Curriculum Vitae

1.1 Basic data

Eric Klavins
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1.2 Educational History

1992	B.M. in Music, San Francisco State University
1996	B.S. in Computer Science, San Francisco State University
1998	M.S. in Computer Science and Engineering, University of Michigan
2001	Ph.D. in Computer Science and Engineering, University of Michigan
2001-03	Postdoc, California Inst. of Technology

1.3 Employment History

Associate Professor, Electrical Engineering, University of Washington, 2009 – present (effective Sept. 2009)
Assistant Professor, Electrical Engineering, University of Washington, 2003 – 2009

1.4 Awards & Honors

2004 NSF CAREER Award

1.5 Affiliations and other appointments

Adjunct appointment in Mechanical Engineering, 2005-present.
Adjunct appointment in Computer Science and Engineering, 2008-present.

2.0 Publications

2.1 Refereed archival journal publications

J. Bishop and E. Klavins. "An Improved Autonomous DNA Nanomotor". *Nanoletters*, Sep., 2007. Vol. 7, No. 9, pp. 2574-7.

E. Klavins, "Programmable Self-Assembly". *Control Systems Magazine*, Aug. 2007. Vol. 24, No. 4, pp. 43-56 **(Cover story).**

S. Waydo, J. Hauser and R. Bailey, E. Klavins and R. Murray, "UAV as a Reliable Wingman: A Flight Demonstration", *IEEE Transactions on Control Systems Technology*, Jul. 2007, Vol. 15, No. 4, pp. 680--688.

M. Yim, W.M. Shen, B. Salemi, D. Rus, M. Moll, H. Lipson, E. Klavins, and G.S. Chirickjian. "Modular self-reconfigurable robot systems". *IEEE Robotics and Automation Magazine*, 14(1):43-52, March 2007.

C. Belta, A. Bicchi, M. Egerstedt, E. Frazzoli, E. Klavins, and G.J. Pappas. "Symbolic planning and control of robot motion". *IEEE Robotics and Automation Magazine*, 14(1):61-70, March 2007.

Eric Klavins, Robert Ghrist, and David Lipsky. "A grammatical approach to self-organizing robotic systems". *IEEE Transactions on Automatic Control*, 51(6):949-962, June 2006.

Domitilla Del Vecchio, Richard Murray, and Eric Klavins. "Discrete state estimators for systems on a lattice". *Automatica*, 42(2):271-285, 2006.

Eric Klavins and Richard M. Murray. "Distributed algorithms for cooperative control". *IEEE Pervasive Computing*, 3(1):56-65, 2004.

E. Klavins and D. E. Koditschek, "Phase Regulation of Decentralized Cyclic Robotic Systems", *International Journal of Robotics Research*. 2002, Vol. 21, No. 3, pp. 257-276.

2.2 Conference proceedings and other non-journal articles

N. Napp, S. Burden and E. Klavins. "Setpoint Regulation for Stochastically Interacting Robots", *Robotics: Science and Systems V*. MIT Press. 2009.

N. Napp, D. Thorsley and E. Klavins, "Hidden Markov Models for Non-Well-Mixed Reaction Networks", *Proceedings of the American Control Conference*, 2009.

D. Thorsley and E. Klavins. "A Theory of Approximation for Stochastic Biochemical Networks", *Control-Theoretic Approaches in Systems Biology*. Eds. B. Ingalls and P. Iglesias. MIT Press, 2009. In press.

D. Georgiev and E. Klavins. "Model Discrimination of Polynomial Systems via Stochastic Inputs". *Conference on Decision and Control*, Dec. 2008.

F. Shaw and E. Klavins. "Distributed Estimation and Control For Stochastically Interacting Robots". *Conference on Decision and Control*, Dec. 2008.

J. M. McNew and E. Klavins. "Non-deterministic Reconfiguration of Tree Formations". *American Control Conference*, June 2008, pp. 690-697.

D. Thorsley and E. Klavins. "Model Reduction of Stochastic Processes Using Wasserstein Pseudometrics". *American Control Conference*, June 2008, pp. 1374-1381 (best paper in session).

J. M. McNew and E. Klavins. "Non-deterministic Reconfiguration of Tree Formations", to appear in the *Proceedings of the American Control Conference*, Seattle, WA. June 2008.

D. Thorsley and E. Klavins. "Model Reduction of Stochastic Processes Using Wasserstein Pseudometrics", to appear in the *Proceedings of the American Control Conference*, Seattle, WA. June 2008.

J. M. McNew, E. Klavins and M. Egerstedt. “Solving Coverage Problems with Embedded Graph Grammars”, *Lecture Notes in Computer Science: Hybrid Systems Computation and Control (HSCC)*, May 2007, Vol. 4416, pp. 413-427.

E. Klavins, S. Burden N. Napp, “Optimal Rules for Programmed Stochastic Self-Assembly”, *Robotics: Science and Systems II*. MIT Press, 2006. pp. 9-16.

J. Bishop and E. Klavins, “Collective Sensing with Self-Organizing Robots”, *45th IEEE Conference on Decision and Control*. San Diego, CA. 2006, pp. 4175-81.

J. M. McNew and E. Klavins, “Locally Interacting Hybrid Systems with Embedded Graph Grammars”, *45th IEEE Conference on Decision and Control*. San Diego, CA. 2006, pp. 6080-87.

E. Klavins, “Self-Assembly From the Point of View of Its Pieces”, *American Control Conference*. Minneapolis, MN. June 2006.

J. M. McNew and E. Klavins, “Model-Checking and Control of Self-Assembly”, *American Control Conference.* Minneapolis, MN. June 2006.

S. Burden, N. Napp, E. Klavins, “The Statistical Dynamics of Programmed Robotic Self-Assembly”, *International Conference on Robotics and Automation*. Orlando, FL. May 2006. pp. 1469-76.

J. Bishop, S. Burden, E. Klavins, R. Kreisberg, W. Malone, N. Napp and T. Nguyen, “Self-Organizing Programmable Parts”, *International Conference on Intelligent Robots and Systems*, Edmonton, Alberta, CA. August 2005.

E. Klavins, “Universal Self-Replication Using Graph Grammars”, In *International Conference on MEMs, NANO and Smart Systems.* Banff, Canada, 2004, pp. 198-204.

E. Klavins, R. Ghrist, and D. Lipsky, “Graph Grammars for Self-Assembling Robotic Systems”, *Proceedings of the International Conference on Robotics and Automation.* New Orleans, LA. May, 2004, pp. 5293- 5300.

E. Klavins, “A Language for Modeling and Programming Cooperative Control Systems”, *Proceedings of the International Conference on Robotics and Automation.* New Orleans, LA. May 2004, pp. 3403- 3410.

E. Klavins, “A Formal Model of a Multi-Robot Control and Communication Task”, *42nd IEEE Conference on Decision and Control*. Maui, HI. Dec. 2003. Pp. 4133-39.

D. Del Vecchio and E. Klavins, Observation of Hybrid Guarded Command Programs, 42nd IEEE Conference on Decision and Control. Maui, HI. Dec. 2003, pp. 3353-59.

S. Waydo. B. Dunbar and E. Klavins, “Toward Feedback Stabilization of Faulty Software Systems: A Case Study”, *42nd IEEE Conference on Decision and Control.* Maui, HI. Dec. 2003, pp. 738-743.

E. Klavins, “Automatically Synthesized Controllers for Distributed Assembly: Partial Correctness”, *Cooperative Control: Models, Applications and Algorithms*. Eds. S. Butenko, R. Murphey and P. M. Pardalos. Kluwer, 2002, pp. 111-127.

E. Klavins, “Toward the Control of Self-Assembling Systems”, *Control Problems in Robotics*. Eds. A. Bicchi, H. Christensen and D. Prattichizzo. Springer, 2003, Vol. 4, pp. 153-168.

E. Klavins and U. Saranli, "Object Oriented State Machines", *Embedded Systems Magazine*. May 2002. pp. 30-42.

E. Klavins, "Automatic Synthesis of Controllers for Distributed Assembly and Formation Forming", In *Proceedings of the IEEE Conference on Robotics and Automation.* Washington D.C., May 2002, pp. 3296-3303.

T. Chung, L. Cremean, B. Dunbar, Z. Jin, E. Klavins, D. Moore, A. Tiwari, D. van Gogh and S. Waydo, "A Platform for Cooperative and Coordinated Control of Multiple Vehicles: The Caltech Multi-Vehicle Wireless Testbed", *Proceedings of the Conference on Cooperative Control and Optimization*. Kluwer, 2002.

E. Klavins, "Communication Complexity of Multi-Robot Systems", *Algorithmic Foundations of Robotics V*. Eds. J.-D. Boissonnat, J. Burdick, K. Goldberg, S. Hutchinson. Springer, 2003, Vol. 7, pp. 275-292.

L. Cremean, B. Dunbar, D. van Gogh, J. Hickey, E. Klavins, J. Meltzer and R. M. Murray, "The Caltech Multi-Vehicle Wireless Testbed", In *41st IEEE Conference on Decision and Control*. Las Vegas, NV, Dec. 2002, pp. 86-92.

E. Klavins, H. Komsuoglu, R. J. Full and D. E. Koditschek, "The Role of Reflexes Versus Central Pattern Generators in Dynamical Legged Locomotion", *Neurotechnology for Biomimetic Robots.* Eds. J. Ayers, J. Davis and A. Rudolph. MIT Press, 2001, pp. 351-382.

E. Klavins and D. E. Koditschek, "Stability of Hybrid Coupled Oscillators", In *International Conference on Robotics and Automation*. Seoul, Korea, 2001, pp. 4200-07.

E. Klavins, "Automatic Compilation of Concurrent Hybrid Factories from Product Assembly Specifications", *Hybrid Systems: Computation and Control*. LNCS 1790. Springer-Verlag, 2000, pp. 174-187.

E. Klavins and D. E. Koditschek, "A Formalism for the Composition of Concurrent Robot Behaviors", In *Proceedings of the IEEE Conference on Robotics and Automation*, San Francisco, CA, 2000, pp. 3395-3402.

E. Klavins, D. E. Koditschek and R. Ghrist, "Toward the Regulation and Composition of Cyclic Behaviors", *Algorithmic and Computational Robotics: New Directions* (WAFR). Eds. B. R. Donald, K. M. Lynch and D. Rus. A. K. Peters, 2001, pp. 205-220.

E. Klavins, W. C. Rounds, and Q.-Q. Zhang, "Experimenting with Power Default Reasoning", In *Proceedings of AAAI-98*. 1998, pp. 846-852.

Abstracts, letters and non-refereed papers

J. Bishop, D. Georgiev and E. Klavins, "Experimental Design of In Vitro DNA Reaction Networks". *2nd q-bio Conference on Cellular Information Processing*. 2008. Abstract + spotlight presentation.

J. Bishop and E. Klavins, "Improved repeatability of an autonomous DNA nanomotor". In *4th Annual Conference on the Foundations of Nanoscience*, Snowbird, UT, April 2007. Poster + Abstract.

N. Napp and E. Klavins, "An extended state-space markov chain model for self-organizing systems in non-well-mixed environments". In *4th Annual Conference on*

the Foundations of Nanoscience, Snowbird, UT, April 2007. Contributed Talk + Abstract.

D. Thorsley and E. Klavins, "Non-equilibrium Analysis of Stochasticity Biochemical Reaction Networks", In *1st q-Bio Conference on Cellular Information Processing*, Santa Fe, NM, Aug. 2007. Poster + Abstract.

S. Burden, N. Napp, and E. Klavins. "Tuning reaction networks for self-assembly". In *3rd Annual Conference on the Foundations of Nanoscience*, Snowbird, UT, April 2006. Poster + Abstract.

E. Klavins, "Directed Self-Assembly Using Graph Grammars", *Foundations of Nanoscience: Self Assembled Architectures and Devices.* Snowbird, UT, 2004. Invited Talk + Extended Abstract.

Other (websitces, software, etc.)

The Computation and Control Language (CCL): A programming language for distributed control systems.

3.0 Other scholarly activity

3.1 Invited lectures and seminars

Selected recent presentations

"Programmed Molecular Self-Organization", U. Penn Grasp Seminar, Sep. 2008.

"Programmed Molecular Self-Organization", Institute for Collaborative Biotechnologies, University of California at Santa Barbara, Apr. 2008.

"Programmed Molecular Self-Organization", BioMaPS Seminar, Rutgers University, Apr. 2008.

"Programmed Molecular Self-Organization", Laboratory for Information and Decision Systems, Massachusetts Institute of Technology, Mar. 2008.

"Programmable Self-Organization", Robotics and Intelligent Machines Seminar, Georgia Institute of Technology, Oct. 2007.

"Programmed Stochastic Self-Organization", Algorithms Seminar, Stanford University, Feb. 2007.

"Programmed Stochastic Self-Assembly", Control Systems Colloquium, University of Michigan, Nov. 2006.

"Programmable Stochastic Self-Assembly", Control and Dynamical Systems, University of California at Santa Barbara, Oct. 2006.

3.2 Presentations given at conferences

Selected presentations

Note: All conference papers above with my name as first author were presented at the associated conference. Some additional presentations are listed below.

"Molecular Robots and Robotic Molecules", Robotics: Science and Systems, **(Early Career Spotlight Presentation)**, Zurich, Switzerland, June 2008.

"Waste Management for DNA Devices", Workshop on Self-Replicating Chemical Systems, Caltech **(Invited Talk)**, August, 2007.

"Controlled and Optimized Stochastic Biochemical Reaction Networks", Workshop on Stochasticity in Biochemical Reaction Networks, Banff, Canada, July 2007.

"Embedded Graph Grammars", Workshop on High-Confidence Embedded Systems, San Diego, CA, Dec. 2006.

"Toward Model Checking Programmed Reaction Networks", Workshop on Symbolic Planning, Philadelphia, PA, Aug. 2006.

"Programmed Stochastic Self-Assembly", Workshop on Modular Robotics, MIT, June. 2006.

"Statistical Dynamics of Programmed Self-Assembly", Swarms, Napa, CA, August 2005.

"Self-Organizing Systems", American Mathematical Society Meeting, Evanston, IL, Sept. 2004.

"Programmed Robotic Self-Assembly", DNA 11 **(Plenary Lecture)**, London, Ontario, Canada, June 2005.

"Coordinated Robotic Systems", Mathematical Foundations of Programming Systems XIX **(Plenary Lecture)**, Montreal, Quebec, Canada, March 2003.

3.3 Professional society memberships

IEEE (Institute for Electrical and Electronic Engineers), senior member.

AAAS (American Association for the Advancement of Science), member.

ISNSCE, (International Society of Nanoscale Science, Computation, and Engineering, member.

3.4 Other

Reviewing

Journals (more than one review): *IEEE Transactions on Automatica Control, IEEE Transactions on Robotics, Automatica, Nanoletters, IEEE Control Systems Magazine, IEEE Robotics and Automation Magazine, PNAS.*

Conferences (more than one review): *Robotic: Science and Systems (RSS), Hybrid Systems Computation and Control (HSCC), International Conference on Robotics and Automation (ICRA), Conference on Decision and Control (CDC), American Control Conference (ACC).*

4.0 Graduate students

4.1 Chaired doctoral degrees

John-Michael McNew. Thesis Title: *Embedded Graph Grammars*. Ph.D. defense scheduled for summer 2008.

4.2 Chaired masters degrees

Crystal Flores, Coursework Option, 2006.

William Malone, Thesis title: *Data acquisition and analysis of self-organizing systems*, 2005.

4.3 Other significant student supervision

Sam Burden. Worked with my group from 2004-2008 (his entire undergraduate career) and has his name on several papers. He will start at UC Berkeley in the fall of 2008.

Brian Wolfe. Worked in my lab from 2007-2008 as a research assistant. He will start at Caltech in the fall of 2008.

5.0 Research activities

Grants and Gifts (PI)

An interdisciplinary undergraduate sequence in systems and synthetic biology, UW CoE Dean's Tax Award, E. Klavins (PI), H. Sauro (co-PI), 2008-2009, $60K.

The *Stochastic Model Builder Applied to Single Cell Kinetics*, Microsoft, E. Klavins (PI), 2008-2009. $100,000 unrestricted gift.

Curriculum Development for Synthetic Biology, UW College of Engineering, E. Klavins (PI), 2007-2008, CoE support for one TA for one year.

CAREER: Programmed Robotic Self-Assembly, NSF #0347955, E. Klavins (PI), 2004 – 2009, $500K.

A Synthesis Method for DNA Machines, UW Royalty Research Fund, 2005-2006, $39.5K.

Grants and Gifts (co-PI)

Expeditions: The Molecular Programming Project. NSF. J. Bruck (co-PI), E. Klavins (co-PI), R. Murray (co-PI) , N. Pierce (co-PI), P. Rothemund (co-PI), E. Winfree (PI, Caltech). $10M. $1.66M to UW.

EFRI-ARESCI: Controlling the Autonomously Reconfiguring Stochastic Factory. NSF. D. Rus (PI, MIT), E. Klavins (co-PI), H. Lipson (co-PI), M. Yim (co-PI). 2008-2011. $2M, $500K to UW.

Modeling 3D Self-Assembly, NSF, K. Böhringer (PI), E. Klavins (co-PI) 2005-2008. $300K.

MURI: Specification, Design and Verification of Distributed Embedded Systems, AFOSR, R. Murray (PI, Caltech-lead), E. Klavins (co-PI, UW Lead), J. Doyle (co-PI), M. Chandy (co-PI), P. Parillo (co-PI, MIT Lead), 2006-2011. 5M with $1.125M to UW.

A Computing Lab for Integrated Teaching of Systems Courses in Electrical Engineering, NSF #0511635. M. Ostendorf (PI), L. Atlas (co-PI), S. Roy (co-PI), E. Klavins (co-PI), M. Gupta (co-PI). 2005-2007. $150K.

MURI: Secure, Tactical MANETS, Radha Poovendran (co-PI and UW Lead), Eric Klavins (co-PI), Jim Ritcey (co-PI), plus. Co-PIs at other insitutions. 2007-2012. $7.5M with $1.4M to UW.

3D Directed Self-Assembly, DARPA(DSO), Karl Böhringer (PI), Eric Klavins (co-PI), Babak Parviz (co-PI), 2004–2005. TDC: $300K.

5.3 Supervision of undergraduate independent studies

Sam Burden (Pre-Engineering, Summer 2004-present): Has done several projects with me, including *Robotic self assembly*, *inexpensive PCR* and *K-12 outreach.* Sam has won two Mary Gates scholarships, one undergraduate research scholarship, and a Goldwater honorable mention.

Ming Wang (EE): *Air table construction and characterization.* 2005-2006

Ashwini Pai (Pre-Engineering): *DNA secondary structure simulations*. 2005-2006.

Mun A Shin (Molecular Biology, Spring 2005-2006): *Spectrofluorimetry for DNA Hybridization*. 2005-2006.

Minyoung Choi (Chemistry): *Spectrofluorimetry for DNA Hybridization*. 2005.

Amanda Horike (AA): *Programmable Part Construction.* 2005.

Chris Takahashi (EE): Optical electrophoresis. 2006.

Tian Xia and Pascal Clark (EE): *Control of a piezoelectric controlled microscope stage.* 2006.

Cheng-Li (EE): *Optical trapping*. 2006.

Daniel Nevestic (EE): *Simulation of self-assembly*. 2006.

Stephen Krieger (EE): Simulation of self-assembly, 2006.

Shelden Rucker (EE2007) and Mike Merserve (EE, 2007): *A Feedback controlled robotic chemical reactions* 2007.

Brian Wolfe (CS/EE, 2007): *Inexpensive PCR (2007)*, *synthetic biology.* 2007-2008.

Alex Leone (EE): *Robotic self-assembly* (2008), *flow cytometry*, 2008.

Alida Mendes (EE), Ernest Doleman (EE), Yevgeniy Maksimenko (EE) and Fedja Karalic (EE): *A Computer controlled turbidostat.* 2008.

6.0 Service

6.1 Departmental service

ExCel Search Committee: 2007-2008 academic year.

EE Faculty Search Committee: 2006-2007 academic year.

EE Chair search Committee, 2005-2006 academic year.

EE Strategic Planning Committee, 2006.

EE Controls and Robotics qualifying exams, 2004-present (chair in Autumn 2006).

6.2 College service

Co-coordinator of the Robotics, Controls and Mechatronics Seminar Series (2004-present).

6.3 University service

None to report.

6.4 Professional society and other service

Area Chair, *Robotics: Science and Systems (RSS),* 2009.

Associate Editor, *IEEE Control Systems Magazine*, 2008-present.

Program Committee, *American Control Conference (ACC)*, 2008.

Program Committee, *Hybrid Systems Computation and Control (HSCC),* 2006, 2007, and 2008.

Committee Member, *Systems Biology Technical Committee,* 2007-present.

Co-organizer (with E. Winfree), *BIRS Conference on Stochasticity in Biochemical Reaction Networks*, 2007.

Organizer, *Workshop on Embedded Systems* at the *IEEE Conference on Decision and Control (CDC)*, 2006.

Program Committee, *International Conference on Robotics and Automation (ICRA),* 2005.

Workshop Chair, *Robotics: Science and Systems (RSS)*, 2005.

Conference Board, Robotics: Science and Systems (RSS), 2005-present.

Program Committee, *IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS),* 2004.

6.5 Community service

Participant in the CoE open house, 2005, 2006 and 2008 by developing outreach materials and making them available during the open house lab tours.

Speaker at the *Seattle Robotics Club*, 2006.

6.6 National or governmental services

Contributor, NSF, *Complex Systems Workshop Report*, 2008.

Panalist, NSF, CISE: *Hybrid and Embedded Systems*, 2007.

Participant, *DARPA ISAT on Programmable Matter*, 2005.

Contributor, *NSF On-site Robotics Demonstration*, 2005.