

Randal E. Bryant

## Publications

### Books and Book Chapters

R. E. Bryant, “Binary Decision Diagrams,” *Handbook of Model Checking*, E. M. Clarke, T. A. Henzinger, H. Veith, and R. Bloem, eds., Springer, 2018, pp. 191–218, Available as

<http://www.cs.cmu.edu/~bryant/pubdir/hmc-bdd18.pdf>.

R. E. Bryant, and D. R. O’Hallaron, *Computer Systems: A Programmer’s Perspective, Third Edition*, Prentice-Hall, 2015. More information available at <http://csapp.cs.cmu.edu/>.

R. E. Bryant, and D. R. O’Hallaron, *Computer Systems: A Programmer’s Perspective, Second Edition*, Prentice-Hall, 2011. More information available at <http://csapp.cs.cmu.edu/>.

R. E. Bryant, and J. H. Kukula, “Formal Methods for Functional Verification,” in *The Best of ICCAD: 20 Years of Excellence in Computer-Aided Design*, A. Kuehlmann, ed. Kluwer Academic Publishers, 2003, pp. 3–16. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/iccad-best02.pdf>.

R. E. Bryant, and D. R. O’Hallaron, *Computer Systems: A Programmer’s Perspective*, Prentice-Hall, 2003.

R. E. Bryant, and C. Meinel, “Ordered Binary Decision Diagrams,” in *Logic Synthesis and Verification*, S. Hassoun and T. Sasao, eds., Kluwer Academic Publishers, 2001.

R. E. Bryant, ed., *Proceedings of the Third Caltech Conference on Very Large Scale Integration*, Computer Science Press, March, 1983.

R. E. Bryant and J. B. Dennis, “Concurrent Programming,” in *Research Directions in Software Technology*, P. Wegner, ed., MIT Press, June, 1979, pp. 584–610. Revised version in *Operating Systems Engineering, Lecture Notes in Computer Science 143*, M. Maekawa and L. A. Belady, eds., Springer-Verlag, 1982, pp. 426–451. Electronic version available as

<http://www.cs.cmu.edu/~bryant/pubdir/MIT-CSG-148-2.pdf>.

### Refereed Journal and Book Articles

R. E. Bryant, “Chain Reduction for Binary and Zero-Suppressed Decision Diagrams,” *Journal of Automated Reasoning*, Vol. 64, No. 7 (2020), pp. 81–98. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/jar20.pdf>.

R. E. Bryant, “Data-Intensive Scalable Computing for Scientific Applications,” *IEEE Computing in Science and Engineering*, Vol. 13, No. 6 (2011), pp. 25–33.

R. E. Bryant, D. Kroening, J. Ouaknine, S. A. Seshia, O. Strichman, and B. Brady, “An Abstraction-Based Decision Procedure for Bit-Vector Arithmetic,” *International Journal of Software Tools for Technology*, Springer-Verlag Vol. 11, No. 2 (April, 2009), pp. 95–104.

R. M. Jensen, M. M. Veloso, and R. E. Bryant, “State-Set Branching: Leveraging BDDs for Heuristic Search,” *Artificial Intelligence*, Vol. 172, Issues 2–3 (February, 2008), pp. 103–139. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/aij07.pdf>.

- S. K. Lahiri, and R. E. Bryant, “Predicate Abstraction with Indexed Predicates,” *ACM Transactions on Computational Logic*, Vol. 9, No. 1 (Dec., 2007). Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/tocl06.pdf>.
- S. A. Seshia, K. Subramani, and R. E. Bryant, “On Solving Boolean Combinations of UTVPI Constraints,” *Journal of Satisfiability, Boolean Modeling and Computation*, Vol. 3 (2007), pp. 67–90. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/jsat07.pdf>.
- M. N. Velev, and R. E. Bryant, “TLSim and EVC: A Term-Level Symbolic Simulator and an Efficient Decision Procedure for the Logic of Equality with Uninterpreted Functions and Memories,” *International Journal of Embedded Systems*, Vol. 1, No. 1/2 (2005), pp. 134–149. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/ijes05.pdf>.
- S. A. Seshia, and R. E. Bryant, “Deciding Quantifier-Free Presburger Formulas Using Parameterized Solution Bounds,” *Logical Methods in Computer Science*, Vol. 1, Issue 2, Paper 7 (December, 2005). Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/lmcs05.pdf>.
- M. N. Velev, and R. E. Bryant, “Effective Use of Boolean Satisfiability Procedures in the Formal Verification of Superscalar and VLIW Microprocessors,” *Journal of Symbolic Computation*. Vol. 35, No. 2 (February, 2003), pp. 73–106. Submitted version available as  
<http://www.cs.cmu.edu/~bryant/pubdir/jsc03.pdf>.
- R. E. Bryant and M. N. Velev, “Boolean Satisfiability with Transitivity Constraints,” *ACM Transactions on Computational Logic*, Vol. 3, No. 4 (October, 2002). Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/tocl-trans01.pdf>.
- Y.-A. Chen, and R. E. Bryant, “An Efficient Graph Representation for Arithmetic Circuit Verification,” *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*, Vol. 20, No. 12 (December, 2001), pp. 1442–1454. Winner of 2003 IEEE CAD Transactions Best Paper Award. Preprint version available as  
<http://www.cs.cmu.edu/~bryant/pubdir/tcad01-chen.pdf>.
- R. E. Bryant, and Y.-A. Chen, “Verification of Arithmetic Circuits Using Binary Moment Diagrams,” *Software Tools for Technology Transfer*, Springer-Verlag, Vol. 3, No. 2 (May, 2001), pp. 137–155. Submitted version available as  
<http://www.cs.cmu.edu/~bryant/pubdir/sttt-submit.pdf>.
- C. B. McDonald and R. E. Bryant, “CMOS Circuit Verification with Symbolic Switch-Level Timing Simulation,” *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*, Vol. 20, No. 3 (March, 2001), pp. 458–474. Preprint version available as  
<http://www.cs.cmu.edu/~bryant/pubdir/tcad01.pdf>.
- R. E. Bryant, S. German, M. N. Velev, “Processor Verification Using Efficient Reductions of the Logic of Uninterpreted Functions to Propositional Logic,” *ACM Transactions on Computational Logic*, Vol. 2, No. 1 (January, 2001). Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/tocl01.pdf>.
- M. Pandey, and R. E. Bryant, “Exploiting symmetry when verifying transistor-level circuits by symbolic trajectory evaluation,” *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*, Vol. 18, No. 7 (July, 1999), pp. 918–935. Winner of 2001 IEEE Circuits and Systems Society Outstanding Young Author Award. Preprint version available as

<http://www.cs.cmu.edu/~bryant/pubdir/tcad99.pdf>.

C.-J. H. Seger, and R. E. Bryant, "Formal Verification by Symbolic Evaluation of Partially-Ordered Trajectories," *Formal Methods in System Design*, Vol. 6, No. 2 (March, 1995), pp. 147–190. Preprint version available as

<http://www.cs.cmu.edu/~bryant/pubdir/fmsd95.pdf>.

R. E. Bryant, J. D. Tygar, and L. P. Huang, "Geometric Characterization of Series-Parallel Variable Resistor Networks," *IEEE Transactions on Circuits and Systems I: Fundamental Theory and Applications*, Vol. 41, No. 11 (November, 1994), pp. 686–698. Manuscript version available as

<http://www.cs.cmu.edu/~bryant/pubdir/tcas94.pdf>.

L. P. Huang, and R. E. Bryant, "Intractability in Linear Switch-Level Simulation," *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*, Vol. 12, No. 6 (June, 1993), pp. 829–836.

R. E. Bryant, "Symbolic Boolean Manipulation with Ordered Binary Decision Diagrams," *ACM Computing Surveys*, Vol. 24, No. 3 (September, 1992), pp. 293–318. Preprint version published as CMU Technical Report CMU-CS-92-160,

<http://www.cs.cmu.edu/~bryant/pubdir/CMU-CS-92-160.pdf>. Also available as

<http://www.cs.cmu.edu/~bryant/pubdir/acmcs92.pdf>

S. A. Kravitz, R. E. Bryant, and R. A. Rutenbar, "Massively Parallel Switch-Level Simulation: A Feasibility Study," *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*, Vol. 10, No. 7 (July, 1991) pp. 871–894.

R. E. Bryant, "A Methodology for Hardware Verification Based on Logic Simulation," *J.ACM*, Vol. 38, No. 2 (April, 1991), pp. 299–328. Preprint available as

<http://www.cs.cmu.edu/~bryant/pubdir/jacm91.pdf>.

R. E. Bryant, "On the Complexity of VLSI Implementations and Graph Representations of Boolean Functions with Application to Integer Multiplication," *IEEE Transactions on Computers*, Vol. 40, No. 2 (February, 1991), pp. 205–213. Preprint available as

<http://www.cs.cmu.edu/~bryant/pubdir/ieeetc91.pdf>.

R. E. Bryant, "Formal Verification of Memory Circuits by Switch-Level Simulation," *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*, Vol. 10, No. 1 (January, 1991), pp. 94–102. Preprint available as

<http://www.cs.cmu.edu/~bryant/pubdir/tcad91.pdf>.

D. L. Beatty, and R. E. Bryant, "Incremental Switch-Level Analysis," *IEEE Design and Test of Computers*, Vol. 5, No. 6 (December, 1988), pp. 33–42.

R. E. Bryant, "A Survey of Switch-Level Algorithms," *IEEE Design and Test of Computers*, Vol. 4, No. 4 (August, 1987), pp. 26–40.

R. E. Bryant, "Algorithmic Aspects of Symbolic Switch Network Analysis," *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*, Vol. CAD-6, No. 4 (July, 1987), pp. 618–633. Winner of 1987 IEEE CAD Transactions Best Paper Award, and the 1989 IEEE W. R. G. Baker Award. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/tcad87a.pdf>.

R. E. Bryant, "Boolean Analysis of MOS Circuits," *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*, Vol. CAD-6, No. 4 (July, 1987), pp. 634–649. Winner of the IEEE W. R. G. Baker Award. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/tcad87b.pdf>.

R. E. Bryant, “Graph-Based Algorithms for Boolean Function Manipulation,” *IEEE Transactions on Computers*, Vol. C-35, No. 8 (August, 1986), pp. 677–691. Reprinted in M. Yoeli, *Formal Verification of Hardware Design*, IEEE Computer Society Press, 1990, pp. 253–267. Electronic version with annotations available as

<http://www.cs.cmu.edu/~bryant/pubdir/ieeetc86.pdf>.

W. J. Dally and R. E. Bryant, “A Hardware Architecture for Switch-Level Simulation,” *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*, Vol. CAD-4, No. 3 (July, 1985), pp. 239–249.

R. E. Bryant, “A Switch-Level Model and Simulator for MOS Digital Systems,” *IEEE Transactions on Computers*, Vol. C-33, No. 2 (February, 1984), pp. 160–177.

## Refereed Conference Articles

R. E. Bryant, “Chain Reduction for Binary and Zero-Suppressed Decision Diagrams,” *Tools and Algorithms for the Construction and Analysis of Systems TACAS 2018*, LNCS 10805, April, 2018, pp. 81–98. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/tacas18.pdf>.

B. P. Railing, and R. E. Bryant, “Implementing Malloc: Students and Systems Programming,” *49th ACM Technical Symposium on Computer Science Education SIGCSE 2018*, February, 2018. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/sigcse18.pdf>.

R. M. Fujimoto, R. Bagrodia, R. E. Bryant, K. M. Chandy, D. Jefferson, J. Misra, D. Nicol, and B. Unger, “Parallel Discrete Event Simulation: The Making of a Field,” *Winter Simulation Conference 2017*, December, 2017. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/wsc17.pdf>

H. Cui, J. Šimša, Y.-H. Ling, H. Li, B. Blum, X. Xu, J. Yang, G. A. Gibson, and R. E. Bryant, “PARROT: A Practical Runtime for Deterministic, Stable, and Reliable Threads,” *24th ACM Symposium on Operating Systems Principles*, 2013.

J. Šimša, R. Bryant, G. A. Gibson, and J. Hickey, “Scalable Dynamic Partial Order Reduction,” *3rd International Conference on Runtime Verification*, 2012.

B. A. Brady, R. E. Bryant, and S. A. Seshia, “Learning Conditional Abstractions,” *Formal Methods in Computer-Aided Design*, October, 2011, pp. 116–124. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/fmcad11.pdf>

J. Šimša, G. A. Gibson, and R. E. Bryant, “dBug: Systematic Testing of Unmodified Distributed and Multi-Threaded Programs,” *18th International Workshop on Model Checking of Software (SPIN ’11)*, 2011.

B. A. Brady, R. E. Bryant, S. A. Seshia, and J. W. O’Leary, “ATLAS: Automatic Term-Level Abstraction of RTL Designs,” *Eighth ACM/IEEE International Conference on Formal Methods and Models for Codesign (MEMOCODE)*, July, 2010. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/memocode10.pdf>.

R. E. Bryant, D. Kroening, J. Ouaknine, S. A. Seshia, O. Strichman, and B. Brady, “Deciding Bit-Vector Arithmetic with Abstraction,” *Tools and Algorithms for the Construction and Analysis of Systems TACAS 2007*, April, 2007. Available as

- <http://www.cs.cmu.edu/~bryant/pubdir/tacas07.pdf>.
- M. Christodorescu, S. Jha, S. A. Seshia, D. Song, and R. E. Bryant, “Semantics Aware Malware Detection,” *IEEE Symposium on Security and Privacy*, May, 2005, pp. 32–46. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/oakland05.pdf>.
- V. Ganapathy, S. A. Seshia, S. Jha, T. W. Reps, and R. E. Bryant, “Automatic Discovery of API-Level Exploits,” *International Conference on Software Engineering ICSE 05*, May, 2005, pp. 312–321. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/icse05.pdf>.
- S. A. Seshia, R. E. Bryant, and K. S. Stevens, “Modeling and Verifying Circuits Using Generalized Relative Timing,” *IEEE International Symposium on Asynchronous Circuits and Systems, ASYNC 05*, March, 2005, pp. 98–108 Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/async05.pdf>.
- S. K. Lahiri and R. E. Bryant, “Indexed Predicate Discovery for Unbounded System Verification,” *Computer-Aided Verification CAV 2004*, R. Alur, and D. A. Peled, eds., LNCS 3114, Springer-Verlag, July, 2004, pp. 135–147. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/cav04b.pdf>.
- A. Goel and R. E. Bryant, “Symbolic Simulation, Model Checking and Abstraction with Partially Ordered Boolean Function Vectors,” *Computer-Aided Verification CAV 2004*, R. Alur, and D. A. Peled, eds., LNCS 3114, Springer-Verlag, July, 2004, pp. 255–267. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/cav04a.pdf>.
- S. A. Seshia and R. E. Bryant, “Deciding Quantifier-Free Presburger Formulas Using Parameterized Solution Bounds,” *Logic in Computer Science LICS 2004*, IEEE, July, 2004, pp. 100–109. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/lics04.pdf>.
- R. M. Jensen, M. M. Veloso, and R. E. Bryant, “Fault Tolerant Planning: Toward Probabilistic Uncertainty Models in Symbolic Non-Deterministic Planning,” *International Conference on Automated Planning and Scheduling ICAPS 04*, June, 2004. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/icaps04.pdf>.
- S. K. Lahiri, R. E. Bryant, A. Goel, and M. Talupur “Revisiting Positive Equality,” *Tools and Algorithms for the Construction and Analysis of Systems TACAS 2004*, K. Jensen, and A. Podelski, eds., LNCS 2988, Springer-Verlag, March, 2004, pp. 1–15 Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/tacas04.pdf>.
- S. K. Lahiri, and R. E. Bryant, “Constructing Quantified Invariants via Predicate Abstraction,” *Verification, Model Checking, and Abstract Interpretation (VMCAI '04)*, B. Steffen, and G. Levi, eds., LNCS 2937, Springer-Verlag, February, 2004, pp. 267–281. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/vmcai04.pdf>. Slightly longer version available (as gzipped postscript) as  
<http://www.cs.cmu.edu/~bryant/pubdir/vmcai04-long.ps.gz.pdf>
- R. E. Bryant, S. K. Lahiri, and S. A. Seshia, “Convergence Testing in Term-Level Bounded Model Checking,” *Correct Hardware Design and Verification Methods CHARME '03*. D. Geist, and E. Tronci, eds., LNCS 2860, Springer-Verlag, October, 2003, pp. 348–362. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/charme03.pdf>.
- R. M. Jensen, M. M. Veloso, and R. E. Bryant, “Guided Symbolic Universal Planning,” *International Con-*

- ference on Automated Planning and Scheduling ICAPS 03*, pp. 123–132, 2003. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/icaps03.pdf>
- S. K. Lahiri, and R. E. Bryant, “Deductive Verification of Advanced Out-of-Order Microprocessors,” *Computer-Aided Verification CAV ’2003*, W. A. Hunt, Jr., and F. Somenzi, eds., LNCS 2725, Springer-Verlag, July, 2003, pp. 341–354. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/cav03a.pdf>
- S. K. Lahiri, R. E. Bryant, and B. Cook, “A Symbolic Approach to Predicate Abstraction,” *Computer-Aided Verification CAV ’2003*, W. A. Hunt, Jr., and F. Somenzi, eds., LNCS 2725, Springer-Verlag, July, 2003, pp. 141–153. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/cav03b.pdf>
- S. A. Seshia, and R. E. Bryant, “Unbounded, Fully Symbolic Model Checking of Timed Automata using Boolean Methods,” *Computer-Aided Verification CAV 2003*, W. A. Hunt, Jr., and F. Somenzi, eds., LNCS 2725, Springer-Verlag, July, 2003, pp. 154–166. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/cav03c.pdf>
- S. A. Seshia, S. K. Lahiri, and R. E. Bryant, “A Hybrid SAT-Based Decision Procedure for Separation Logic with Uninterpreted Functions,” *40th Design Automation Conference*, 2003, pp. 425–430. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/dac03a.pdf>
- A. Goel, G. Hasteer, and R. E. Bryant, “Symbolic Representation with Ordered Function Templates,” *40th Design Automation Conference*, 2003, pp. 431–435. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/dac03b.pdf>
- A. Goel, and R. E. Bryant “Set Manipulation with Boolean Functional Vectors for Symbolic Reachability Analysis,” *Design and Test Europe DATE 2003*, March, 2003. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/date03.pdf>.
- S. K. Lahiri, S. A. Seshia, and R. E. Bryant, “Modeling and Verification of Out-of-Order Processors in UCLID,” *Formal Methods in Computer-Aided Design FMCAD ’2002*, M. D. Aagaard and J. W. O’Leary, eds., LNCS 2517, November, 2002, pp. 142–159. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/fmcad02.pdf>.
- R. E. Bryant, S. K. Lahiri, and S. A. Seshia, “Modeling and Verifying Systems using a Logic of Counter Arithmetic with Lambda Expressions and Uninterpreted Functions,” *Computer-Aided Verification CAV ’2002*, E. Brinksma, and K. G. Larsen, eds., LNCS 2404, Springer-Verlag, July, 2002, pp. 78–92. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/cav02a.pdf>
- O. Strichtman, S. A. Seshia, and R. E. Bryant, “Deciding Separation Formulas with SAT,” *Computer-Aided Verification CAV ’2002*, E. Brinksma, and K. G. Larsen, eds., LNCS 2404, Springer-Verlag, July, 2002, pp. 209–222. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/cav02b.pdf>
- R. M. Jensen, R. E. Bryant, and M. M. Veloso, “An Efficient BDD-Based A\* Algorithm,” *Proceedings of AIPS-02 Workshop on Planning via Model Checking*, 2002. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/aips02.pdf>
- R. M. Jensen, R. E. Bryant, and M. M. Veloso, “SetA\*: An Efficient BDD-Based Heuristic Search Algorithm,” *Proceedings of the 18th National Conference on Artificial Intelligence AAAI-02*, 2002. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/aaai02.pdf>
- M. N. Velev, and R. E. Bryant, “EVC: A Validity Checker for the Logic of Equality with Uninterpreted Func-

tions and Memories, Exploiting Positive Equality, and Conservative Transformations,” *Computer-Aided Verification CAV ’2001*, G. Berry, H. Comon, and A. Finkel, eds., LNCS 2102, Springer-Verlag, July, 2001, pp. 235–240. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/cav01.pdf>

C. B. McDonald, and R. E. Bryant, “Computing Logic-Stage Delays Using Circuit Simulation and Symbolic Elmore Analysis,” *38th Design Automation Conference DAC 2001*, June, 2001. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/dac01a.pdf>

M. N. Velev, and R. E. Bryant, “Effective Use of Boolean Satisfiability Procedures in the Formal Verification of Superscalar and VLIW Microprocessors,” *38th Design Automation Conference DAC 2001*, June, 2001. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/dac01b.pdf>

R. E. Bryant, and D. R. O’Hallaron, “Teaching Computer Systems from a Programmer’s Perspective,” *32nd Technical Symposium on Computer Science Education SIGCSE ’01*, February, 2001. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/sigcse01.pdf>

R. E. Bryant, P. Chauhan, E. M. Clarke, and A. Goel, “A Theory of Consistency for Modular Synchronous Systems,” *Formal Methods in Computer-Aided Design FMCAD ’2000*, W. A. Hunt, Jr., and S. D. Johnson, eds., LNCS 1954, November, 2000. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/fmcad00a.pdf>

C. Wilson, D. L. Dill, and R. E. Bryant, “Symbolic Simulation with Approximate Values,” *Formal Methods in Computer-Aided Design FMCAD ’2000*, W. A. Hunt, Jr., and S. D. Johnson, eds., LNCS 1954, November, 2000, pp. 486–504. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/fmcad00b.pdf>

R. E. Bryant, and M. N. Velev, “Boolean Satisfiability with Transitivity Constraints,” *Computer-Aided Verification CAV ’2000*, E. A. Emerson and A. P. Sistla, eds., LNCS 1855, Springer-Verlag, July, 2000, pp. 85–98, Available as

<http://www.cs.cmu.edu/~bryant/pubdir/cav00.pdf>

C. B. McDonald, and R. E. Bryant, “Symbolic Timing Simulation Using Cluster Scheduling,” *37th Design Automation Conference DAC 2000*, pp. 254–259, June, 2000. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/dac00a.pdf>

M. N. Velev, and R. E. Bryant, “Formal Verification of Superscalar Microprocessors with Multicycle Functional Units, Exceptions, and Branch Predication,” *37th Design Automation Conference DAC 2000*, pp. 112–117, June, 2000. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/dac00b.pdf>

C. B. McDonald, and R. E. Bryant, “Symbolic Functional and Timing Verification of Transistor-Level Circuits,” *International Conference on Computer-Aided Design (ICCAD ’99)*, November, 1999. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/iccad99.pdf>

M. N. Velev, and R. E. Bryant, “Superscalar Processor Verification Using Efficient Reductions of the Logic of Equality with Uninterpreted Functions,” *Correct Hardware Design and Verification Methods CHARME ’99*, L. Pierre, and T. Kropf, eds., LNCS 1703, Springer-Verlag, September, 1999, pp. 37–53. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/charme99.pdf>

R. E. Bryant, S. German, and M. N. Velev, “Exploiting Positive Equality in a Logic of Equality With

- Uninterpreted Functions,” *Computer-Aided Verification CAV ’99*, N. Halbwachs, and D. Peled, eds., LNCS 1633, Springer-Verlag, July, 1999, pp. 470–482. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/cav99a.pdf>.
- B. Yang, R. Simmons, R. E. Bryant, and D. R. O’Hallaron, “Optimizing Symbolic Model Checking for Constraint-Rich Models,” *Computer-Aided Verification CAV ’99*, 1999. N. Halbwachs, and D. Peled eds., LNCS 1633, Springer-Verlag, July, 1999, pp. 328–340. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/cav99b.pdf>. Expanded version available as Technical Report  
<http://reports-archive.adm.cs.cmu.edu/anon/1999/CMU-CS-99-118.ps>.
- V. A. Patankar, A. Jain, and R. E. Bryant, “Formal Verification of an ARM Processor,” *12th International Conference on VLSI Design*, Goa, India, Jan. 1999. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/vlsi99.vishnu.pdf>
- M. N. Velev, and R. E. Bryant, “Exploiting Positive Equality and Partial Nonconsistency in the Formal Verification of Pipelined Microprocessors,” *36th Design Automation Conference DAC ’99*, June, 1999, pp. 397–401. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/dac99.pdf>
- M. N. Velev, and R. E. Bryant, “Bit-level abstraction in the verification of pipelined microprocessors by correspondence checking.” *Formal Methods in Computer-Aided Design FMCAD ’98*, G. Gopalakrishnan and P. Windley, eds., LNCS 1522, Springer-Verlag, November, 1998, pp. 18–35. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/fmcad98a.pdf>.
- B. Yang, R. E. Bryant, D. R. O’Hallaron, A. Biere, O. Coudert, G. Janssen, R. K. Ranjan, and F. Somenzi, “A Performance Study of BDD-Based Model Checking,” *Formal Methods in Computer-Aided Design FMCAD ’98*, G. Gopalakrishnan and P. Windley, eds., LNCS 1522, Springer-Verlag, November, 1998, pp. 255–289. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/fmcad98b.pdf>.
- M. N. Velev, and R. E. Bryant, “Incorporating Timing Constraints in the Efficient Memory Model for Symbolic Ternary Simulation,” *International Conference on Computer Design ICCD ’98*, IEEE, October, 1998, pp. 400–406. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/iccd98.pdf>.
- Y.-A. Chen, and R. E. Bryant, “Verification of Floating Point Adders,” *Computer-Aided Verification CAV ’98*, A. J. Hu and M. Y. Vardi, eds., LNCS 1427, Springer-Verlag, June, 1998, pp. 488–499. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/cav98.pdf>
- B. Yang, Y.-A. Chen, R. E. Bryant, and D. R. O’Hallaron, “Space- and Time-Efficient BDD Construction by Working Set Control,” *Asian-Pacific Design Automation Conference ASPDAC ’98*, Feb., 1998, pp. 423–432. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/aspdac98.pdf>.
- M. N. Velev, and R. E. Bryant, “Efficient Modeling of Memory Arrays in Symbolic Ternary Simulation,” *International Conference on Tools and Algorithms for the Construction and Analysis of Systems TACAS ’98*, B. Steffen, ed., LNCS 1384, Springer-Verlag, March 1998, pp. 136–150. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/tacas98.pdf>.
- M. N. Velev, and R. E. Bryant, “Verification of Pipelined Microprocessors by Correspondence Checking in Symbolic Ternary Simulation,” *International Conference on Application of Concurrency to System Design*

- CSD '98, IEEE, March, 1998. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/csd98.pdf>.
- M. N. Velev, and R. E. Bryant, "Verification of Pipelined Microprocessors by Comparing Memory Execution Sequences in Symbolic Simulation," *Asian Computer Science Conference ASIAN '97*, R. K. Shyamasundar and K. Ueda, eds., LNCS 1345, Springer-Verlag, December 1997, pp. 18–31. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/asian97.pdf>.
- Y.-A. Chen, and R. E. Bryant, "PHDD: An Efficient Graph Representation for Floating Point Circuit Verification," *International Conference on Computer-Aided Design ICCAD '97*, November, 1997, pp. 2–7. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/iccad97.pdf>.
- M. Pandey, and R. E. Bryant, "Formal Verification of Memory Arrays using Symbolic Trajectory Evaluation," *IEEE International Workshop on Memory Technology, Design and Testing*, August, 1997.
- M. Pandey, and R. E. Bryant, "Exploiting Symmetry when Verifying Transistor-Level Circuits by Symbolic Trajectory Evaluation," *Computer-Aided Verification CAV '97*, O. Grumberg, ed., LNCS 1254, Springer-Verlag, June, 1997, pp. 244–255. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/cav97a.pdf>.
- M. N. Velev, R. E. Bryant, and A. Jain, "Efficient Modeling of Memory Arrays in Symbolic Simulation," *Computer-Aided Verification CAV '97*, O. Grumberg, ed., LNCS 1254, Springer-Verlag, June, 1997, pp. 388–399. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/cav97b.pdf>.
- K. L. Nelson, A. Jain, and R. E. Bryant, "Formal Verification of a Superscalar Execution Unit," *34th Design Automation Conference DAC '97*, June, 1997, pp. 161–166. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/dac97a.pdf>.
- M. Pandey, R. E. Bryant, R. Raimi, M. S. Abadir, "Formal Verification of Content Addressable Memories Using Symbolic Simulation," *34th Design Automation Conference DAC '97*, June, 1997, pp. 167–172.
- Y.-A. Chen, and R. E. Bryant, "ACV: An Arithmetic Circuit Verifier," *International Conference on Computer-Aided Design ICCAD '96*, November, 1996, pp. 361–365. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/iccad96.pdf>.
- A. Jain, K. A. Nelson, and R. E. Bryant, "Verifying Nondeterministic Implementations of Deterministic Systems," *Formal Methods in Computer-Aided Design FMCAD '96*, M. Srivas and A. Camilleri, eds., LNCS 1166, Springer-Verlag, November, 1996, pp. 109–125. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/fmcad96.pdf>.
- M. Pandey, R. Raimi, D. L. Beatty, and R. E. Bryant, "Formal Verification of PowerPC(TM) Arrays using Symbolic Trajectory Evaluation," *33rd Design Automation Conference*, June, 1996, pp. 649–654. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/dac96a.pdf>.
- R. E. Bryant, "Bit-Level Analysis of an SRT Divider Circuit," *33rd Design Automation Conference*, June, 1996, pp. 661–665. Available as  
<http://www.cs.cmu.edu/~bryant/pubdir/dac96b.pdf>.
- R. E. Bryant, "Binary Decision Diagrams and Beyond: Enabling Technologies for Formal Verification," *International Conference on Computer-Aided Design ICCAD '95*, November, 1995, pp. 236–243. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/iccad95.pdf>.

M. Pandey, A. Jain, R. E. Bryant, D. Beatty, G. York, and S. Jain, "Extraction of finite state machines from transistor netlists by symbolic simulation," *International Conference on Computer Design*, 1995, pp. 596–601. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/iccd95.pdf>. (The postscript has problems with ghostview, but it prints OK).

R. E. Bryant, and Y.-A. Chen, "Verification of Arithmetic Circuits with Binary Moment Diagrams," *32nd Design Automation Conference*, June, 1995, pp. 535–541. Winner of best paper award in category "Verification, Simulation, and Test." Available as

<http://www.cs.cmu.edu/~bryant/pubdir/dac95a.pdf>.

S. Jain, R. E. Bryant, and A. Jain, "Automatic Clock Abstraction from Sequential Circuits," *32nd Design Automation Conference*, June, 1995, pp. 707–711. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/dac95b.pdf>.

D. L. Beatty, and R. E. Bryant, "Formally Verifying a Microprocessor using a Simulation Methodology," *31st Design Automation Conference*, June, 1994, pp. 596–602.

R. E. Bryant, and C.-J. H. Seger, "Digital Circuit Verification using Partially-Ordered State Models," Invited paper, *International Symposium on Multi-Valued Logic*, May, 1994, pp. 2–7. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/ismvl94.pdf>.

A. Jain, and R. E. Bryant, "Inverter Minimization in Logic Networks," *International Conference on Computer-Aided Design*, November, 1993, pp. 462–465. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/iccad93.pdf>.

T. J. Sheffler, and R. E. Bryant, "An Analysis of Hashing on Parallel and Vector Computers," *International Conference on Parallel Processing*, August, 1993.

R. E. Bryant, J. D. Tygar, and L. P. Huang, "Geometric Characterization of Series-Parallel Variable Resistor Networks," *International Symposium on Circuits and Systems*, May, 1993. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/iscas93.pdf>.

T. J. Sheffler, and R. E. Bryant, "Match and Move: an Approach to Data Parallel Computing," *MIT/Brown Conference on Advanced Research in VLSI and Parallel Systems*, MIT Press, March, 1992, pp. 299–317.

R. E. Bryant, "Extraction of Gate Level Models from Transistor Circuits by Four-Valued Symbolic Analysis," *International Conference on Computer-Aided Design*, November, 1991, pp. 350–353. Reprinted in *The Best of ICCAD: 20 Years of Excellence in Computer-Aided Design*, A. Kuehlmann, ed. Kluwer Academic Publishers, 2003, pp. 337–346.

Available as

<http://www.cs.cmu.edu/~bryant/pubdir/iccad91.pdf>.

R. E. Bryant, D. L. Beatty, and C.-J. H. Seger, "Formal Hardware Verification by Symbolic Ternary Trajectory Evaluation," *28th Design Automation Conference*, June, 1991, pp. 397–402. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/dac91a.pdf>.

A. Jain, and R. E. Bryant, "Mapping Switch-Level Simulation onto Gate-Level Hardware Accelerators," *28th Design Automation Conference*, June, 1991, pp. 219–222. Version with figures and references omitted available as

<http://www.cs.cmu.edu/~bryant/pubdir/dac91b.pdf>.

- R. E. Bryant, and C.-J. H. Seger, “Formal Verification of Digital Circuits Using Symbolic Ternary System Models,” *Computer-Aided Verification '90*, E. M. Clarke, and R. P. Kurshan, eds. American Mathematical Society, 1991, pp. 121–146. Version with figures omitted available as <http://www.cs.cmu.edu/~bryant/pubdir/cav90.pdf>. Also available as technical report CMU-CS-90-131.
- R. E. Bryant, “Symbolic Simulation—Techniques and Applications,” *27th Design Automation Conference*, June, 1990, pp. 517–521. Available as <http://www.cs.cmu.edu/~bryant/pubdir/dac90.pdf>.
- K. S. Brace, R. L. Rudell, and R. E. Bryant, “Efficient Implementation of a BDD Package,” *27th Design Automation Conference*, June, 1990, pp. 40–45. For those who subscribe to the IEEE Xplore publication service, you can get an electronic copy from <http://ieeexplore.ieee.org/iel2/790/3382/00114826.pdf?isNumber=3382>.
- D. L. Beatty, R. E. Bryant, and C.-J. H. Seger, “Synchronous Circuit Verification by Symbolic Simulation: An Illustration,” *6th MIT Conference on Advanced Research in VLSI and Parallel Systems*, April, 1990, pp. 98–112.
- C.-J. Seger, and R. E. Bryant, “Modeling of Circuit Delays in Symbolic Simulation,” *IFIP Workshop on Applied Formal Methods for VLSI Design*, November, 1989, pp. 625–639.
- A. L. Fisher, and R. E. Bryant, “Performance of COSMOS on the IFIP Workshop Benchmarks,” *IFIP Workshop on Applied Formal Methods for VLSI Design*, November, 1989.
- K. Cho, and R. E. Bryant, “Test Pattern Generation for Sequential MOS Circuits by Symbolic Fault Simulation,” *26th Design Automation Conference*, June, 1989, pp. 418–423. Available as <http://www.cs.cmu.edu/~bryant/pubdir/dac89.pdf>.
- S. A. Kravitz, R. E. Bryant, and R. A. Rutenbar, “Massively Parallel Switch-Level Simulation—A Feasibility Study,” *26th Design Automation Conference*, June, 1989, pp. 91–97.
- S. A. Kravitz, R. E. Bryant, and R. A. Rutenbar, “Logic Simulation on Massively Parallel Architectures,” *International Symposium on Computer Architecture*, May, 1989, pp. 336–343.
- R. E. Bryant, “Data Parallel Switch-Level Simulation,” *IEEE International Conference on Computer-Aided Design*, November, 1988, pp. 354–357. Available as <http://www.cs.cmu.edu/~bryant/pubdir/iccad88.pdf>
- D. Beatty and R. E. Bryant, “Fast Incremental Circuit Analysis Using Extracted Hierarchy,” *25th Design Automation Conference*, June, 1988, pp. 495–500. Winner of the Best Paper Award, Design, Simulation and Test Category.
- R. E. Bryant, “Verification of a Static RAM Design by Logic Simulation,” *Fifth MIT Conference on Advanced Research in VLSI*, March, 1988, pp. 335–349. Available as <http://www.cs.cmu.edu/~bryant/pubdir/mit88.pdf>.
- R. E. Bryant, D. Beatty, K. Brace, K. Cho, and T. Sheffler, “COSMOS: A Compiled Simulator for MOS Circuits,” *24th Design Automation Conference*, 1987, pp. 9–16. Also in *25 Years of Electronic Design Automation*, ACM/IEEE, 1988, pp. 496–503. Available as <http://www.cs.cmu.edu/~bryant/pubdir/dac87.pdf>.
- H. R. Sucar, P. Gelsinger, and R. E. Bryant, “Functional Test Grading as Applied to the 80386,” *International Conference on Computer Design*, IEEE, October, 1986, pp. 393–396.

- R. E. Bryant and M. D. Schuster, "Performance Evaluation of FMOSSIM, a Concurrent, Switch-Level Fault Simulator," *22nd Design Automation Conference*, June, 1985, pp. 715–719.
- R. E. Bryant, "Symbolic Manipulation of Boolean Functions Using a Graphical Representation," *22nd Design Automation Conference*, June, 1985, pp. 688–694. Electronic version with figures omitted available as <http://www.cs.cmu.edu/~bryant/pubdir/dac85.pdf>
- R. E. Bryant, "Symbolic Verification of MOS Circuits," *1985 Chapel Hill Conference on VLSI*, May, 1985, pp. 419–438. Electronic version with figures omitted available as <http://www.cs.cmu.edu/~bryant/pubdir/unc85.pdf>
- W. J. Dally and R. E. Bryant, "A Special Purpose Processor for Switch-Level Simulation," *International Conference on Computer-Aided Design*, IEEE, 1984.
- M. D. Schuster and R. E. Bryant, "Concurrent Fault Simulation of MOS Digital Circuits," *Advanced Research in VLSI*, P. Penfield, ed., Artech House, Dedham, MA., 1984, pp. 245–248. Reprinted in V. D. Agrawal and S. C. Seth, *Test Generation for VLSI Chips*, IEEE Computer Society Press, 1988, pp. 219–228.
- R. E. Bryant, "Race Detection in MOS Circuits by Ternary Simulation," *VLSI 83*, F. Anceau, ed., North-Holland, August, 1983, pp. 85–95.
- R. E. Bryant, "A Switch-Level Model of MOS Logic Circuits," *VLSI 81*, J. Gray, ed., Academic Press, August, 1981, pp. 329–340.
- R. E. Bryant, "MOSSIM: A Switch-Level Simulator for MOS LSI," *18th Design Automation Conference*, July, 1981, pp. 786–790. Also in *25 Years of Electronic Design Automation*, ACM/IEEE, 1988, pp. 426–430.
- R. E. Bryant, "Simulation on a Distributed System," *First International Conference on Distributed Systems*, IEEE, October, 1979, pp. 544–552. Electronic version available as <http://www.cs.cmu.edu/~bryant/pubdir/MIT-CSG-182.pdf>

## Unrefereed Articles

- D. McDonald, D. Ackley, R. Bryant, M. Gedney, H. Hirsh, L. Shanley, "Antisocial Computing: Exploring Design Risks in Social Computing Systems," *ACM Interactions*, Vol. 21, No. 6 (October, 2014), pp. 72–75, available as <http://www.cs.cmu.edu/~bryant/pubdir/interactions14.pdf>.
- R. E. Bryant, "A View from the Engine Room: Computational Support for Symbolic Model Checking," *25 Years of Model Checking*, H. Veith and O. Grunberg, eds. LNCS-4925, Springer-Verlag, 2007, available as <http://www.cs.cmu.edu/~bryant/pubdir/mcxxv06.pdf>.
- R. E. Bryant, "Formal Verification of Infinite State Systems Using Boolean Methods," *Logic in Computer Science LICS 2006*, IEEE, July, 2006, pp. 3–4, available as <http://www.cs.cmu.edu/~bryant/pubdir/lics06.pdf>, and *Term Rewriting and Applications RTA 2006*, LNCS 4098, Springer-Verlag, July, 2006, pp. 1–3, available as <http://www.cs.cmu.edu/~bryant/pubdir/rta06.pdf>.
- R. E. Bryant, S. A. Seshia, "Decision Procedures Customized for Formal Verification," *Automated Deduction CADE 2005*, LNCS 3632, Springer-Verlag, July, 2005, pp. 255–259. Available as <http://www.cs.cmu.edu/~bryant/pubdir/cade06.pdf>.
- R. E. Bryant, and S. K. Rajamani, "Verifying Properties of Hardware and Software by Predicate Abstraction and Model Checking," *International Conference on Computer-Aided Design ICCAD '04*, November, 2004,

pp. 236–243. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/iccad04.pdf>.

R. E. Bryant, “System Modeling and Verification with UCLID,” *Formal Methods and Models for Co-Design MEMOCODE '04*, June, 2004, IEEE, June, 2004, pp. 3–4. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/memocode04.pdf>.

R. E. Bryant, “Reasoning about Infinite-State Systems Using Boolean Methods,” *Foundations of Software Technology and Theoretical Computer Science FSTTCS '03*, December, 2003. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/fsttcs03.pdf>.

R. E. Bryant, S. German, and M. N. Velev, “Microprocessor Verification Using Efficient Decision Procedures for a Logic of Equality with Uninterpreted Functions,” *Tableaux '99*, N. Murray, ed., LNAI 1617, Springer-Verlag, June, 1999. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/tableaux99.pdf>.

R. E. Bryant, “Formal Verification of Pipelined Processors,” *Tools and Algorithms for the Construction and Analysis of Systems TACAS '98*, B. Steffen, ed., LNCS 1384, Springer-Verlag, March 1998, pp. 1–4.

R. E. Bryant, “Multipliers and Dividers: Insights on Arithmetic Circuit Verification,” Invited paper, *Computer-Aided Verification CAV '97*, P. Wolper, Ed., LNCS 939, Springer-Verlag, 1995, pp. 1–3.

R. E. Bryant, “Symbolic Analysis Methods for Masks, Circuits, and Systems,” Invited paper, *International Conference on Computer Design ICCD '93*, October, 1993. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/iccd93.pdf>.

R. E. Bryant, “Symbolic Boolean Manipulation with Ordered Binary Decision Diagrams,” *Second Makuhari International Conference on High Technology*, Chiba, Japan, 1990.

R. E. Bryant, “Formal Hardware Verification by Symbolic Simulation,” *VLSI Logic Synthesis and Design*, R. W. Dutton, ed., IOS Press, Amsterdam, 1991.

R. E. Bryant, “Verification of Synchronous Circuits by Symbolic Logic Simulation,” in *Hardware Specification, Verification, and Synthesis: Mathematical Aspects*, M. Leeser and G. Brown, eds., Springer-Verlag, 1990, pp. 14–24. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/cornell89.pdf>.

K. Cho, and R. E. Bryant, “Test Pattern Generation for Combinational and Sequential MOS Circuits by Symbolic Fault Simulation,” *TECHCON-88*, Semiconductor Research Corp., October, 1988.

S. A. Kravitz, and R. E. Bryant “Massively Parallel Logic Simulation,” *TECHCON-88*, Semiconductor Research Corp., October, 1988.

R. E. Bryant, “Compiled Simulation of MOS Circuits,” *Canadian Conference on VLSI*, October, 1986, pp. 217–219.

R. E. Bryant, “Can a Simulator Verify a Circuit?,” in *Formal Aspects of VLSI Design*, G. J. Milne, and P. A. Subrahmanyam, eds., North-Holland, 1986, pp. 125–136. Reprinted in M. Yoeli, *Formal Verification of Hardware Design*, IEEE Computer Society Press, 1990, pp. 272–281.

R. E. Bryant and M. D. Schuster, “Fault Simulation of MOS Digital Circuits,” *VLSI Design*, October, 1983, pp. 24–30.

R. E. Bryant, “Switch-Level Modeling of MOS Digital Circuits,” *International Conference on Circuits and Systems*, Rome, Italy, May, 1982, pp. 68–71.

R. E. Bryant, “An Algorithm for MOS Logic Simulation,” *Lambda Magazine*, Fourth Quarter, 1980, pp. 46–

53.

Arvind, and R. E. Bryant, "Design Considerations for a Partial Differential Equation Machine," *Proceedings of the Scientific Computing Information Exchange Meeting*, 1979.

## Unpublished

R. E. Bryant, "Formal Verification of Pipelined Y86-64 Microprocessors with UCLID5," Technical report CMU-CS-18-122. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/CMU-CS-18-122.pdf>.

R. E. Bryant, "Introductory Computer Science Education at Carnegie Mellon University: A Deans' Perspective," Technical report CMU-CS-10-140. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/cmu-cs-10-140.pdf>.

R. E. Bryant, "Data-Intensive Supercomputing: The Case for DISC," Technical report CMU-CS-07-128. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/cmu-cs-07-128.pdf>.

R. E. Bryant, "Term-Level Verification of a CISC Microprocessor," Technical report CMU-CS-05-195. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/CMU-CS-05-195.pdf>.

S. A. Seshia, and R. E. Bryant, "The Hardness of Approximating Minima in OBDDs, FBDDs, and Boolean Functions," Technical report CMU-CS-00-156. Available as

<http://reports-archive.adm.cs.cmu.edu/anon/2000/CMU-CS-00-156.ps>.

Y.-A. Chen, B. Yang, and R. E. Bryant, "Breadth-First with Depth-First BDD Construction: A Hybrid Approach," Technical Report CMU-CS-97-120, March, 1997. Available as

<http://reports-archive.adm.cs.cmu.edu/anon/1997/CMU-CS-97-120.ps>.

M. Starkey, and R. E. Bryant, "Using Ordered Binary-Decision Diagrams for Compressing Images and Image Sequences," Technical Report CMU-CS-95-105, January, 1995. Available as

<http://reports-archive.adm.cs.cmu.edu/anon/1995/CMU-CS-95-105.ps>.

R. E. Bryant, "An Analysis of U.S. Patent 5,243,538 'Comparison and Verification System for Logic Circuits and Method Thereof'," unpublished manuscript, 1994. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/patent94.pdf>.

R. E. Bryant, and Y.-A. Chen, "Verification of Arithmetic Functions with Binary Moment Diagrams," Technical Report CMU-CS-94-160, May 31, 1994. Available as

<http://reports-archive.adm.cs.cmu.edu/anon/1994/CMU-CS-94-160.ps>, and

also as

<http://www.cs.cmu.edu/~bryant/pubdir/CMU-CS-94-160.pdf>.

D. Beatty, K. Brace, R. E. Bryant, K. Cho, and L. Huang, *User's Guide to COSMOS*, 1987.

M. Schuster, and R. E. Bryant, *FMOSSIM: A Switch-Level Logic and Fault Simulator*, unpublished user's manual, 1985.

R. E. Bryant, M. Schuster, and D. Whiting, *MOSSIM II: A Switch-Level Simulator for MOS LSI, User's Manual*, Technical Report 5033, Caltech Computer Science, 1982. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/Caltech-82-5033.pdf>.

R. E. Bryant, *A Switch-Level Simulation Model for Integrated Logic Circuits*, (PhD thesis), Technical Report

TR-259, MIT Laboratory for Computer Science, March, 1981. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/MIT-LCS-TR-259.pdf>.

R. E. Bryant, *Simulation of Packet Communication Architecture Computer Systems*, (Master's thesis), Technical Report TR-188, MIT Laboratory for Computer Science, November, 1977. Available as

<http://www.cs.cmu.edu/~bryant/pubdir/MIT-LCS-TR-188.pdf>.