorial isolation lemmas. In *Proceedings of the 38th Design Automation Conference (DAC 2001)*, ACM Press, pages 480–485, 2001.
- [9] T. Ball, R. Majumdar, T. Millstein, and S.K. Rajamani. Automatic predicate abstraction of C programs. In *Proceedings of the 2001 ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI '01)*, ACM Press, page 203–213, 2001.
- [10] L. de Alfaro, T.A. Henzinger, and R. Majumdar. From verification and control: dynamic programs for omega-regular properties. In *Proceedings of the 16th Annual Symposium on Logic in Computer Science (LICS 01)*, IEEE Computer Society Press, pages 279–290, 2001.
- [11] L. de Alfaro, T.A. Henzinger, and R. Majumdar. Symbolic algorithms for infinite-state games. In *Proceedings of the 12th International Conference on Concurrency Theory (CONCUR 01)*, Lecture Notes in Computer Science 2154, Springer-Verlag, pages 536–550, 2001. Best paper award.

- [12] T.A. Henzinger, R. Jhala, R. Majumdar, and G. Sutre. Lazy abstraction. In *Proceedings of the 29th Annual Symposium on Principles of Programming Languages (POPL 02)*, ACM Press, pages 58–70, 2002.
- [13] T.A. Henzinger, R. Jhala, R. Majumdar, G.C. Necula, G. Sutre, and W. Weimer. Temporal-safety proofs for systems code. In *Proceedings of the Computer-Aided Verification (CAV 02)*, Lecture Notes in Computer Science 2404, Springer-Verlag, pages 526–538, 2002.
- [14] T.A. Henzinger, C. Kirsch, R. Majumdar, and S. Matic. Time safety checking for embedded programs. In *Proceedings of the 2nd Conference on Embedded Software (EMSOFT 02)*, Lecture Notes in Computer Science, Springer-Verlag, pages 76–92, 2002.
- [15] T.A. Henzinger, R. Jhala, R. Majumdar, and G. Sutre. Software verification with Blast (Tool Paper). In *SPIN 03: SPIN Model Checking and Software verification*, Lecture Notes in Computer Science 2648. Springer-Verlag, pages 235–239, 2003.
- [16] T.A. Henzinger, O. Kupferman, and R. Majumdar. On the universal and existential fragments of the μ -calculus. In *TACAS 03: Tools and Algorithms for the Construction and Analysis of Systems*, Lecture Notes in Computer Science 2619. Springer-Verlag, pages 49–64, 2003.
- [17] L. de Alfaro, T.A. Henzinger, and R. Majumdar. Discounting the future in systems theory. In *ICALP 03: International Colloquium on Automata, Languages, and Programming*, Lecture Notes in Computer Science 2719. Springer-Verlag, pages 1022–1037, 2003.
- [18] T.A. Henzinger, R. Jhala, and R. Majumdar. Counterexample guided control. In *ICALP 03: International Colloquium on Automata, Languages, and Programming*, Lecture Notes in Computer Science 2719. Springer-Verlag, pages 886–902, 2003.
- [19] K. Chatterjee, D. Ma, R. Majumdar, T. Zhao, T.A. Henzinger, and J. Palsberg. Stack size analysis for interrupt driven programs. In *SAS 03: Static Analysis Symposium*, Lecture Notes in Computer Science 2694, Springer-Verlag, pages 109–126, 2003.
- [20] L. de Alfaro, M. Faella, T.A. Henzinger, R. Majumdar, and M. Stoelinga. The element of surprise in timed games. In *CONCUR 03: Concurrency Theory*, Lecture Notes in Computer Science 2761. Springer-Verlag, pages 142–156, 2003.
- [21] T.A. Henzinger, R. Jhala, R. Majumdar, and S. Qadeer. Thread modular abstraction refinement. In *CAV 03: Computer-Aided Verification*, Lecture Notes in Computer Science 2725. Springer-Verlag, pages 262–274, 2003.
- [22] T.A. Henzinger, R. Jhala, R. Majumdar, and K.L. McMillan. Abstractions from proofs. In *POPL 04: Principles of Programming Languages*, ACM press. To appear, 2004.
- [23] L. de Alfaro, M. Faella, T.A. Henzinger, R. Majumdar, and M. Stoelinga. Model checking discounted temporal properties. In *TACAS 04: Tools and Algorithms for the*

Construction and Analysis of Systems, Lecture Notes in Computer Science. Springer-Verlag, 2004.

- [24] D. Beyer, A.J. Chlipala, T.A. Henzinger, R. Jhala, and R. Majumdar. Generating tests from counterexamples. In *ICSE 04: International Conference on Software Engineering*, ACM press. To appear, 2004.
- [25] T.A. Henzinger, R. Jhala, and R. Majumdar. Race checking by context inference. In *PLDI 04: Programming Languages Design and Implementation*, ACM press. To appear, 2004.
- [26] D. Beyer, T.A. Henzinger, R. Jhala, and R. Majumdar. An Eclipse plug-in for model checking. In *IWPC 04: International Workshop on Program Comprehension*, ACM press. 2004.
- [27] K. Chatterjee, R. Majumdar, and M. Jurdzinski. On Nash equilibria in stochastic games. In *CSL 04: Computer Science Logic*, Lecture Notes in Computer Science 3210, pages 26–40. Springer, 2004.
- [28] R. Jhala and R. Majumdar. Path slicing. In *PLDI 05: Programming Languages Design and Implementation*, pages 38–47. ACM, 2005.
- [29] J. Fischer, R. Jhala, and R. Majumdar. Joining dataflow with predicates. In *FSE 05: Foundations of Software Engineering*, ACM Press, 2005.
- [30] T.A. Henzinger, R. Jhala, and R. Majumdar. Permissive interfaces. In *FSE 05: Foundations of Software Engineering*, ACM Press, 2005.
- [31] A. Chakrabarti, K. Chatterjee, T.A. Henzinger, O. Kupferman, and R. Majumdar. Verifying quantitative properties using bound functions. In *CHARME 2005*, Springer. 2005.
- [32] K. Chatterjee, T.A. Henzinger, R. Jhala, and R. Majumdar. Counterexample-guided planning. In *UAI 2005*.
- [33] L. de Alfaro, M. Faella, R. Majumdar, and V. Raman. Code aware resource management. In *EMSOFT 05: Embedded Software*, ACM, 2005.
- [34] T.A. Henzinger, R. Majumdar, and V. Prabhu. Quantifying Similarities Between Timed Systems. In *FORMATS 2005*, Springer.
- [35] M.J. Emmi and R. Majumdar. Decision problems for model checking real-time software. In *HSCC 06: Hybrid Systems: Computation and Control*, Springer, 2006.
- [36] K. Chatterjee, R. Majumdar, and T.A. Henzinger. Markov decision processes with multiple objectives. In *STACS 06: Symposium on Theoretical Aspects of Computer Science*, Springer, 2006.
- [37] R. Jhala, R. Majumdar, and R. Xu. Structural invariants. In *SAS 06: Static Analysis Symposium*, Springer, 2006.

- [38] K. Chatterjee, L. de Alfaro, M. Faella, T.A. Henzinger, R. Majumdar, and M. Stoelinga. Compositional quantitative reasoning. In *QEST 06*, ACM, 2006.
- [39] R. Jhala and R. Majumdar. Bit level types for high level reasoning. In *FSE 06: Foundations of Software Engineering*, ACM, 2006.
- [40] D. Kapur, R. Majumdar, and C.G. Zarba. Interpolation for data structures. In *FSE 06: Foundations of Software Engineering*, ACM, 2006.
- [41] R. Jhala and R. Majumdar. The analysis of asynchronous programs. In *POPL 07: Principles of Programming Languages*, ACM, 2007.
- [42] M. Emmi, J. Fischer, R. Jhala, and R. Majumdar. Lock allocation. In *POPL 07: Principles of Programming Languages*, ACM, 2007.
- [43] M. Emmi and R. Majumdar. Verifying compensating transactions. In *VMCAI 07: Verification, Model Checking, and Abstract Interpretation*, Lecture Notes in Computer Science, Springer-Verlag, 2007.
- [44] D. Beyer, T.A. Henzinger, R. Majumdar, and A. Rybalchenko. Invariant Generation for Combined Theories. In *VMCAI 07: Verification, Model Checking, and Abstract Interpretation*, Lecture Notes in Computer Science, Springer-Verlag, 2007.
- [45] R. Jhala, R. Majumdar, and R.-G. Xu. State of the union: Type inference using Craig interpolation. In *TACAS 07: Tools and Algorithms for the Construction and Analysis of Systems*, Lecture Notes in Computer Science, Springer-Verlag, 2007.
- [46] L. de Alfaro, R. Majumdar, V. Raman, and M. Stoelinga. Game relations and metrics. In *LICS 07: Logic in Computer Science*, IEEE, 2007.
- [47] J. Fischer, R. Majumdar, and T. Millstein. Tasks: Language support for event-driven programming. In *PEPM 07: Partial Evaluation and Program Manipulation*, ACM, 2007.
- [48] R. Majumdar and K. Sen. Hybrid concolic testing. In *ICSE 07: International Conference on Software Engineering*, ACM and IEEE, 2007.
- [49] D. Beyer, T.A. Henzinger, R. Majumdar, and A. Rybalchenko. Path Invariants. In *PLDI 07: Programming Languages Design and Implementation*, ACM, 2007.
- [50] M. Emmi, R. Majumdar, and K. Sen. Dynamic test input generation for database applications. In *ISSTA 07: International Symposium on Software Testing and Analysis*, ACM, 2007.
- [51] Y. Hu, V. Shih, R. Majumdar, and L. He. Efficient SAT-Based Boolean Matching for Heterogeneous FPGA Technology Mapping. In *ICCAD 07: International Conference on Computer-Aided Design*, ACM, 2007.
- [52] J. Fischer and R. Majumdar. Ensuring consistency in long-running transactions. In *ASE 07: Automated Software Engineering*, ACM, 2007.

- [53] R. Majumdar and R. Xu. Directed test generation using symbolic grammars. In *ASE 07: Automated Software Engineering*, ACM, 2007. (A preliminary version appeared in *ESEC/FSE 07: Foundations of Software Engineering*.)
- [54] A. Gupta, T. Henzinger, R. Majumdar, A. Rybalchenko, R. Xu. Proving non-termination. In *POPL 08: Principles of Programming Languages*, ACM, 2008.
- [55] K. Chatterjee, R. Majumdar, and T. Henzinger. Controller synthesis with budget constraints. In *HSCC 08: Hybrid Systems Computation and Control*, Springer, 2008.
- [56] G. Ercal, R. Izhak-Ratzin, R. Majumdar, and A. Meyerson. Frugal routing in random geometric graphs. In *SAGT 08: Symposium on Algorithmic Game Theory*, Springer, 2008.
- [57] J. Fischer, R. Majumdar, and F. Sorrentino. The Consistency of Web Conversations. In *ASE 08: Automated Software Engineering*, IEEE, 2008.
- [58] R.-G. Xu, P. Godefroid, and R. Majumdar. Testing for Buffer Overflows using Length Abstraction. In *ISSTA 08: International Symposium on Software Testing and Analysis*, ACM, 2008.
- [59] D. Beyer, D. Zufferey, and R. Majumdar. CSIsat: Interpolation for LA+EUF. In *CAV 08: Computer-Aided Verification*, Springer, 2008.
- [60] Y. Hu, V. Shih, L. He, and R. Majumdar. FPGA area reduction by multi-output function based sequential resynthesis. In *DAC 08: Design Automation Conference*, ACM, 2008.
- [61] K. Chatterjee, L. de Alfaro, and R. Majumdar. The complexity of coverage. In *APLAS 08: Asian Symposium on Programming Languages and Systems*, Springer, 2008.
- [62] Y. Hu, Z. Feng, L. He, and R. Majumdar. Robust FPGA resynthesis based on fault tolerant Boolean matching. In *ICCAD 08: International Conference on Computer-Aided Design*, ACM, 2008.
- [63] J. Fischer and R. Majumdar. A theory of role composition. In *ICWS 08: International Conference on Web Services*, IEEE, 2008.
- [64] K. Chatterjee, L. de Alfaro, R. Majumdar, and V. Raman. Algorithms for game relations. In *FSTTCS 08: Foundations of Software Technology and Theoretical Computer Science*, Springer. To appear, 2008.
- [65] P. Ganty, R. Majumdar, and A. Rybalchenko. Liveness for asynchronous programs. In *POPL 09: Principles of Programming Languages*, ACM. 2009.
- [66] . Lee, Y. Hu, R. Majumdar, and L. He. Simultaneous Test Pattern Compaction, Ordering and X-Filling for Testing Power Reduction. In *ISQED 09: International Symposium on Quality Electronic Design*. IEEE, 2009.

- [67] A. Gupta, R. Majumdar, and A. Rybalchenko. From tests to proofs. In *TACAS 09: Tools and Algorithms for the Construction and Analysis of Systems*. Springer, 2009. **Best paper award.**
- [68] M.Emmi, R. Jhala, E. Kohler, and R. Majumdar. Verifying reference counted objects. In *TACAS 09: Tools and Algorithms for the Construction and Analysis of Systems*. Springer, 2009.
- [69] R. Majumdar and R. Xu. Reducing test inputs using information partitions. In *CAV 09: Computer-Aided Verification*. Springer 2009.
- [70] R. Izhak-Ratzin, N. Liogkas, and R. Majumdar. Team incentives in BitTorrent programs. In *ICCCN 09: International Conference on Computer Communications and Networks*, IEEE 2009.
- [71] P. Ganty and R. Majumdar. Analyzing real-time event-driven programs. In *FORMATS 09: Formal Modeling and Analysis of Timed Systems*. Springer 2009.
- [72] Z. Feng, Y. Hu, L. He, and R. Majumdar. IPR: In-place reconfiguration for FPGA fault tolerance. In *ICCAD 09: International Conference on Computer-Aided Design*. ACM, 2009.

Invited Papers

- [1] T.A. Henzinger and R. Majumdar. A classification of symbolic transition systems. In *STACS 00: Theoretical Aspects of Computer Science*, Lecture Notes in Computer Science, vol 1770, pages 13–34, Springer-Verlag, 2000.
- [2] T.A. Henzinger, R. Jhala, R. Majumdar, and M.A.A. Sanvido. Extreme model checking. In *Proceedings of the International Symposium on Verification (Theory and Practice): Celebrating Zohar Manna's 64-th Birthday*, Lecture Notes in Computer Science 2722, pages 332–358, 2003.
- [3] D. Beyer, A. Chlipala, T.A. Henzinger, R. Jhala, and R. Majumdar. The Blast query language for software verification. In *SAS 04: Static Analysis Symposium*, Lecture Notes in Computer Science. Springer, 2004.
- [4] D. Beyer, T.A. Henzinger, R. Jhala, and R. Majumdar. Checking memory safety with Blast. In *FASE 05: Fundamental Approaches to Software Engineering*, 2005.
- [5] T.A. Henzinger, R. Jhala, and R. Majumdar. Software verification with BLAST. In *SPIN 05: Software Model Checking*, Springer. 2005.

Patents

US Patent 7058925: System and method for generating a predicate abstraction of a program.

Professional Activities

Teaching and Organization

- CS284 Advanced Automata Theory (Graduate class).
- CS234 Computer-Aided Verification (Graduate class).
- CS239 Topics in Software Verification (Graduate class).
- CS181 Formal Languages and Automata Theory (Undergraduate class).

Conference Organization

- GDV 2005: Games in Design and Verification (Program co-Chair).
- SPIN 2008: Software Model Checking (Program co-Chair).
- HSCC 2009: Hybrid Systems Computation and Control (Program co-Chair).
- TACAS 2010: Tools and Algorithms for the Construction and Analysis of Systems (Program co-Chair).

Students and Post-doctoral Associates

Post-doctoral associate: Pierre Ganty.

Graduate Students: Michael Emmi, Rafit Izhak-Ratzin, Indranil Saha, Ru-Gang Xu.

Graduated: Manav Mital (MS), Viktor Shih (MS), Jeffrey Fischer (PhD).

References

Available upon request.