

**ERIK WINFREE**

Professor of Computer Science and Computation & Neural Systems and Bioengineering  
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**Education:**

Ph.D., Computation & Neural Systems, California Institute of Technology, 1998.

Thesis advisor: John Hopfield. Title: *Algorithmic Self-Assembly of DNA*.

B.S. with Honors, Mathematics (spec. in Computer Science), University of Chicago, 1991.

Budapest Technological Institute, Hungary Budapest Semesters in Mathematics, 1989.

**Professional Positions:**

2010-Present	Professor of Computer Science and Computation & Neural Systems and Bioengineering
2012-2012	Visiting Professor at Harvard, Wyss Institute for Biologically Inspired Engineering
2007-2010	Associate Professor of Comp. Sci. and Computation & Neural Systems, and Bioengineering
2006-2007	Associate Professor of Computer Science and Computation & Neural Systems
2000-2006	Assistant Professor of Computer Science and Computation & Neural Systems
1999-2000	Visiting Scientist, MIT Artificial Intelligence Laboratory
1998-1999	Lewis Thomas Postdoctoral Fellow, Princeton Department of Molecular Biology
1990-1992	Wolfram Research, Inc., Research Assistant to Stephen Wolfram

**Teaching experience (courses taught at Caltech):**

- CNS/Bi/Ph/CS 187: Neural Computation (Fall 2000 – Fall 2008)
- CS/EE/Ma 129a: Information and Complexity (Fall 2002, 2003, 2006, Winter 2008, Fall 2009, Winter 2009, Fall 2011), section b: (Winter 2007, Spring 2008, 2010)
- CNS 288: DNA and Molecular Computation (Winter 2001)
- Computing Beyond Silicon Summer School (Summer 2002, Summer 2004)
- BE/CS/CNS/Bi 191ab: Biomolecular Computation (Winter/Spring 2002, 2005, 2007, 2010, 2011, Fall 2011, Winter/Spring 2013, 2014, 2015)
- BE 168: Reading the Bioengineering Literature (Winter 2013, 2015)

**Graduate and post-graduate and undergraduate research advisees:*****Current Postdoctoral Advisees:***

Damien Woods (MPP and CS Postdoc 2009-Current)

Dave Doty (CI Fellow Postdoc 2010-Current)

Constantine Evans (BE Postdoc 2014-Current)

Chris Thachuk (CMS Postdoc 2014-Current)

***Current Graduate Advisees:***

James Parkin (Bioengineering graduate student 2015-Current)

Robert Johnson (Bioengineering graduate student 2014-Current)

Niranjan Srinivas (CNS graduate student 2010-Current)

***Current Undergraduate Research Advisees:***

Nicholas Schiefer (CS undergraduate research 2014-Current)

Joseph Berleant (CNS undergraduate research 2014-Current)

Masa Ono (CS undergraduate research 2015-Current)

***Previous Graduate Advisees:***

- Jongmin Kim (Bio, 2001-2007 Ph.D.)  
Thesis: *In Vitro* Synthetic Transcriptional Networks  
Now postdoc with Peng Yin, Wyss Institute for Biologically Inspired Engineering, Harvard
- Rebecca Schulman (CNS, 2001-2007 Ph.D., postdoc 2007-2008)  
Thesis: Self-Replication and Evolution of DNA Crystals  
Now Assistant Professor of Chemical and Biomolecular Engineering at Johns Hopkins
- David Soloveichik (CNS, 2002-2008 Ph.D., postdoc 2008-2009)  
Thesis: Molecules Computing: Self-Assembled Nanostructures, Molecular Automata, and Chemical Reaction Networks  
Soon to be Assistant Professor in Electrical and Computer Engineering at UT Austin (Aug. 2015)
- David Zhang (CNS, 2005-2010 Ph.D.)  
Thesis: Dynamic DNA Strand Displacement Circuits  
Now Assistant Professor of Bioengineering at Rice University
- Rizal Hariadi (APh, 2003-2011 Ph.D.)  
Thesis: Non-equilibrium Dynamics of DNA Nanotubes  
Now postdoc with Sivaraj Sivaramakrishnan, U. Michigan, Cell & Developmental Biology
- Seung Woo Shin (CS, 2010-2011 M.S.)  
Thesis: Compiling and Verifying DNA-Based Chemical Reaction Network Implementations  
Now graduate student in CS at UC Berkeley with Umesh Vazirani
- Elisa Franco (CDS, 2006-2011 Ph.D., co-advised with Richard Murray)  
Thesis: Analysis, design, and in vitro implementation of robust biochemical networks  
Now Assistant Professor of Mechanical Engineering at UC Riverside
- Qing Dong (CS, 2012 M.S. from SUNY Stony Brook, co-advised with Steven Skiena)  
Thesis: A Bisimulation Approach to Verification of Molecular Implementations of Formal Chemical Reaction Networks  
Now at Epic Systems, Madison Wisconsin
- Joseph Schaeffer (CS, 2003-2013 M.S. & Ph.D.)  
Thesis: Stochastic Simulation of the Kinetics of Multiple Interacting Nucleic Acid Strands  
Now at Autodesk Research, Bio/Nano Programmable Matter group
- Constantine Evans (Ph, 2007-2014 Ph.D.)  
Thesis: Crystals that count! Physical principles and experimental investigations of DNA tile self-assembly  
Now completing a postdoc year at Caltech in my group

***Previous Postdoctoral Advisees:***

- Paul W. K. Rothmund (BI & CNS Research Fellow 2001-2007)  
Now Senior Research Associate in Bioengineering, Caltech
- Sung Ha Park (CPI Postdoc 2005-2007)  
Now Assistant Professor of Physics at Sungkyunkwan University, Korea
- Georg Seelig (APh Postdoc 2003-2009, joint with Michael Elowitz)  
Now Assistant Professor of EE and CSE at U. Washington, Seattle
- Lulu Qian (BE Postdoc 2008-2009)  
Now Assistant Professor of Bioengineering, Caltech
- Tosan Omabegho (BE Postdoc 2009-2010)  
Now postdoc with Zev Bryant, Stanford, Bioengineering
- Peng Yin (CBCD Postdoc 2005-2010, joint with Niles Pierce)  
Now Assistant Professor of Systems Biology at Harvard
- Ho-Lin Chen (CMI & MPP Postdoc 2007-2011, joint with Jehoshua Bruck)  
Now Assistant Professor of Electrical Engineering at Taiwan National University

***Previous Undergraduate Research Advisees:***

- Kevin Chen (undergraduate, Princeton 1999)
- Maria Neimark (undergraduate, Princeton 1999, Caltech 2001)
- Neha Soni (undergraduate summer student, 2001)
- Dan Stick (undergraduate summer student, 2001)
- David Zhang (undergraduate student, 2001-2005)
- Renat Bekbolatov (undergraduate student, 2002)

Milo Lin (undergraduate summer student, 2002)  
Shaun Lee (undergraduate summer student, 2002-2003)  
Jeremy Leibs (undergraduate summer student, 2002-2003)  
Kristin Shantz (undergraduate summer student, 2003)  
Robert Barish (undergraduate summer student, 2004-2007)  
Jing Chen (undergraduate summer student, 2005)  
Alex Huth (undergraduate summer student, 2005)  
Jon Seitel (undergraduate summer student, 2005)  
Christina Wright (undergraduate summer student 2005-2006)  
Pakpoom Subsoontorn (undergraduate student, 2005-2006, Caltech 2008)  
Esther Shyu (undergraduate summer student, 2007)  
Yudistira Virgus (undergraduate summer student, 2007)  
Jian Fung (undergraduate summer student, 2007)  
Kevin Tjho (undergraduate summer student, 2007)  
Shawn Ligocki (undergraduate summer student and research assistant, 2007-2009)  
Daniel Guetta (undergraduate summer student, 2008)  
Amy Proctor (undergraduate summer student, 2009)  
Talia Weiss (undergraduate student, 2009-2010)  
Joshua Loving (undergraduate summer student, 2009-2010)  
Karthik Sarma (undergraduate student, 2009-2011)  
Seung Woo Shin (undergraduate student & senior thesis, 2009-2010)  
Chris Berlind (undergraduate student & senior thesis, 2009-2011)  
Chris Kennelly (undergraduate summer student, 2010)  
Yae Lim Lee (undergraduate student & senior thesis, 2010-2011)  
Zibo Chen (sponsored summer undergraduate, Singapore National University, 2011, 2013)  
Shayan Doroudi (undergraduate summer student, 2011, 2013)  
Sarah Whitman (undergraduate summer student, 2011)  
Greg Izatt (undergraduate summer student, 2011)  
Feliz Zhou (undergraduate summer student, 2012)  
Joy Hui (undergraduate summer student, 2013)  
Xander Rudelis (undergraduate summer researcher, 2013)  
Robert Johnson (undergraduate summer student & senior thesis, 2013-2014)

### **Awards and Honors:**

Interviewed by Discover Magazine (July-August 2009)  
Feynman Prize for Nanotechnology (2006)  
NSF PECASE Award (2002)  
NSF CAREER Award (2001)  
ONR Young Investigator (2001)  
MacArthur Fellow (2000)  
Tulip Prize in DNA Computing (2000)  
MIT's Technology Review Mag. TR100 Award: "top 100 young innovators" (1999)  
Caltech Distinguished Teaching Assistant award (1997)  
Ranked in top 150 four times, Putnam Mathematical Competition (1987—1990)

### **Professional Memberships:**

American Association for the Advancement of Science (AAAS)  
American Chemistry Society (ACS)  
Association for Computing Machinery (ACM)  
International Society of Nanoscale Science, Computation, and Engineering (ISNSCE)  
Mathematical Association of America (MAA)

### **Other Professional Activities:**

- Co-Organizer, Advances in Molecular Programming and Computing: Toward Chemistry as a New Information Technology (NSF co-sponsored workshop in Denmark, 2013)
- Co-Organizer, 17<sup>th</sup> International Conference on DNA Computing and Molecular Programming (2011)
- Member of the Caltech Beckman Institute Executive Committee (2008-Current)
- Co-Organizer, Banff Workshop on Stochasticity in Biochemical Reaction Networks (2007)
- Co-Organizer, CBCD Workshop on Self-Replicating Chemical Systems (2007)
- Co-Organizer, CBCD Workshop on Engineering a DNA World (2005)
- Co-Organizer, Banff Workshop on Dynamics, Control and Computation in Biochemical Networks (2004)
- Advisory Board, Springer-Verlag Series on Natural Computation (1999-present)
- Invited Panelist on NPR's "Talk of the Nation" discussing the topic of Biological Electronics (2004)
- Participant in NAE Frontiers of Engineering Symposium (2000), Speaker (2003)
- Participant in NAS Frontiers of Science Symposium (2003)
- Participant in NSF Qubic Grant Review Panel (2003)
- Program Committee, Conferences on DNA-Based Computers (1997-2001, 2003)
- Program Committee, RECOMB 2000 (Tokyo, 2000)
- CRA advisory on DNA computing, to House of Representatives (August, 2000)
- Panelist, NIH BECON Nanoscience and Nanotechnology: Shaping Biomedical Research (2000)
- Co-organizer, 5<sup>th</sup> Conference on DNA-Based Computers (MIT, 1999)
- Co-organizer, DIMACS Workshop on Evolution as Computation (Princeton, 1999)
- Participant in NSF DNA/Biomolecular Computing Workshop (1996)
- Occasional Reviewer for Nature, Science, Biochemistry, Biomacromolecules, JACS, Nano Letters, PNAS, Journal of Theoretical Biology, Nucleic Acids Research, IEEE Transactions on Evolutionary Computation, Complex Systems, and Discrete Applied Mathematics, ACS Synthetic Biology, Royal Society Interface, ACS Nano, Theoretical Computer Science, PLoS Computational Biology

### **Invited Speaker:**

- Physics & Astronomy Colloquium, UC Riverside, October 2014
- Computer Aided Verification conference (CAV), Vienna, July 2014
- "Programming with chemical reaction networks: mathematical foundations", BIRS Keynote, June 2014
- 113<sup>th</sup> Statistical Mechanics Conference, Rutgers, May 2014
- NSF Workshop on Self-Organizing Particle Systems, Portland, January 2014
- Electrical Engineering Distinguished Lecturer seminar series, USC, November 2013
- Machines, Computation, and Universality (MCU), Zurich, September 2013
- Computer Science Colloquium, ETH Zurich, April 2013
- Department of Biosystems, Science, and Engineering, ETH Zurich at Basel, April 2013
- Q-Bio Conference, St. Johns College, Santa Fe, August 2013
- "Frontiers in Quantitative Biology" seminar series, Stanford, March 2013
- Rice University, Bioengineering seminar, March 2013
- "Frontiers of Information Science and Technology", Shanghai Tech, December 2012
- Janelia Farm, May 2012
- Harvard Systems Biology Theory Lunch, April 2012
- Biological Engineering, MIT, March 2012
- Lederberg – von Neumann Symposium, Princeton, March 2012
- "Brains, Minds, and Models" Symposium, CUNY, New York, March 2012
- AAAS Annual Meeting, "Is there life beyond Moore's Law?" workshop, Vancouver, February 2012
- ICES, University of Texas, Austin, February 2012
- Challenges in Chemical Biology (ISACS5), Manchester, UK, July 2011
- Physics, University of Oxford, UK, July 2011
- Third International Workshop on Bio-Design Automation, San Diego, June 2011
- Nordic Institute for Theoretical Physics, Mariehamn, Finland, May 2011
- Princeton Plasma Physics Laboratory, May 2011
- Foundations of Nanoscience: Self-Assembled Architectures and Devices, (FNANO) April 2011
- University of California, San Francisco, QB3 February 2011

- U New Mexico, SANDIA, and Santa Fe Institute, November 2010
- University of Maryland, September 2010
- Unconventional Computation, Tokyo, June 2010
- DNA Computing and Molecular Programming (DNA16), Hong Kong, June 2010
- Foundations of Nanoscience: Self-Assembled Architectures and Devices, Keynote, April 2010
- Symposium Autonomous Systems, Max Planck Institute, Stuttgart, Germany, May 2010
- MBI Workshop, Cleveland, March 2010
- Harvard, March 2010
- Highs in Chemistry and Biology Conference, Dead Sea, Israel, March 2010
- University of Chicago, February 2009
- Analytical Chemistry Seminar, Purdue, February 2009
- CNSi UC Santa Barbara, May 2009
- CERMACS (Keynote speaker), Cleveland, May 2009
- Les Houches School, Switzerland, Physics of DNA Assembly, May 2009
- DNATEC, Dresden, May 2009
- Emergence in Complex Systems Conference, Alaska, June 2009
- CHAOS Conference (Boston University) Woods Hole, MA, July 2009
- Caltech's Board of Trustees' annual meeting retreat, Carlsbad, CA, October 2008
- Institute of Physics Conference: Physics Meets Biology, Oxford, July 2008
- Center for the Study of Language and Information Seminar, Stanford, CA, April 2008
- Chemical Biophysics Symposium, University of Toronto, Canada, April 2008
- Nichols Symposium, New York, March 2008
- ASPLOS-XIII, Seattle, WA, March 2008
- Molecular Foundry Lab, UC Berkeley, February 2008
- Mini Statistical Mechanics, UC Berkeley, January 2008
- Nano Seminar, University of Washington, November 2007
- UCLA LSSA Seminar, October 2007
- Quantitative and Computational Biology Seminar, Lewis-Sigler Institute, October, 2007
- PPPL Colloquium Series, Princeton, September 2007
- Center for Bits and Atoms, MIT, May 2007
- CS Colloquium, Tufts University, May 2007
- Workshop on Algorithmic Bioprocesses, Lorentz Center, Leiden, The Netherlands, December 2007
- Workshop on Tilings and Self-Assembly (Keynote speaker), July 2007
- International Conference on Morphological Computation, Venice, March 2007
- CeNS Workshop, Venice, Italy, September 2006
- Ninth Annual Japanese-American Kavli Frontiers of Science Symposium, Irvine, CA, December 2006
- Unconventional Computation, York, UK, September 2006, March 2007
- CSBi, MIT, September 2006
- Symposium on Digital Fabrication, Pretoria, South Africa, June 2006
- EIPBN, Baltimore, Maryland, June 2006
- International Conference on Microtechnologies in Medicine and Biology, Japan, May 2006
- Design Principles in Biological Systems, Banbury Center, CSHL, May 2006
- Exploratorium in San Francisco, February 2004
- Information Science and Technology Colloquium Series, Goddard Space Flight Center, May 2003
- TIGR Distinguished Lecture Series, Rockville, February 2002
- Robotics Conference, Boston, June 2005
- Frontiers in Interdisciplinary Biosciences Seminar Series, University of Arizona, January 2004
- USC, March 2004
- Media Lab, MIT March 2004
- Computer Science, Boston University, March 2004
- Hopfield Symposium at Princeton University, June 2003
- Physical chemistry and condensed matter physics, University of Chicago, April 2003
- Frontiers in Interdisciplinary Biosciences Seminar Series, Bio-X, Stanford, January 2003
- NanoSystems Seminar Series, UCLA, March 2003
- Physics, Cambridge University, May 2002
- Computer Science, Weizmann Institute, May 2002
- IPAM Alternative Computing Workshop, UCLA, September 2002

- Chemical Engineering ,University of Pennsylvania, December 2001
- UC Irvine, March 2002
- Electrical Engineering Lecture Series, ETH Zurich, May 2002
- International Colloquium on Graph Transformation and DNA-Computing, Technical U, Berlin, Feb. 2002
- International seminar on Nano-Physics and Bio-Electronic, Planck-Institute in Dresden, August 2001
- Chemistry and Physics of Nanostructure Fabrication, Gordon Research Conference, June 1998
- U. Wisconsin-Madison, Computer Science, September 1998
- Computer Science, Weizmann Institute, March 1999
- Physiology and Biophysics, U.C. Irvine, April 1999
- Physical Chemistry, U.C. Berkeley, April 1999
- “Mathematical Problems in the Molecular Sciences”, The Courant Institute, NYU, October 1999
- MIT, February 2000
- Boston University, February 2000
- Oregon State University, May 3, 2001
- Harvey Mudd, October 2001
- Chemistry of Electronic Materials, Gordon Conference, July 2001
- Sigma Xi keynote lecture at Corvallis, May 2001
- Berkeley, March 1998
- MIT, March 1998
- Princeton, March 1998
- U. of Electro-Communications, U. of Saitama, U. of Tokyo, and RIKEN Institute, April 1997
- Bell Labs, December 1997; MIT, December 1997.

#### **Conference Speaker:**

• IBE Conference, California, March 2010, March 2009; DAMOPS Virginia, May 2009; DNA 15 Bentonville, AR, June 2009; SWARMS 3<sup>rd</sup> Workshop, Block Island, June 2009; Synthetic Biology 4.0, Hong Kong, October 2008; DNA 14, Prague, Czech Republic, June 2008; American Chemical Society, Boston, August 2007; FNANO Snowbird, April 2010, April 2009, April 2005, April 2004; DNA 11 Conference, London, Ontario, June 2005; BIRS Conference, Banff, August 2004; AMS Meeting Special Session on Discrete Models, Baltimore, January 2003; National Academy of Engineering Conference, Irvine, September 2003; Complex Systems Summer School, Santa Fe Institute, May 2001; Sixth International Meeting on DNA-Based Computers, Leiden University, June 2000; The Machine Learning Conference, Snowbird, April 2000; Agora Meeting on Fluctuations in Biological Systems, Sweden, August 1999; Boston University, February 2000; Unconventional Models of Computation, Brussels, December 2000; SPIE International Symposium, San Diego, August 2000; Machine Learning Conference, Snowbird, April 1999; DNA Computing, Leiden, Netherlands, July 1998; New England Complex Systems Institute, International Conference on Complex Systems, October 1998; AMS--MAA Joint Meeting, San Francisco, January 1991.

#### **Patents and Non-provisional:**

US Patent No: US 7,745,594

Title: Nucleic Acid-Based Logic Circuits

Inventors: Georg Seelig, David Soloveichik, Erik Winfree, David Zhang

Date: 6/29/2010

US Patent No: US 7,538,202

Title: Enzyme-Free Isothermal Exponential Amplification of Nucleic Acids and Nucleic Acid Analog Signals

Inventors: David Y. Zhang, Bernard Yurke and Erik Winfree

Date: 5/26/2009

US Patent No: US 6,255,469 B1

Title: Periodic Two and Three Dimensional Nucleic Acid Structures

Inventors: Nadrian Seeman, Erik Winfree, Furong Liu and Lisa Wenzler Savin

Date: 5/7/2003

Non-provisional US

Title: Polynucleotides and Related Nanoassemblies, Structures, Arrangements, Methods, and Systems

Inventors: Hareem T. Maune, Si-Ping Han, Robert D. Barish, Marc W. Bockrath, William A. Goddard, Paul W. K. Rothmund, and Erik Winfree

Date: 8/12/2009

Non-provisional US

Title: Engineered Toehold Reactions and Networks

Inventors: Dave Zhang, Andrew J. Turberfield, Erik Winfree

Date: 2/4/2008

Non-provisional US

Title: Algorithmically Self-Assembled Circuits and Templates

Inventors: Matthew Cook, Paul Rothmund, and Erik Winfree

Date: 5/16/2007

Non-provisional US

Title: An Enzyme-Free Isothermal DNA Chain-Reaction Amplifier

Inventors: Dave Zhang, Bernard Yurke, Erik Winfree

Date: 12/20/2007

### **Refereed Journal Publications:**

1. Rizal F. Hariadi, Bernard Yurke, and Erik Winfree, "Thermodynamics and kinetics of DNA nanotube polymerization from single-filament measurements," *Chemical Science* **6**: 2252-2267, 2015.
2. Maximilian Weitz, Jongmin Kim, Korbinian Kapsner, Erik Winfree, Elisa Franco and Friedrich C. Simmel, "Diversity in the dynamical behaviour of a compartmentalized programmable biochemical oscillator," *Nature Chemistry* **6**, 295–302, 2014.
3. Niranjan Srinivas, Thomas E. Ouldridge, Petr Šulc, Joseph M. Schaeffer, Bernard Yurke, Ard A. Louis, Jonathan P. K. Doye, and Erik Winfree, "On the biophysics and kinetics of toehold-mediated DNA strand displacement," *Nucleic Acids Research* **41**: 10641-10658, 2013.
4. David Yu Zhang, Rizal F. Hariadi, Harry M. T. Choi, and Erik Winfree, "Integrating DNA strand-displacement circuitry with DNA tile self-assembly," *Nature Communications* **4**: 1965, 2013.
5. Pakpoom Subsoontorn, Jongmin Kim, and Erik Winfree, "Ensemble Bayesian Analysis of Bistability in a Synthetic Transcriptional Switch," *ACS Synthetic Biology* **1**: 299-316, 2012.
6. Constantine Evans, Rizal F. Hariadi, and Erik Winfree, "Direct Atomic Force Microscope Observation of DNA Tile Crystal Growth the the Single-Molecule Level," *Journal of the American Chemical Society* **134**: 10485-10492, 2012.
7. Rebecca Schulman, Bernard Yurke, and Erik Winfree, "Robust self-replication of combinatorial information via crystal growth and scission," *Proceedings of the National Academy of Science USA*, **109**: 6405-6410, 2012.
8. Elisa Franco, Eike Friedrichs, Jongmin Kim, Ralf Jungmann, Richard M. Murray, Erik Winfree, and Friedrich C. Simmel, "Timing molecular production and motion with a synthetic transcriptional clock," *Proceedings of the National Academy of Science USA*, **108**: E784-E793, 2011.
9. Lulu Qian, Erik Winfree, and Jehoshua Bruck, "Neural network computation with DNA strand displacement cascades," *Nature* **475**: 368-372, 2011.
10. Lulu Qian and Erik Winfree, "Scaling up digital circuit computation with DNA strand displacement cascades," *Science* **332**: 1196-1201, 2011.
11. Lulu Qian and Erik Winfree, "A simple DNA gate motif for synthesizing large-scale circuits," *Journal of the Royal Society Interface* **8**: 1281-1297, 2011.
12. Jongmin Kim and Erik Winfree, "Synthetic *in vitro* transcriptional oscillators," *Molecular Systems Biology* **7**: 465, 2011.
13. Kyle Lund, Anthony T. Manzo, Nadine Dabby, Nicole Michelotti, Alexander Johnson-Buck, Jeanette Nangreave, Steven Taylor, Renjun Pei, Milan N. Stojanovic, Nils G. Walter, Erik Winfree, and Hao Yan, "Molecular Robots Guided by Prescriptive Landscapes," *Nature* **465**: 206-210, 2010.
14. David Yu Zhang and Erik Winfree, "Robustness and Modularity Properties of Non-covalent DNA Catalytic Reaction," *Nucleic Acids Research* **38**: 4182-4197, 2010.

15. Hareem T. Maune, Si-Ping Han, Robert D. Barish, Marc Bockrath, William A. Goddard III, Paul W. K. Rothemund, Erik Winfree, "Self-assembly of Carbon Nanotubes into Two-dimensional Geometries using DNA Origami Templates," *Nature Nanotechnology* **5**: 61-66, 2010.
16. David Soloveichik, Georg Seelig, and Erik Winfree, "DNA as a Universal Substrate for Chemical Kinetics," *Proceedings of the National Academy of Science USA* **107**: 5393-5398, 2010.
17. David Yu Zhang and Erik Winfree, "Control of DNA Strand Displacement Kinetics using Toehold Exchange," *Journal of the American Chemical Society* **131**: 17303-17314, 2009.
18. Robert D. Barish, Rebecca Schulman, Paul W. K. Rothemund, and Erik Winfree, "An Information-Bearing Seed for Nucleating Algorithmic Self-Assembly," *Proceedings of the National Academy of Science USA* **106**: 6054-6059, 2009.
19. David Yu Zhang and Erik Winfree, "Dynamic Allosteric Control of Noncovalent DNA Catalysis Reactions," *Journal of the American Chemical Society* **130**: 13921-13926, 2008.
20. Kenichi Fujibayashi, David Yu Zhang, Erik Winfree, and Satoshi Murata, "Error Suppression Mechanisms for DNA Tile Self-Assembly and Their Simulation," *Natural Computing* **8**: 589-612, 2008.
21. David Soloveichik, Matt Cook, Erik Winfree, and Jehoshua Bruck, "Computation with Finite Stochastic Chemical Reaction Networks," *Natural Computing* **7**: 615-633, 2008.
22. Rebecca Schulman and Erik Winfree, "How Crystals that Sense and Respond to Their Environment Could Evolve," *Natural Computing* **7**: 219-237, 2008.
23. David Soloveichik, Matthew Cook, and Erik Winfree, "Combining Self-Healing and Proofreading in Self-Assembly," *Natural Computing* **7**: 203-218, 2008.
24. Kenichi Fujibayashi, Rizal Hariadi, Sung Ha Park, Erik Winfree, and Satoshi Murata, "Toward Reliable Algorithmic Self-Assembly of DNA Tiles: A Fixed-Width Cellular Automaton Pattern," *Nano Letters* **8**: 1791-1797, 2008.
25. David Yu Zhang, Andrew J. Turberfield, Bernard Yurke, and Erik Winfree, "Engineering Entropy-Driven Reactions and Networks Catalyzed by DNA," *Science* **318**: 1121-1125, 2007.
26. Ho-Lin Chen, Rebecca Schulman, Ashish Goel, and Erik Winfree, "Reducing Facet Nucleation during Algorithmic Self-Assembly," *Nano Letters* **7**: 2913-2919, 2007.
27. Suvir Venkataraman, Robert M. Dirks, Paul W. K. Rothemund, Erik Winfree, Niles A. Pierce, "An Autonomous Polymerization Motor Powered by DNA hybridization," *Nature Nanotechnology* **2**: 490-494, 2007.
28. Robert M. Dirks, Justin S. Bois, Joseph M. Schaeffer, Erik Winfree, and Niles A. Pierce, "Thermodynamic Analysis of Interacting Nucleic Acid Strands," *SIAM Review* **49**: 65-88, 2007.
29. Rebecca Schulman and Erik Winfree, "Synthesis of Crystals with a Programmable Kinetic Barrier to Nucleation," *Proceedings of the National Academy of Science USA* **104**: 15236-15241, 2007.
30. Jongmin Kim, Kristin S. White, and Erik Winfree, "Construction of an *in vitro* bistable circuit from synthetic transcriptional switches," *Molecular Systems Biology* **2**: 68, 2006.
31. Georg Seelig, David Soloveichik, David Yu Zhang, and Erik Winfree, "Enzyme-Free Nucleic Acid Logic Circuits," *Science* **314**: 1585-1588, 2006.
32. Robert D. Barish, Paul W. K. Rothemund, Erik Winfree, "Two Computational Primitives for Algorithmic Self-Assembly: Copying and Counting," *Nano Letters* **5**: 2586-2592, 2005.
33. Georg Seelig, Bernard Yurke, Erik Winfree, "Catalyzed Relaxation of a Metastable DNA Fuel," *Journal of the American Chemical Society* **128**: 12211-12220, 2006.
34. David Soloveichik and Erik Winfree, "The Computational Power of Benenson Automata," *Theoretical Computer Science* **244**: 279-297, 2005.
35. Paul W.K. Rothemund, Nick Papadakis, Erik Winfree, "Algorithmic Self-Assembly of DNA Sierpinski Triangles," *Public Library of Science Biology* **2**: 2041-2053, 2004.
36. Paul W.K. Rothemund, Axel Ekani-Nkodo, Nick Papadakis, Ashish Kumar, Deborah Kuchnir Fygenson, and Erik Winfree, "Design and Characterization of Programmable DNA Nanotubes," *Journal of American Chemical Society* **126**: 16344-16353, 2004.
37. Robert M. Dirks, Milo Lin, Erik Winfree, and Niles A. Pierce, "Paradigms for Computational Nucleic Acid Design," *Nucleic Acid Research* **32**: 1392-1403, 2004.
38. Niles A. Pierce and Erik Winfree, "Protein Design is NP-hard", *Protein Engineering* **15**: 779-782, 2002.
39. Thomas H. LaBean, Hao Yan, Jens Kopatsch, Furong Liu, Erik Winfree, John H. Reif, and Nadrian C. Seeman. "Construction, Analysis, Ligation, and Self-Assembly of DNA Triple Crossover Complexes." *Journal of the American Chemical Society* **122**: 1848-1860, 2000.
40. Sam Roweis and Erik Winfree. "On the Reduction of Errors in DNA Computation." *Journal of Computational Biology* **6**: 65-75, 1999.



41. Leonard M. Adleman, Paul W. K. Rothmund, Sam Roweis, and Erik Winfree. "On Applying Molecular Computation to the Data Encryption Standard." *Journal of Computational Biology* **6**: 53-63, 1999.
42. Sam Roweis, Erik Winfree, Richard Burgoyne, Nickolas V. Chelyapov, Myron F. Goodman, Paul W. K. Rothmund, Leonard M. Adleman. "A Sticker-Based Model for DNA Computation." *Journal of Computational Biology* **5**: 615-629, 1998.
43. Erik Winfree, Furong Liu, Lisa A. Wenzler, and Nadrian C. Seeman. "Design and Self-Assembly of Two-Dimensional DNA Crystals." *Nature* **394**: 539-544, 1998.
44. A. T. Winfree, E. M. Winfree, H. Seifert. "Organizing Centers in a Cellular Excitable Medium." *Physica* **17D**: 109-115, 1985.

#### **Refereed Conference Publications:**

1. Lulu Qian and Erik Winfree, "Parallel and scalable computation and spatial dynamics with DNA-based chemical reaction networks on a surface," *DNA Computing and Molecular Programming (DNA20)*, *LNCS 8727*: 114-131, 2014.
2. Casey Grun, Karthik Sarma, Brian Wolfe, Seung Woo Shin, and Erik Winfree, "A domain-level DNA strand displacement reaction enumerator allowing arbitrary non-pseudoknotted secondary structures," *Verification of Engineered Molecular Devices and Programs (VEMDP)*, June 2014.
3. Seung Woo Shin, Chris Thachuk, and Erik Winfree, "Verifying chemical reaction networks implementations: a pathway decomposition approach," *Verification of Engineered Molecular Devices and Programs (VEMDP)*, June 2014.
4. Robert Johnson and Erik Winfree, "Verifying polymer reaction networks using bisimulation," *Verification of Engineered Molecular Devices and Programs (VEMDP)*, June 2014.
5. Constantine G. Evans and Erik Winfree, "DNA sticky end design and assignment for robust algorithmic self-assembly," *LNCS 8141*: 61-75, 2013.
6. Lulu Qian, David Soloveichik, and Erik Winfree, "Efficient Turing-universal Computation with DNA Polymers," *LNCS 6518*: 147-161, 2011.
7. Rebecca Schulman and Erik Winfree, "Simple Evolution of Complex Crystal Species," *LNCS 6518*: 123-140, 2011.
8. David Soloveichik, Georg Seelig, and Erik Winfree, "DNA as a Universal Substrate for Chemical Kinetics," *LNCS 5347*: 57-69, 2009.
9. Lulu Qian and Erik Winfree, "A simple DNA gate motif for synthesizing large-scale circuits," *LNCS 5347*: 70-89, 2009.
10. David Soloveichik and Erik Winfree, "Complexity of Compact Proofreading for Self-Assembled Patterns," *LNCS 3892*: 305-324, 2005.
11. Rebecca Schulman and Erik Winfree, "Self-Replication and Evolution of DNA Crystals," ECAL Conference Proceedings, *LNCS 3630*: 734-743, 2005. (*Won the conference best paper award out of 94 papers*)
12. Georg Seelig and Bernard Yurke and Erik Winfree, "DNA Hybridization Catalysts and Catalyst Circuits," *DNA Computing 10*, *LNCS 3384*: 329-343, 2005.
13. Rebecca Schulman and Erik Winfree, "Programmable Control of Nucleation for Algorithmic Self-Assembly," *DNA Computing 10*, *LNCS 3384*: 319-328, 2005.
14. David Soloveichik and Erik Winfree, "Complexity of Self-Assembled Shapes," *DNA Computing 10*, *LNCS 3384*: 344-354, 2005.
15. Jongmin Kim, John K. Hopfield, Erik Winfree, "Neural Network Computation by *in vitro* Transcriptional Circuits," *NIPS Conference Proceedings* **17**: 681-688, 2004.
16. Erik Winfree and Renat Bekbolatov, "Proofreading Titles Sets: Error Rates and Error Correction in Algorithmic Self-Assembly," *DNA Computing 9*, *LNCS 2943*: 126-144, 2004.
17. Matthew Cook, Paul W. K. Rothmund, and Erik Winfree, "Self-Assembled Circuit Patterns," *DNA Computing 9*, *LNCS 2943*: 91-107, 2004.
18. Rebecca Schulman, Shaun Lee, Nick Papadakis, and Erik Winfree, "One Dimensional Boundaries for DNA Tile Self-Assembly," *DNA Computing 9*, *LNCS 2943*: 108-125, 2004.
19. Erik Winfree, Tony Eng, and Grzegorz Rozenberg. "String Tile Models for DNA Computing by Self-Assembly," *DNA Computing 6*, *LNCS 2054*: 63-88, 2001.
20. Paul W. K. Rothmund and Erik Winfree. "The Program-Size Complexity of Self-Assembled Squares." *STOC*, 459-468, 2000.

21. Thomas H. LaBean, Erik Winfree, and John H. Reif. "Experimental Progress in Computation by Self-Assembly of DNA Tilings," *DNA Based Computers 5, DIMACS 54*: 123-140, 1999.
22. Kevin Chen and Erik Winfree. "Error Correction in DNA Computing: Misclassification and Strand Loss," *DNA Based Computers 5, DIMACS 54*: 49-63, 1999.
23. Erik Winfree, Xiaoping Yang, and Nadrian C. Seeman. "Universal Computation via Self-Assembly of DNA: Some Theory and Experiments." *DNA Based Computers 2, DIMACS 44*: 191-213, 1998.
24. Erik Winfree. "On the Computational Power of DNA Annealing and Ligation." *DNA Based Computers, DIMACS 27*: 199-221, 1996.
25. Erik Winfree. "Complexity of Restricted and Unrestricted Models of Molecular Computation." *DNA Based Computers, DIMACS 27*: 187-198, 1996.

### **Non-Refereed Publications:**

1. Matthew Cook, David Soloveichik, Erik Winfree, and Jehoshua Bruck, "Programmability of Chemical Reaction Networks," *Algorithmic Bioprocesses*, Springer special volume: 543-584, 2009.
2. Erik Winfree, "Self-Healing Tile Sets," *Foundations of Computing: Nanotechnology: Science and Computation*, 55-78, 2006.
3. Erik Winfree, "DNA Computing by Self-Assembly," *National Academy of Engineering: The Bridge 33*: 31-38, 2003.
4. Erik Winfree, "Algorithmic Self-Assembly of DNA: Theoretical Motivations and 2D Assembly Experiments," *Journal of Biomolecular Structure & Dynamics, Conversation 11 S2*: 263-270, 2000.
5. Nadrian C. Seeman, Furong Liu, Chengde Mao, Xiaoping Yang, Lisa A. Wenzler, Ruojie Sha, Weiqiong Sun, Zhiyong Shen, Xiaojun Li, Jing Qi, Yuwen Zhang, Tsu-Ju Fu, Junghuei Chen and Erik Winfree. "Two Dimensions and Two States in DNA Nanotechnology," *Journal of Biomolecular Structure & Dynamics, Conversation 11 S2*: 253-262, 2000.
6. Erik Winfree, "Algorithmic Self-Assembly of DNA," PhD Thesis: California Institute of Technology. 110 pages, 1998.
7. Erik Winfree, "Simulations of Computing by Self-Assembly," (1998) Pasadena, California: California Institute of Technology. Technical report CS-TR:1998.22.
8. Erik Winfree, "Whiplash PCR for  $O(1)$  Computing," (1998) Pasadena, California: California Institute of Technology. Technical report CS-TR:1998.23.

### **Books:**

1. Winfree, E. and Gifford, D. (eds.), *DNA Based Computers V: DIMACS Workshop, June 14-15, 1999. American Mathematical Society DIMACS 54*: 249 pages, 2000.
2. Laura F. Landweber and Erik Winfree (eds.), *Evolution as Computation DIMACS Workshop, Princeton, January 1999, Springer Verlag*, 332 pages, 2002.