

Zhiru Zhang

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- RESEARCH INTERESTS Design automation for heterogeneous computing, including high-level synthesis, architecture and compiler optimization for hardware specialization, software-defined reconfigurable systems, and approximate computing substrate.
- EDUCATION **University of California, Los Angeles**, Los Angeles, CA
- Ph.D., Computer Science, 2007 (with Highest Distinction)
 - Thesis Topic: Behavior-Level Scheduling and Planning for Nanometer IC Designs
 - Advisor: Professor Jason Cong
 - M.S., Computer Science, 2003
- Peking University**, Beijing, China
- B.S., Computer Science, 2001 (with Highest Distinction)
- PROFESSIONAL EXPERIENCE **Cornell University**, Ithaca, NY Aug. 2012–present
- Assistant Professor*, School of Electrical and Computer Engineering
 - Graduate Field Member*, Computer Science
- Xilinx Inc.**, San Jose, CA Jan. 2011–Aug. 2012
- Software Development Manager*
- AutoESL Design Technologies Inc.**, Los Angeles, CA May 2006–Jan. 2011
- Co-founder, Director of Research and Development*
- Altera Corp.**, San Jose, CA Jun. 2004–Sept. 2004
- Software Intern*
- AWARDS AND HONORS
- Best Paper Award Nomination, International Symposium on Field-Programmable Gate Arrays (4 out of 101 submissions), 2017.
 - Michael Tien'72 Excellence in Teaching Award, College of Engineering, Cornell University, 2016.
 - DARPA Young Faculty Award (YFA), 2015.
 - IEEE CEDA Ernest S. Kuh Early Career Award, 2015.
 - NSF CAREER Award, National Science Foundation, 2015.
 - Best Paper Award, ACM Transactions on Design Automation of Electronic Systems, 2012.
 - Ross Freeman Award for Technical Innovation, Xilinx, 2012.
 - Best Paper Award Nomination, International Conference on Computer-Aided Design (14 out of 438 submissions), 2009.
 - Outstanding Ph.D. Award, UCLA Computer Science Department, 2007.
 - Phi Tau Phi Scholarship Award, Phi Tau Phi Scholastic Honor Society of America, 2005.
 - Best Graduate Award, Peking University, 2001.

TEACHING
EXPERIENCE

- **ECE/ENGRD 2300** – Digital Logic and Computer Organization
Spring 2017 (92 students), Spring 2016 (62 students), Spring 2015 (58 students),
Spring 2014 (63 students)
- **ECE 5775** – High-Level Digital Design Automation
Fall 2016 (30 students), Fall 2015 (36 students), Fall 2014 (33 students), Fall 2013
(17 students)
- **ENGRG 1050** – Freshman Engineering Seminar
Fall 2013 (18 students)
- **ECE 5950** – Special Topics on High-Level Digital Design Automation
Spring 2013 (14 students)

EXTERNAL
PROFESSIONAL
ACTIVITIES

Conference Technical Program Committee Member

- IEEE International Conference on Application-specific Systems, Architectures and Processors (ASAP) 2017.
- Asia and South Pacific Design Automation Conference (ASP-DAC) 2013-2015, 2017-2018.
- Design Automation Conference (DAC) 2016-2017.
- International Conference on Computer-Aided Design (ICCAD) 2015-2017.
- International Symposium on Field-Programmable Gate Arrays (FPGA) 2015-2017.
- International Conference on Hardware/Software Codesign and System Synthesis (CODES+ISSS) 2015-2016.
- International Conference on Computing Frontiers (CF) 2016.
- International Conference on Computer Design (ICCD) 2015.
- International Conference on Field-Programmable Logic and Applications (FPL) 2016.
- International Symposium on Low Power Electronics and Design (ISLPED) 2016.
- IEEE International Symposium on Circuits and Systems (ISCAS) 2011-2015.
- International Conference on Very Large Scale Integration (VLSI-SOC) 2011, 2015.
- Design, Automation, and Test in Europe (DATE) 2014.
- Electronic System Level Synthesis Conference (ESLSyn) 2012-2015.
- International Symposium on Application Accelerators in High Performance Computing (SAAHPC) 2009-2012.

Conference Technical Program Chair

- Electronic System Level Synthesis Conference (ESLSyn) 2015.

Journal Editor

- Springer Journal on Design Automation for Embedded Systems, *Associate Editor*, 2016-present.
- Journal of Electrical and Computer Engineering, Special Issue on ESL Design Methodology (JECE), *Guest Editor*, 2011-2012.

Journal Reviewer

- ACM Transactions on Design Automation of Electronic Systems (TODAES)
- ACM Transactions on Architecture and Code Optimization (TACO)
- ACM Transactions on Reconfigurable Technology and Systems (TRETTS)
- IEEE Transactions on Computers (TC)
- IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (TCAD)
- IEEE Transactions on Signal Processing (T-SP)
- IEEE Computer Architecture Letters (CAL)
- IEEE Transactions on Very Large Scale Integration Systems (TVLSI)
- IET Computers & Digital Techniques (IET-CDT)
- IEEE Design & Test Magazine
- Journal of Parallel and Distributed Computing (JPDC)

Grant Proposal Review Panelist

- NSF, CISE Directorate (2015, 2016)

Professional Society Memberships

- ACM Member, 2015-present
- ACM SIGDA Member, 2012-present
- IEEE Member, 2011-present
- IEEE CAS/CEDA CANDE (Computer Aided Network DEsign) Technical Committee, *Publicity Chair*, 2012-present.

PUBLICATIONS

Conference Publications

- G. Liu and Z. Zhang. Statistically Certified Approximate Logic Synthesis, to appear in *International Conference on Computer-Aided Design (ICCAD)*, Nov. 2017.
- T. Ajayi, K. Al-Hawaj, A. Amarnath, S. Dai, S. Davidson, P. Gao, G. Liu, A. Lotfi, J. Puscar, A. Rao, A. Rovinski, L. Salem, N. Sun, C. Torng, L. Vega, B. Veluri, X. Wang, S. Xie, C. Zhao, R. Zhao, C. Batten, R. Dreslinski, I. Galton, R. Gupta, P. Mercier, M. Srivastava, M. Taylor, and Z. Zhang. Celerity: An Open-Source RISC-V Tiered Accelerator Fabric, to appear in *ACM/IEEE Symposium on High-Performance Chips (HOTCHIPS)*, Aug. 2017.
- J.H. Lin, T. Xing, R. Zhao, Z. Zhang, M. Srivastava, Z. Tu, and R. Gupta. Binarized Neural Networks with Separable Filters for Efficient Hardware Acceleration. to appear in *IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW)*, Jul. 2017.
- E. Bartz, J. Chaves, Y. Gershtein, E. Halkiadakis, M. Hildreth, S. Kyriacou, K. Lannon, A. Lefeld, A. Ryd, L. Skinnari, R. Stone, C. Strohman, Z. Tao, B. Winer, P. Wittich, Z. Zhang, and M. Zientek. FPGA-based Real-time Charged Particle Trajectory Reconstruction at the Large Hadron Collider. *International Symposium on Field-Programmable Custom Computing Machines (FCCM)*, May 2017.
- G. Liu and Z. Zhang. A Parallelized Iterative Improvement Approach to Area Optimization for LUT-Based Technology Mapping. *International Symposium on Field-Programmable Gate Arrays (FPGA)*, Feb. 2017.
- Y. Zhou, K. Al-Hawaj, and Z. Zhang. A New Approach to Automatic Memory Banking using Trace-Based Address Mining, *International Symposium on Field-Programmable Gate Arrays (FPGA)*, Feb. 2017.
- R. Zhao, W. Song, W. Zhang, T. Xing, J.-H. Lin, M. Srivastava, R. Gupta, and Z. Zhang. Accelerating Binarized Convolutional Neural Networks with Software-Programmable FPGAs, *International Symposium on Field-Programmable Gate Arrays (FPGA)*, Feb. 2017.
- C. Xu, G. Liu, R. Zhao, S. Yang, G. Luo, and Z. Zhang. A Parallel Bandit-Based Approach for Autotuning FPGA Compilation, *International Symposium on Field-Programmable Gate Arrays (FPGA)*, Feb. 2017.
- S. Dai, R. Zhao, G. Liu, S. Srinath, U. Gupta, C. Batten, and Z. Zhang. Dynamic Hazard Resolution for Pipelining Irregular Loops in High-Level Synthesis, *International Symposium on Field-Programmable Gate Arrays (FPGA)*, Feb. 2017.
- N. Srivastava, S. Dai, R. Manohar, and Z. Zhang. Accelerating Face Detection on Programmable SoC Using C-Based Synthesis, *International Symposium on Field-Programmable Gate Arrays (FPGA)*, Feb. 2017.
- R. Zhao, G. Liu, S. Srinath, C. Batten, and Z. Zhang. Improving High-Level Synthesis with Decoupled Data Structure Optimization. *Design Automation Conference (DAC)*, Jun. 2016.
- A. Majumdar, Z. Zhang, and D. Albonesi. Characterizing the Benefits and Limitations of Smart Building Meeting Room Scheduling. *International Conference on Cyber-Physical Systems (ICCPs)*, Apr. 2016.
- D. Chen, J. Cong, S. Gurumani, W-M. Hwu, K. Rupnow, and Z. Zhang. System

Synthesis and Automated Verification: Design Demands for IoT Devices. *Sensors to Cloud Architectures Workshop (SCAW)*, Mar. 2016.

- F. Koushanfar, A. Mirhoseini, G. Qu, and Z. Zhang. DA Systemization of Knowledge: A Catalog of Prior Forward-Looking Initiatives. *International Conference on Computer-Aided Design (ICCAD)*, Nov. 2015. (Invited Paper)
- M. Tan, G. Liu, R. Zhao, S. Dai, and Z. Zhang. ElasticFlow: A Complexity-Effective Approach for Pipelining Irregular Loop Nests. *International Conference on Computer-Aided Design (ICCAD)*, Nov. 2015.
- G. Liu and Z. Zhang. A Reconfigurable Analog Substrate for Highly Efficient Maximum Flow Computation. *Design Automation Conference (DAC)*, Jun. 2015.
- R. Zhao, M. Tan, S. Dai, and Z. Zhang. Area-Efficient Pipelining for FPGA-Targeted High-Level Synthesis. *Design Automation Conference (DAC)*, Jun. 2015.
- M. Tan, S. Dai, U. Gupta, and Z. Zhang. Mapping-Aware Constrained Scheduling for LUT-Based FPGAs. *International Symposium on Field-Programmable Gate Arrays (FPGA)*, Feb. 2015.
- S. Srinath, B. Ilbeyi, M. Tan, G. Liu, Z. Zhang, and C. Batten. Architectural Specialization for Inter-Iteration Loop Dependence Patterns. *International Symposium on Microarchitecture (MICRO)*, Dec. 2014.
- M. Tan, B. Liu, S. Dai, and Z. Zhang. Multithreaded Pipeline Synthesis for Data-Parallel Kernels. *International Conference on Computer-Aided Design (ICCAD)*, Nov. 2014.
- G. Liu, Y. Tao, M. Tan, and Z. Zhang. CASA: Correlation-Aware Speculative Adders. *International Symposium on Low Power Electronics and Design (ISLPED)*, Aug. 2014.
- S. Dai, M. Tan, K. Hao, and Z. Zhang. Flushing-Enabled Loop Pipelining for High-Level Synthesis. *Design Automation Conference (DAC)*, Jun. 2014.
- Z. Zhang and B. Liu. SDC-Based Modulo Scheduling for Pipeline Synthesis. *International Conference on Computer-Aided Design (ICCAD)*, Nov. 2013.
- Z. Zhang and D. Chen. Challenges and Opportunities of ESL Design Automation. *IEEE International Conference on Solid-State and Integrated Circuit Technology*, Oct. 2012. (Invited Paper)
- J. Zhang, Z. Zhang, S. Zhou, M. Tan, X. Liu, X. Cheng, and J. Cong. Bit-Level Optimization for High-Level Synthesis and FPGA-Based Acceleration. *International Symposium on FPGAs (FPGA)*, Feb. 2010.
- J. Cong, B. Liu, and Z. Zhang. Scheduling with Soft Constraints. *International Conference on Computer-Aided Design (ICCAD)*, Nov. 2009. (**Best Paper Nominee**)
- J. Cong, B. Liu, and Z. Zhang. Behavior-Level Observability Don't-Cares and Application to Low-Power Behavioral Synthesis. *International Symposium on Low Power Electronics and Design (ISLPED)*, Aug. 2009.
- J. Cong, K. Gururaj, B. Liu, C. Liu, Z. Zhang, S. Zhou, and Y. Zou. Evaluation of Static Analysis Techniques for Fixed-Point Precision Optimization. *IEEE Symposium on Field-Programmable Custom Computing Machines (FCCM)*, Apr. 2009.
- W. Jiang, Z. Zhang, M. Potkonjak, and J. Cong. Scheduling with Integer Time Budgeting for Low-Power Optimization. *Asia and South Pacific Design Automation Conference (ASP-DAC)*, Jan. 2008.
- C.T. Hsieh, J. Cong, S.C. Chang, and Z. Zhang. Behavioral Synthesis with Activating Unused Flip-Flops for Reducing Glitch Power in FPGA. *Asia and South Pacific Design Automation Conference (ASP-DAC)*, Jan. 2008.
- D. Chen, J. Cong, Y. Fan, and Z. Zhang. High-Level Power Estimation and Low-Power Design Space Exploration for FPGAs. *Asia and South Pacific Design Automation Conference (ASP-DAC)*, Jan. 2007.
- J. Cong, Y. Fan, G. Han, W. Jiang, and Z. Zhang. Platform-Based Behavior-Level and System-Level Synthesis. *IEEE International SOC Conference (SOCC)*, Sept.

2006. (Invited Paper)
- J. Cong and Z. Zhang. An Efficient and Versatile Scheduling Algorithm Based on SDC Formulation. *Design Automation Conference (DAC)*, Jul. 2006.
 - J. Cong, Y. Fan, G. Han, W. Jiang, and Z. Zhang. Behavior and Communication Co-Optimization for Systems with Sequential Communication Media. *Design Automation Conference (DAC)*, Jul. 2006.
 - J. Cong, G. Han, and Z. Zhang. Architecture and Compilation for Data Bandwidth Improvement in Configurable Embedded Processors. *International Conference on Computer-Aided Design (ICCAD)*, Nov. 2005.
 - J. Cong, Y. Fan, G. Han, A. Jagannathan, G. Reinman, and Z. Zhang. Instruction Set Extension with Shadow Registers for Configurable Processors. *International Symposium on FPGAs (FPGA)*, Feb. 2005.
 - J. Cong, Y. Fan, G. Han, Y. Lin, J. Xu, Z. Zhang, and X. Cheng. Bitwidth-Aware Scheduling and Binding in High-Level Synthesis. *Asia and South Pacific Design Automation Conference (ASP-DAC)*, Jan. 2005.
 - J. Cong, Y. Fan, and Z. Zhang. Architecture-Level Synthesis for Automatic Interconnect Pipelining. *Design Automation Conference (DAC)*, Jun. 2004.
 - J. Cong, Y. Fan, G. Han, and Z. Zhang. Application-Specific Instruction Generation for Configurable Processor Architectures. *International Symposium on FPGAs (FPGA)*, Feb. 2004. **(Among the Top 10 most-cited articles from FPGA symposium since 1995)**
 - J. Cong, Y. Fan, G. Han, X. Yang, and Z. Zhang. Architectural Synthesis Integrated with Global Placement for Multi-Cycle Communication. *International Conference on Computer-Aided Design (ICCAD)*, Nov. 2003.
 - Z. Zhang, Y. Fan, M. Potkonjak, and J. Cong. Gradual Relaxation Technique with Application to Behavioral Synthesis. *International Conference on Computer-Aided Design (ICCAD)*, Nov. 2003.
 - J. Cong, Y. Fan, X. Yang, and Z. Zhang. Architecture and Synthesis for Multi-Cycle Communication. *International Symposium on Physical Design (ISPD)*, Apr. 2003. (Invited Paper)

Journal Publications

- G. Liu, M. Tan, S. Dai, R. Zhao, and Z. Zhang. Architecture and Synthesis for Area-Efficient Pipelining of Irregular Loop Nests, *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (TCAD)*, Feb. 2017.
- D. Chen, J. Cong, S. Gurumani, W-M. Hwu, K. Rupnow, and Z. Zhang. Platform Choices and Design Demands for IoT Platforms: Cost, Power and Performance Tradeoffs, *IET Cyber-Physical Systems: Theory & Applications (IET-CPS)*, Nov. 2016.
- Z. Zhang, D. Chen, S. Dai, and K. Campbell. High-Level Synthesis for Low-Power Design. in *IPSS Transactions on System LSI Design Methodology (T-SLDM)*, Feb. 2015. (Invited Paper)
- J. Cong, B. Liu, S. Neuendorffer, J. Noguera, K. Vissers, and Z. Zhang. High-Level Synthesis for FPGAs: From Prototyping to Deployment. *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (TCAD)*. 30(4):473–491. Apr. 2011. **(Keynote Paper)**
- J. Cong, B. Liu, R. Majumdar, and Z. Zhang. Behavior-Level Observability Analysis and Operation Gating in Low-Power Behavioral Synthesis. *ACM Transactions on Design Automation of Electronic Systems (TODAES)*, 16(1):1–29. Nov. 2010. **(Best Paper Award)**
- J. Cong, G. Han, and Z. Zhang. Architecture and Compiler Optimization for Data Bandwidth Improvement in Configurable Processors. *IEEE Transaction on Very Large Scale Integration Systems (TVLSI)*, 14(9):986–997. Sept. 2006.

- J. Cong, Y. Fan, G. Han, X. Yang, and Z. Zhang. Architecture and Synthesis for On-Chip Multicycle Communication. *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (TCAD)*, 23(4):550–564. Apr. 2004.

Book Chapters

- Z. Zhang, Y. Fan, W. Jiang, G. Han, C. Yang, and J. Cong. AutoPilot: A Platform-Based ESL Synthesis System. *High-Level Synthesis: From Algorithm to Digital Circuit* ed. P. Coussy and A. Morawiec, Springer Publishers, 2008.

PATENTS

- *Soft Constraints in Scheduling*. U.S. Patent 8296710, (co-invented with B. Liu and J. Cong,) issued Oct. 2012.
- *Performance Visualization System*. U.S. Patent 7784008, (co-invented with M. Hutton and D. Karchmer,) issued Aug. 2010.

INVITED TALKS

- *Enabling Software-Defined Reconfigurable Computing*, ICC Distinguished Lecturer Series, Michigan Technological University, Houghton, MI, Dec. 2016.
- *Productive High-Level Programming for Deep Learning Acceleration on FPGAs*, Machine Learning on FPGAs Summit, Intel, San Jose, CA, Oct. 2016.
- *Rapid Hardware Specialization with HLS: Glass Half Full*, International Symposium on Microarchitecture (MICRO), Taipei, Taiwan, Oct. 2016.
- *Design Automation for Software-Defined Reconfigurable Computing*, National Taiwan University, Taipei, Taiwan, Oct. 2016.
- *Complexity-Effective Loop Specialization*. Institute of Microelectronics, Tsinghua University, Beijing, China, Dec. 2015.
- *Intelligent High-Level Synthesis for Effort-Less Hardware Specialization*. ICCAD'15 Workshop on “Towards Efficient Computing in the Dark Silicon Era”, Austin, TX, Nov. 2015.
- *DA Systemization of Knowledge: A Catalog of Prior Forward-Looking Initiatives*. ICCAD'15 Special Session on “From EDA to DA: Can We Evolve Beyond Our E-Roots?”, Austin, TX, Nov. 2015.
- *Programming Software-Defined FPGAs: Progress and Roadblocks*. SEAK 2015: DAC Workshop on Suite of Embedded Applications and Kernels, San Francisco, CA, Jun. 2015.
- *Synthesis with Higher Abstractions for Effort-Less FPGA Programming*. CALCM Seminars, Carnegie Mellon University, Pittsburgh, PA, Feb. 2015.
- *Towards Reconfigurable Computing for Software Programmers*. Institute of Microelectronics, Tsinghua University, Beijing, China, Dec. 2014.
- *Architecture and Synthesis for Effort-Less Hardware Specialization*. Center for Energy-Efficient Computing and Applications, Peking University, Beijing, China, Dec. 2014.
- *Mapping-Aware Scheduling for LUT-Based FPGAs*. Research Seminar, Xilinx, San Jose, CA, Nov. 2014.
- *Synthesis with Higher Abstractions for Software Programmable FPGAs*. Distinguished Lecturer Series, USC Information Sciences Institute (ISI), Arlington, VA, Aug. 2014.
- *High-Level Synthesis for FPGAs: From Prototyping to Deployment*. The Third Workshop on the Intersections of Computer Architecture and Reconfigurable Logic (CARL 2013), Davis, CA, Dec. 2013.
- *Intelligent Modulo Scheduling for Pipeline Synthesis*. Research Seminar, Xilinx, San Jose, CA, Nov. 2013.
- *Scheduling Algorithms for High-Quality High-Level Synthesis*. Research seminar, Electronic Engineering Department, Tsinghua University, Beijing, China, Dec. 2012.
- *Scheduling Algorithms for High-Quality High-Level Synthesis*. DA PIC seminar, IBM T.J. Watson Research Center, Yorktown Heights, NY, Dec. 2012.

RESEARCH
FUNDING

- *C-Based Hardware Synthesis with AutoPilot*. Invited Tutorial at Center of Domain-Specific Computing Symposium (CDSC) at UCLA, Los Angeles, CA, Feb. 2010.
- *Domain-Specific Reconfigurable Computing with C-Based Synthesis*. Invited Tutorial at IEEE International SOC Conference (SOCC), New Port Beach, CA, Sept. 2008.
- *C/C++/SystemC to RTL Synthesis for FPGA*. Invited Tutorial at Reconfigurable System Summer Institute (RSSI) at UIUC, Champaign, IL, Jul. 2008.
- *Enabling Intelligent Programmer Support for FPGA-Based Accelerated Computing*. Intel Strategic Research Alliance (ISRA), Sep. 2016–Aug. 2019.
- *Automatic Synthesis of Verifiably Secure Hardware Accelerators* (Co-PI: Gookwon Suh). SRC Trustworthy and Secure Semiconductors and Systems (T3S), Oct. 2016–Sep. 2019.
- *STARSS: Small: Automatic Synthesis of Verifiably Secure Hardware Accelerators* (Co-PI: Gookwon Suh). NSF Secure and Trustworthy Cyberspace: Secure, Trustworthy, Assured and Resilient Semiconductors and Systems (SaTC: STARSS), Award CNS-1618275, Sep. 2016–Aug. 2019.
- *A Synthesis Methodology for Accelerator-Centric SOCs and Tool Flows* (in Collaboration with UCSD (lead, PI: Rajesh Gupta), Michigan, and UCLA; Cornell Co-PI: Christopher Batten). DARPA Circuit Realization at Faster Timescales (CRAFT), May 2016–Aug. 2017.
- *Ultrasonic Fourier Computing for Ultrafast Solver for the Vlasov Equation* (PI: Amit Lal, Co-PIs: David Hammer, Charles Seyler). DARPA Defense Sciences Office, Feb. 2016–Feb. 2018.
- *Scale-Out Design Automation for Highly Productive Hardware Specialization*. DARPA Young Faculty Award (YFA), Sep. 2015–Sep. 2018.
- *II-New: PyMTL: A Unified Framework for Vertically Integrated Computer Architecture Research* (PI: Christopher Batten). NSF CISE Research Infrastructure (CRI), Award CNS-1512937, Jul. 2015–Jun. 2018.
- *CAREER: Synthesizing Highly Efficient Hardware Accelerators for Irregular Programs: A Synergistic Approach*. NSF Faculty Early Career Development (CAREER), Award CCF-1453378, Mar. 2015–Feb. 2020.
- *Polymorphic Hardware Specialization for Domain-Specific Algorithms and Data Structures* (PI: Christopher Batten). NSF Exploiting Parallelism and Scalability (XPS), Award CCF-1337240, Sept. 2013–Aug. 2017.
- *Domain-Specific High-Level Synthesis for FPGAs*. Xilinx, 2012-2017.