

**Multi-University Research Initiative on
High-Confidence Design for Distributed Embedded Systems**

**Frameworks and Tools for High-Confidence Design of
Adaptive, Distributed Embedded Control Systems**

Year 2 Data

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TEAM MEMBERS:

Vanderbilt: J. Sztipanovits (PI), G. Karsai and P. Volgyesi
UC Berkeley: C. Tomlin (Lead and co-PI), Edward Lee, George Nacula and S. Sastry
CMU: Bruce Krogh (Lead and co-PI) and Edmund Clarke
Stanford: (Lead and co-PI) Stephen Boyd

1. Conference Papers Written

1. Gang Zhou, Man-Kit Leung, and Edward A. Lee, "A Code Generation Framework for Actor-Oriented Models with Partial Evaluation", in Proceedings of International Conference on Embedded Software and Systems 2007, LNCS 4523, pp. 786-799, Daegu, South Korea, May 14-16, 2007, Y.-H. Lee et al. (Eds.) <http://ptolemy.eecs.berkeley.edu/publications/papers/07/codegen/>
2. Antoon Goderis, Christopher Brooks, Ilay Altintas, Edward A. Lee, "Composing Different Models of Computation in Ptolemy II and Kepler," 2007 Proceedings, International Conference on Computational Science (ICCS), May, 2007; <http://chess.eecs.berkeley.edu/pubs/193.html>
3. Yang Zhao, Jie Liu and Edward A. Lee, "A Programming Model for Time-Synchronized Distributed Real-Time Systems", in Proceedings of the 13th IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS 07), Bellevue, WA, United States, April 3-6, 2007. <http://ptolemy.eecs.berkeley.edu/publications/papers/07/RTAS/>
4. Gang Zhou, Man-Kit Leung, and Edward A. Lee, "A Code Generation Framework for Actor-Oriented Models with Partial Evaluation," in Proceedings of International Conference of Embedded Software and Systems 2007, LNCS 4523, pp. 786-799, Daegu, South Korea, May 14-16, 2007, Y.-H. Lee et al. (Eds.) ©Springer-Verlag Berlin Heidelberg 2007.
5. J. Ding, C. Fischione, A. Sangiovanni-Vincentelli, C. J. Tomlin: "Design of Wireless Communication Parameters for Collision Avoidance on a UAV Platform," Submitted to the IEEE Conference on Decision and Control, February 2008.
6. J. Ding, J. Sprinkle, S. S. Sastry and C. J. Tomlin: "Reachability analysis for an Automatic Refueling Protocol," Submitted to the IEEE Conference on Decision and Control, February 2008.
7. G. M. Hoffmann, H. Huang, S. L. Waslander, and C. J. Tomlin: "Quadrotor Helicopter Flight Dynamics and Control: Theory and Experiment," Proceedings of the AIAA Guidance, Navigation, and Control Conference, Hilton Head, AIAA Paper Number 2007-6461, August 2007.
8. G. M. Hoffmann, D. Gorinevsky, R. W. Mah, C. J. Tomlin, and J. D. Mitchell: "Fault Tolerant Relative Navigation using Inertial and Relative Sensors," Proceedings of the AIAA

Guidance, Navigation, and Control Conference, Hilton Head, AIAA Paper Number 2007-6789, August 2007.

9. S. L. Waslander and C. J. Tomlin: "Convergence of lump-sum markets with price-anticipating agents," Proceedings of the AACC American Control Conference, New York, July 2007.
10. Holger Giese, Gabor Karsai, Edward Lee, Bernhard Rumpe, and Bernhard Schätz, Model-based Engineering of Embedded Real-time Systems, Dagstuhl Seminar Proceedings 07451, Internationales Begegnungs- und Forschungszentrum für Informatik (IBFI), Schloss Dagstuhl, Germany, Nov. 5-9, 2007
11. J. Mikael Eklund, Jonathan Sprinkle, Todd Templeton, S. Shankar Satry, "Transitioning Intelligence to Embedded Platforms", AVT-146 Symposium on "Platform Innovations and System Integration for Unmanned Air, Land and Sea Vehicles", series in Applied Vehicle Technology, NATO, (in publication), Florence, Italy, May., 14--17, 2007.
12. Joëlle Skaf and Stephen Boyd: "Controller Coefficient Truncation Using Lyapunov Performance Certificate," Proceedings of the European Control Conference, July 2007.
13. Stephen Boyd: "Hyperspectral Image Unmixing via Alternating Projected Subgradients," Proceedings Asilomar Conference, November 2007
14. Stephen Boyd: "A Tractable Method for Robust Downlink Beamforming in Wireless Communications," Proceedings Asilomar Conference, November 2007
15. Stephen Boyd: "Dynamic Network Utility Maximization with Delivery Contracts," To appear in IFAC World Congress, July 2008.
16. An Efficient Method for Large-Scale ℓ_1 -Regularized Convex Loss Minimization K. Koh, S.-J. Kim, and S. Boyd Proceedings IEEE Information Theory and Applications Workshop, pages 223-230, January 2007
17. A. Mutapcic, S.-J. Kim, and S. Boyd: "Robust Chebyshev FIR Equalization," Proc. 50th IEEE Global Communications Conference (GLOBECOM '07), pages 3074-3079, Washington DC, Nov. 2007
18. Distributed Estimation via Dual Decomposition S. Samar, S. Boyd, and D. Gorinevsky Proceedings European Control Conference (ECC), pages 1511-1516, Kos, Greece, July 2007.
19. S. Samar, S. Boyd, and D. Gorinevsky, "Distributed estimation via dual decomposition", Proceedings of European Control Conference, Kos, Greece, July 2007.

20. Sumit Jha, Bruce Krogh, James Weimer and Edmund Clarke , “Reachability for Linear Hybrid Automata Using Iterative Relaxation Abstraction” in Proceedings of HSCC 2007.
21. Murali, A. Mutapcic, D. Atienza, R. Gupta, S. Boyd, and G. De Micheli: “Temperature-Aware Processor Frequency Assignment for MPSoCs Using Convex Optimization,” Proc. 5th Int. Conf. on Hardware/Software Codesign and System Synthesis (CODES+ISSS), pages 111-116, Salzburg, Austria, Oct. 2007
22. André Platzer and Edmund M. Clarke, “The Image Computation Problem in Hybrid Systems Model Checking”, in Proceedings of HSCC 2007.
23. Azadeh Farzan, Y. Chen, E. M. Clarke, Y. Tsan, B. Wang: “Extending Automated Compositional Verification to the Full Class of Omega-Regular Languages,” To appear in Proceedings of Tools and Algorithms for the Construction and Analysis of Systems (TACAS) 2008.
24. Himanshu Jain, Daniel Kroening, Natasha Sharygina, Edmund Clarke: “VCEGAR: Verilog CounterExample Guided Abstraction Refinement,” TACAS 2007, 13th International Conference on Tools and Algorithms for the Construction and Analysis of Systems.
25. Flavio Lerda, James Kapinski, Hitashyam Maka, Edmund M. Clarke, Bruce H. Krogh: “Model Checking In-The-Loop,” To appear in Proceedings of the 2008 American Control Conference.
26. Flavio Lerda, James Kapinski, Edmund M. Clarke, and Bruce H. Krogh: “Verification of Supervisory Control Software Using State Proximity and Merging,” To appear in Proceedings of the 11th International Conference on Hybrid Systems: Computation and Control.
27. Edmund M. Clarke, Flavio Lerda, and Muralidhar Talupur, “An Abstraction Technique for Real-Time Verification”, in Proceedings of the GM R&D Workshop on Next Generation Design and Verification Methodologies for Distributed Embedded Control System. 2007. (Invited Paper)
28. Kai Chen, Janos Sztipanovits and Sandeep Neema, “Compositional Specification of Behavioral Semantics,” in Proceedings of DATE 2007, Nice, France.
29. Kai Chen, Janos Sztipanovits, Sandeep Neema: “A Case Study on Semantic Unit Composition,” *Proceedings of International Workshop on Modeling in Software Engineering*, ICSE 2007, Minneapolis MN, May 20-26, 2007
30. Ethan Jackson and Janos Sztipanovits, “Constructive Techniques for Meta- and Model-level Reasoning,” *Proceedings of MODELS07*, Nashville, TN, October 2-5, 2007
31. D. Balasubramanian, A. Narayanan, S. Neema, F. Shi, R. Thibodeaux, G. Karsai: A Sub-graph Operator for Graph Transformation Languages, accepted for presentation at 6th In-

ternational Workshop on Graph Transformation and Visual Modeling Techniques, March 31 - April 1, 2007, Braga, Portugal.

32. Ryan Thibodeaux and Gabor Karsai. "Model-Based Specification and Implementation of a Model of Computation," Fourth European Conference on Model-Driven Architecture – Foundations and Applications, Berlin, Germany, June 2008.
33. Gabor Karsai and Ryan Thibodeaux. "Modeling Models of Computations," Workshop on Modeling, Validation and Heterogeneity at the IEEE International Conference on Software Testing, Verification, and Validation, Lillehammer, Norway, April 2008.

2. Accepted Journal Papers Written

1. Himanshu Jain, Daniel Kroening, Natasha Sharygina, Edmund Clarke: "Word Level Predicate Abstraction and Refinement for Verifying RTL Verilog," To appear in IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems, 2007
2. G. M. Hoffmann, S. L. Waslander, and C. J. Tomlin, "STARMAC: The Stanford Testbed of Autonomous Rotorcraft for Multiple Agent Control", in preparation for submission to the AIAA Journal of Guidance, Control, and Dynamics. February, 2008
3. M. K. Oishi, I. M. Mitchell, A. M. Bayen and C. J. Tomlin: "Hybrid system verification: application to user-interface design," Accepted to appear in the IEEE Transactions on Control Systems Technology, 2007.
4. A. M. Bayen, I. Mitchell, M. K. Oishi and C. J. Tomlin: "Reachability Analysis and Optimal Control Applied to Aircraft Autoland Systems," AIAA Journal on Guidance, Control and Dynamics, 30(1), pp. 68-77, January-February 2007.
5. J. Hu, M. Prandini, and C. Tomlin: "Conjugate points in formation constrained optimal multi-agent coordination: a case study," SIAM J. Control and Optimization, vol. 45, no. 6, pp. 2119-2137, 2007.
6. A. Mutapcic, S.-J. Kim, and S. Boyd, "Beamforming with uncertain weights", published in IEEE Signal Processing Letters, May 2007.
7. L. Vandenberghe, S. Boyd, and K. Comanor, "Generalized Chebyshev bounds via semi definite programming", published in SIAM Review, March 2007.
8. L. Xiao, S. Boyd, and S.-J. Kim, "Distributed average consensus with least-mean-square deviation" published in Journal of Parallel and Distributed Computing, 2007.
9. S.-J. Kim, K. Koh, S. Boyd, and D. Gorinesvsky, " ℓ_1 trend filtering", submitted to SIAM Review, problems and techniques section, May 2007.

10. S. Boyd, S.-J. Kim, L. Vandenberghe, and A. Hassibi, "A tutorial on geometric programming", published online in Optimization and Engineering, Springer, April 2007.
11. R. Panicker, J. Kahn, and S. Boyd, "Compensation of multimode fiber dispersion using adaptive optics via convex optimization", submitted to IEEE Journal of Lightwave Technology, May 2007.
12. K. Koh, S.-J. Kim, and S. Boyd, "An interior-point method for large-scale ℓ_1 -regularized logistic regression", to appear in Journal of Machine Learning Research, 2007.
13. Edmund Clarke and Flavio Lerda, "Model Checking: Software and Beyond", published in Computer Society of India Communications. Vol. 31, Issue 2, May 2007.
14. K.-L. Hsiung, S.-J. Kim, and S. Boyd Tractable Approximate Robust Geometric Programming Optimization and Engineering, published online October 2007.
15. J. Skaf and S. Boyd: "Filter Design with Low Complexity Coefficients," To appear in IEEE Transactions on Signal Processing.
16. M. Lobo, M. Fazel, and S. Boyd: "Portfolio Optimization with Linear and Fixed Transaction Costs," Annals of Operations Research, 152(1):376-394, July 2007.
17. S.-J. Kim, S. Boyd, S. Yun, D. Patil, and M. Horowitz: "A Heuristic for Optimizing Stochastic Activity Networks with Applications to Statistical Digital Circuit Sizing," Optimization and Engineering, 8(4):397-430, December 2007
18. L. Xiao, S. Boyd, and S.-J. Kim: "Distributed Average Consensus with Least-Mean-Square Deviation," Journal of Parallel and Distributed Computing, 67(1):33-46, 2007.
19. S.-J. Kim, K. Koh, M. Lustig, S. Boyd, and D. Gorinevsky: "A Method for Large-Scale ℓ_1 -Regularized Least Squares," IEEE Journal on Selected Topics in Signal Processing, 4(1):606-617, December 2007.
20. A. Ghosh, S. Boyd and A. Saberi: "Minimizing Effective Resistance of a Graph," SIAM Review, problems and techniques section, 50(1):37-66, February 2008.

3. Books/Chapters Written

1. C. Brooks, E.A. Lee, X. Liu, S. Neuendorffer, Y. Zhao, H. Zheng (eds.), "Heterogeneous Concurrent Modeling and Design in Java (Volume 2: Ptolemy II Software Architecture)," EECS Department, University of California, Berkeley, UCB/EECS-2007-8, January 11, 2007. (Chapter 7 covers code generation)
2. M. Grant and S. Boyd: "Graph Implementations for Nonsmooth Convex Programs," Recent Advances in Learning and Control (tribute to M. Vidyasagar), V. Blondel, S. Boyd, and H. Kimura, editors, pages 95-110, Lecture Notes in Control and Information Sciences, Springer, 2008.

3. Yi Ma, Rene Vidal and Shankar Sastry, "Generalized Principal Component Analysis, Springer Verlag to appear 2009.

4. Any other papers not covered in the first 3

1. Gang Zhou, Man-Kit Leung and Edward A. Lee, "A Code Generation Framework for Actor-Oriented Models with Partial Evaluation," EECS Department, University of California, Berkeley, Technical Report No. UCB/EECS-2007-29, February 23, 2007.
(This technical report preceded the conference paper above)
2. Ryan Thibodeaux. "The Specification and Implementation of a Model of Computation." Master's Thesis, Vanderbilt University, EECS Dept, Nashville, TN, May 2008

5. Did you make Academic Promotion/Tenure

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6. Any awards received this year

1. Edmund C. Clarke: A.M. Turing Award, 2008
2. Claire Tomlin:
 - a. Chancellor's Professorship of EECS, UC Berkeley (2007-2010)
 - b. Plenary Speaker, International Conference on Systems Biology (ICSB), San Diego, October 2007.
 - c. Plenary Speaker, IFAC Symposium on Nonlinear Control Systems (NOLCOS), Pretoria, August 2007.
3. Shankar Sastry:
 - a. Appointed Dean of Engineering, UC Berkeley, July 2007
 - b. Technical Advisory Group, President's Council on Science and Technology, 2006-07
 - c. Plenary Speaker, ICASSP, Honolulu, April 2007
 - d. Plenary Speaker, IEEE CASE 2007, Phoenix, Arizona, October 2007
 - e. Plenary Speaker, Hybrid Systems Computation and Control, Pisa, March 2007
4. Janos Sztipanovits:
 - a. Kai Chen, Janos Sztipanovits and Sandeep Neema, "Compositional Specification of Behavioral Semantics," in Proceedings of DATE 2007, Nice, France.
- Best Paper Award, DATE 2007
- Selected for publishing in the Springer volume of The Most Influential Papers of 10 Years of DATE
 - b. Elected to chair the AF SAB FY08 Study on "Gaining Operational Readiness in Cyber Contested Environment"
 - c. Sztipanovits, J.: "Model-Based Software Development," *NASA ESMD Software Workshop*, Houston TX, March 13, 2007 (Keynote)
 - d. Sztipanovits, J.: "Composition of Cyber-Physical Systems," 14th Annual IEEE International Conference on the Engineering of Computer Based Systems (ECBS), Tucson, AZ, March 26-29, 2007 (Keynote)

- e. Sztipanovits, J.: “Domain Specific Modeling Languages: making Semantics Explicit” *OMG Technical Workshop*, Jacksonville, FL, September 25, 2007 (Keynote)
- f. Sztipanovits, J.: “Towards Systematic Model-based Development of Embedded Systems,” *Workshop on Towards a Systematic Approach to Embedded Systems Design - DATE 07*, Nice, France, April 20, 2007 (Keynote)