

**David Yu Zhang**  
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(last updated 10 Apr 2012)

## Academic Background:

Ph.D., Computational Neural Systems, California Institute of Technology (Caltech), 2010.  
Dissertation: *Dynamic DNA Strand Displacement Circuits*  
B.S., Biology, Caltech, 2005.

## Research Experience:

Jul 2010 – present: Postdoctoral scholar in the Yin Group, Harvard University. Research in dynamic DNA nanotechnology.  
Oct 2005 – Jun 2010: Graduate student in the Winfree Group, Caltech. Research in bio-molecular computation and engineering.  
Oct 2007 – Apr 2009: Safety officer for the Winfree Group, Caltech. In charge of waste management, safety protocols/trainings, instrument maintenance, etc.  
Oct 2004 – Sep 2005: Research visitor in the Turberfield Group, Clarendon Laboratory, Oxford University. Research in condensed matter physics.  
Apr 2001 – Jun 2004: Research student in the Winfree Group, Caltech. Research in bio-molecular computation and engineering.  
Jun 2000 – Dec 2000: Research student in the Psaltis Group, Caltech. Research in applied optics and holography.

## Awards:

2012 NIH K99/R00 Transition to Independence Award (NIBIB)  
2010 Howard Hughes Medical Institute Fellow of the Life Sciences Research Foundation (15 offered, 800+ applicants)  
2010 NHI F32 NRSA Postdoctoral Fellowship (NCI, declined)  
2008 Best Student Paper Award, 14<sup>th</sup> Annual Conference on DNA and Molecular Computation (2 offered, 50+ entries)  
2006 Fannie and John Hertz Foundation Graduate Fellow (15 offered, 600+ applicants)  
2004 Caltech \$50K Grubstake Grant  
2000 Caltech Axline Full Tuition Merit Scholarship (12 offered, 200+ students)  
2000 US National Chemistry Olympiad Camp Finalist  
1999 Research Science Institute Scholar  
1996 National Mathcounts, 2<sup>nd</sup> Place in the United States

## Journal Publications:

Upcoming manuscripts:

[18] Chen, Sherry X; **Zhang, David Yu**; Seelig, Georg. "Strand displacement-based method for detection of single-base changes in double-stranded DNA." (manuscript in preparation)

- [17] Sadowski, John; Calvert, Colby; **Zhang, David Yu**; Pierce, Niles A.; Yin, Peng. "Triggered Isothermal Assembly of a DNA Tetrahedron." (manuscript in preparation)
- [16] **Zhang, David Yu\***; Hariadi, Rizal F.\*; Choi, H. M. T.; Winfree, Erik. "Integrating Strand Displacement Circuitry with DNA Tile Self-assembly." (manuscript in preparation)

#### Published Manuscripts:

- [15] **Zhang, David Yu<sup>^</sup>**; Chen, Sherry X; Yin, Peng. "Optimizing the Specificity of Nucleic Acid Hybridization." *Nature Chemistry*, 4: 208-214 (2012).
- [14] Genot, Anthony J; **Zhang, David Yu**; Bath, Jonathan; Turberfield, Andrew J. "The Remote Toehold, a Flexible Mechanism to Control Hybridization Kinetics." *Journal of the American Chemical Society*, 133: 2177-2182 (2011).
- [13] **Zhang, David Yu<sup>^</sup>**; Seelig, Georg. "Dynamic DNA nanotechnology: reconfigurable and autonomous devices using DNA strand displacement." *Nature Chemistry*, 3: 103-113 (2011).
- [12] **Zhang, David Yu<sup>^</sup>**. "Cooperative Hybridization of Oligonucleotides." *Journal of the American Chemical Society*, 133: 1077-1086 (2011).
- [11] **Zhang, David Yu<sup>^</sup>**; Seelig, Georg. "DNA-based Fixed Gain Amplifiers and Linear Classifier Circuits." *Lecture Notes of Computer Science*, 6518: 176-186 (2011).
- [10] **Zhang, David Yu<sup>^</sup>**. "Towards Domain-Based Sequence Design for DNA Strand Displacement Reactions." *Lecture Notes in Computer Science*, 6518: 162-175 (2011).
- [9] **Zhang, David Yu<sup>^</sup>**; Winfree, Erik. "Robustness and Modularity Properties of a Non-covalent DNA Catalytic Reaction." *Nucleic Acids Research*, 38: 4182-4197 (2010).
- [8] **Zhang, David Yu<sup>^</sup>**; Winfree, Erik. "Control of DNA Strand Displacement Kinetics using Toehold Exchange." *Journal of the American Chemical Society*, 131: 17303-17314 (2009).
- [7] Fujibayashi, Kenichi; **Zhang, David Yu**; Winfree, Erik; Murata, Satoshi. "Error Suppression Mechanisms for DNA Tile Self-Assembly." *Natural Computing*, 8: 589-612 (2009).
- [6] **Zhang, David Yu<sup>^</sup>**; Winfree, Erik. "Dynamic Allosteric Control of Non-covalent DNA Catalysis Reactions." *Journal of the American Chemical Society* 130: 13921-13926 (2008).
- [5] **Zhang, David Yu<sup>^</sup>**; Turberfield, Andrew J; Yurke, Bernard; Winfree, Erik. "Engineering Entropy-Driven Reactions and Networks Catalyzed by DNA." *Science* 318: 1121-1125 (2007).
- [4] Seelig, Georg; Soloveichik, David; **Zhang, David Yu**; Winfree, Erik. "Enzyme-Free Nucleic Acid Logic Circuits." *Science* 314: 1585-1588 (2006).
- [3] **Zhang, David Yu<sup>^</sup>**; Yurke, Bernard. "A Superstructure-based DNA Replicator without Product Inhibition." *Natural Computing* 5: 183-202 (2006).
- [2] Schoenmeyr, Tor; **Zhang, David Yu<sup>^</sup>**. "FFT-based Algorithms for the String Matching with Mismatches Problem." *Journal of Algorithms* 57(2): 130-139 (2005).
- [1] Yurke, Bernard; **Zhang, David Yu**. "A Clocked DNA-based Replicator." *Lecture Notes of Computer Science* 3384: 445-457 (2004).

\* - Equal contribution authors

<sup>^</sup> - Corresponding or co-corresponding author

#### Conference Talks:

- 2011 "Thermodynamic optimization of nucleic acid hybridization specificity," presented at the 17<sup>th</sup> Annual DNA Computing Conference.

- 2011 "Optimizing nucleic acid hybridization specificity: applying biophysics to molecular design," presented at the 3<sup>rd</sup> annual Molecular Programming Project Workshop.
- 2010 "Cooperative DNA strand displacement and its applications in nucleic acid detection, quantitation, and logic," presented at the 16<sup>th</sup> Annual DNA Computing Conference.
- 2010 "Poking a gray box: 'What-if' questions about an entropy-driven DNA catalyst system," presented at the 2<sup>nd</sup> annual Molecular Programming Project Workshop.
- 2009 "Bioengineering with (only) DNA," presented at the 2<sup>nd</sup> annual United Therapeutics Conference on Nanomedicine and Telemedicine (Invited).
- 2009 "Toehold exchange and DNA strand displacement kinetics," presented at the 1<sup>st</sup> annual Molecular Programming Project Workshop.
- 2008 "Dynamic Allosteric Control of Non-covalent DNA Catalysis Reactions," presented at the 14<sup>th</sup> Annual DNA Computing Conference.
- 2006 "Entropy-Driven DNA-based Catalytic Systems," presented at the 12<sup>th</sup> Annual DNA Computing Conference.

## Patents:

- [7] **Zhang, David Y**; Marblestone, Adam H; Yin, Peng. "Ligation-based Assembly of Nucleic Acid Molecules Guided by Self-Assembled DNA Nanostructures." US provisional patent filed.
- [6] Schaus, Thomas E; **Zhang, David Y**; Sun, Wei; Yin, Peng. "Spatial Sequestration of Dynamic Nucleic Acid Circuits." US provisional patent filed May 2011.
- [5] **Zhang, David Y**; Yin, Peng. "Nucleic Acid Probe Systems." Patent Cooperative Treaty (PCT) filed October 2011.
- [4] **Zhang, David Y**. "Cooperative DNA Strand Displacement for Nucleic Acid Detection, Quantitation, and Logic." US non-provisional patent filed Apr 2011.
- [3] **Zhang, David Y**; Turberfield, Andrew J; Winfree, Erik. "Engineered Toehold Reactions and Networks." US patent number 8,110,353.
- [2] Seelig, Georg; Solovechik, David; **Zhang, David Y**; Winfree, Erik. "Enzyme-Free DNA Logic Gates and Circuits." US patent number 7,745,594.
- [1] **Zhang, David Y**; Yurke, Bernard; Winfree, Erik. "Enzyme-Free DNA Amplifier," US patent number 7,538,202 B2.

**Skills and Qualifications:** United States Citizen; fluent in speaking, reading and writing Mandarin Chinese; fluent in C, C++, and Javascript.

## Professional Service:

Referee for the following journals: Nature Chemistry, Nature Communications, Journal of the American Chemical Society, Advanced Materials, Nucleic Acids Research, Bioinformatics, Chemical Science, Chemical Communications.

Program committee for the 17<sup>th</sup> annual DNA Computing conference (2011).

## Teaching/Mentoring Experience:

Graduate Students: Luvena Ong (2011-2012, Harvard), Mingjie Dai (2011-2012, Harvard), John Sadowski (2010-2012, Harvard), Adam Marblestone (2010-2011, Harvard)

Undergraduates: Sherrie Wang (2012, Harvard), Casey Grun (2011, Harvard), Karthik Sarma (2009, Caltech), Daniel Guetta (2008, Caltech), Esther Shyu (2006-2007, Caltech).

#### Teaching:

- 2012 Guest lecturer for course: Physical Biology (MIT)
- 2011 Guest lecturer for courses: Biomolecular Engineering and Synthetic Biology (Harvard), Biologically Inspired Molecular Engineering (Harvard), Introduction to Synthetic Biology (U. Washington)
- 2004 Tutor for the 2004 Research Science Institute (RSI) high school summer program. Coordinated student research with Caltech professors, edited proposals, papers, and oral presentations of 34 high school students. Five projects qualified as 2005 Intel STS semifinalists and two projects qualified as finalists.
- 2001 Tutor for Caltech's Introductory Computer Science course (CS 2).

#### References:

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