

# Yipeng Huang

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## Current Position

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### Princeton University

Postdoctoral research associate  
Advisor: Dr. Margaret Martonosi

June 2018 - present

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## Education

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### Columbia University

Ph.D., computer science  
Dissertation: Hybrid Analog-Digital Co-Processing for Scientific Computation  
Advisor: Dr. Simha Sethumadhavan

2018

M.Phil., computer science

2015

M.S., computer science

2013

B.S. *magna cum laude*, computer engineering, minor in economics

2011

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## Honors and Awards

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- Rising Stars in Computer Architecture Workshop 2019 participant (one of seven)
- Heidelberg Laureate Forum 2017 participant
- IEEE Micro Top Picks from the 2017 Computer Architecture Conferences honorable mention
- IEEE Micro Top Picks from the 2016 Computer Architecture Conferences (one of 12)
- DARPA Small Business Technology Transfer Phase I grant (for investigating analog computing applications)
- Columbia University Computer Engineering Award of Excellence (annual departmental award)
- Columbia University George Vincent Wendell Memorial Medal nominee (annual school award)

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## Publications

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### Conference Publications

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#### **Statistical Assertions for Validating Patterns and Finding Bugs in Quantum Programs**

Yipeng Huang and Margaret Martonosi

ACM/IEEE International Symposium on Computer Architecture (ISCA), Phoenix, AZ, 2019

*Invited for submission to the ACM Transactions on Quantum Computing*

#### **Hybrid Analog-Digital Solution of Nonlinear Partial Differential Equations**

Yipeng Huang, Ning Guo, Mingoo Seok, Yannis Tsividis, Kyle Mandli, and Simha Sethumadhavan

IEEE/ACM International Symposium on Microarchitecture (MICRO), Cambridge, MA, 2017

*IEEE Micro Top Picks from the 2017 Computer Architecture Conferences honorable mention*

#### **Evaluation of an Analog Accelerator for Linear Algebra**

Yipeng Huang, Ning Guo, Mingoo Seok, Yannis Tsividis, and Simha Sethumadhavan

ACM/IEEE International Symposium on Computer Architecture (ISCA), Seoul, South Korea, 2016

*IEEE Micro Top Picks from the 2016 Computer Architecture Conferences*

### **RoboBench: Towards Sustainable Robotics System Benchmarking**

Jonathan Weisz, Yipeng Huang, Florian Lier, Simha Sethumadhavan, and Peter K. Allen  
IEEE International Conference on Robotics and Automation (ICRA), Stockholm, Sweden, 2016

### **Continuous-Time Hybrid Computation with Programmable Nonlinearities**

Ning Guo, Yipeng Huang, Tao Mai, Sharvil Patil, Chi Cao, Mingoo Seok, Simha Sethumadhavan, and Yannis Tsividis  
European Solid-State Circuits Conference (ESSCIRC), Graz, Austria, 2015  
*Invited for submission to the IEEE Journal of Solid-State Circuits*

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## Journal Publications

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### **Analog Computing in a Modern Context: A Linear Algebra Accelerator Case Study**

Yipeng Huang, Ning Guo, Mingoo Seok, Yannis Tsividis, and Simha Sethumadhavan  
IEEE Micro, Top Picks Special Issue, vol. 37, no. 3, pp. 30-38, 2017

### **Energy-Efficient Hybrid Analog/Digital Approximate Computation in Continuous Time**

Ning Guo, Yipeng Huang, Tao Mai, Sharvil Patil, Chi Cao, Mingoo Seok, Simha Sethumadhavan, and Yannis Tsividis  
IEEE Journal of Solid-State Circuits (JSSC), vol. 51, no. 7, pp. 1514-1524, July 2016

### **Trustworthy Hardware from Untrusted Components**

Simha Sethumadhavan, Adam Waksman, Matthew Suozzo, Yipeng Huang, and Julianna Eum  
Communications of the ACM, vol. 58, no. 9, pp. 60-71, August 2015”

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## Workshop Papers

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### **QDB: From Quantum Algorithms Towards Correct Quantum Programs**

Yipeng Huang and Margaret Martonosi  
2018 PLATEAU Workshop at ACM conference on Systems, Programming, Languages and Applications: Software for Humanity (SPLASH), Boston, MA, 2018

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## Dissertation

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### **Hybrid Analog-Digital Co-Processing for Scientific Computation**

Committee: Simha Sethumadhavan, Yannis Tsividis, Margaret Martonosi, Martha Kim, and Kyle Mandli  
*Nominated by Columbia University Computer Science Department for the ACM Doctoral Dissertation Award*

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## Selected Presentations

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## Invited Talks

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### **Emerging Architectures for Humanity’s Grand Challenges**

Georgia Tech Rising Stars in Computer Architecture (RISC-A) Workshop, Atlanta, GA, October 2019  
*Hosts: Alex Daglis and Tushar Krishna*

### **Probabilistic Inference and Statistical Tests for Correct Quantum Programs**

Sandia National Laboratories Assessing Performance of Quantum Computers workshop, Estes Park, CO, September 2019  
*Host: Robin Blume-Kohout*

### **Knowledge Compilation-Based Exact Inference for Quantum Simulation**

Quantum Resource Estimation workshop at ISCA/FCRC, Phoenix, AZ, June 2019  
*Hosts: Alexandru Paler, Simon Devitt, and Daniel Herr*

### **Approximate Computing Across the (Quantum) Stack**

Workshop on Approximate Computing Across the Stack at PLDI/FCRC, Phoenix, AZ, June 2019

Host: *Ulya Karpuzcu*

### **A Case Study in Analog Co-Processing for Solving Stochastic Differential Equations**

IEEE International Conference on Digital Signal Processing, Shanghai, China, November 2018

Hosts: *Arjuna Madanayake, Zhiping Lin, and Sankar Basu*

### **Hybrid Analog-Digital Co-Processor for Scientific Computation**

DARPA Accelerated Computation for Efficient Scientific Simulation (ACCESS) principal investigators' meeting  
Arlington, VA, December 2016

Host: *Vincent Tang*

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## Selected Posters

### **Hybrid Analog-Digital Accelerator for Differential and Algebraic Equations**

IEEE International Conference on Rebooting Computing, Tysons Corner, VA, November 2017

### **Hybrid Analog-Digital Solution of Nonlinear Partial Differential Equations**

Heidelberg Laureate Forum, Heidelberg, Germany, September 2017

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## Grants

### **Hybrid Analog-Digital Co-Processor for Scientific Computation**

I was the principal investigator for this Small Business Technology Transfer grant, in response to DARPA's Accelerated Computation for Efficient Scientific Simulation (ACCESS) program. The research was conducted at a startup I founded, Allegory Labs, LLC, with Columbia University as a subcontractor. Grant amount: \$100,000; DoD DARPA contract number D16PC00089

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## Research Artifacts & Impact

### **Columbia University Prototype Analog Accelerators**

I was a part of a team that taped-out two iterations of analog accelerators for solving differential and algebraic equations. I led the effort in building the chips' digital interfaces, validating the chips' functionality, and programming the chips. The prototypes have been used at MIT, Ulm University, Sendyne Corporation, and Allegory Labs, LLC for further research.

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## Press Mentions

<b>Headline</b>	<b>Publication</b>	<b>Date</b>
Quantum computing made easier through new debugging tools	Science Times	July 4, 2019
Researchers make steps toward debugging tools for quantum computers	phys.org	June 21, 2019
Not your father's analog computer	IEEE Spectrum	Dec. 1, 2017
Maths on a boat: Yipeng Huang and analog computing	maths.org Plus magazine	Oct. 10, 2017
Back to analog computing: Columbia researchers merge analog and digital computing on a single chip	Columbia CS press release	Nov. 22, 2016

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## Academic Service

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Venue	Role	Years
Programming Languages and Quantum Computing workshop at POPL	PC	2020
ACM/IEEE International Symposium on Computer Architecture (ISCA)	ERC	2019, 2020
ACM International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS)	ERC	2019, 2020
IEEE/ACM International Symposium on Microarchitecture (MICRO)	ERC	2019
IEEE International Symposium on High Performance Computer Architecture (HPCA)	External reviewer	2015, 2019
IEEE Computer Architecture Letters	Reviewer	2019
IEEE Micro Magazine	Reviewer	2017, 2018
IEEE Transactions on Circuits and Systems-I	Reviewer	2018, 2019
Columbia University Computer Science M.S. program admissions	Reviewer	2014

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## Teaching Experience

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Course	Role	Primary instructor	Term
Quantum Undergraduate Research at IBM and Princeton (QURIP) mentor for Emma Dasgupta and Lia Yeh <i>Their work won the bronze medal at the ACM Student Research Competition undergraduate division at MICRO 2019</i>	Mentor	Margaret Martonosi	Summer 2019
Undergraduate thesis mentor for Lois Dzebissov	Mentor	Margaret Martonosi	Fall 2018
Undergraduate research project mentor for Lusa Zhan	Mentor	Simha Sethumadhavan	Fall 2016
Masters research project mentor for Mingrui Liu	Mentor	Simha Sethumadhavan	Spring 2015
Masters research project mentor for Kenneth Harvey	Mentor	Simha Sethumadhavan	Spring 2015
Computer Hardware Design (graduate course in RTL design, validation, synthesis)	Teaching assistant	Simha Sethumadhavan	Fall 2012, Fall 2014
Fundamentals of Computer Systems (undergraduate course in logic and architecture)	Teaching assistant	Dan Rubenstein	Fall 2010
Object Oriented Design in Java	Teaching assistant	Bert Huang	Spring 2010

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## Professional Experience

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<b>Sendyne</b> Research Intern	New York, NY Summer 2017
• Developed novel stochastic application-specific integrated circuit for financial modeling applications	
<b>Allegory Labs, LLC</b> Founder & Principal Investigator	New York, NY Nov. 2015 – May 2017
• Founded IP-backed startup via \$100K Small Business Technology Transfer federal government contract	
• Collaborated with university subcontractor to research new class of analog continuous-time numerical methods	
• Identified and assessed commercial potential in modern scientific computation applications	
• Communicated with DARPA in-person and in response to request for information, phase I, and phase II proposals	
<b>Boeing</b> Information Technology Career Foundation Program Participant	Seattle, WA June 2011 – July 2012
• Built MPI interface to parallelize computational fluid dynamics and engineering geometry applications	
<b>ZS Associates</b> Business Information Specialist Intern	New York, NY Summer 2010
<b>Hutchison Port Holdings</b> Information Technology Intern	Hong Kong Summer 2009

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## Science Education Outreach, Leadership, and Professional Memberships

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Organization	Role	Years
Summer Science Program (high school astrophysics summer program)	Admissions Committee	2019, 2020
New York Hall of Science STEM Night: Exploring the Tech Workforce	Panelist	October 2019
UC Santa Barbara School for Scientific Thought (high school quantum computing weekend program)	Short Course Instructor	October 2019
FIRST Robotics Competition (high school annual robotics competition)	Team Mentor	Spring 2014
Western Aerospace Scholars at Seattle Museum of Flight (high school aerospace summer program)	Summer Residency Mentor	2012, 2013
Columbia Daily Spectator	Staff Director & Design Editor	2007 – 2010
ACM SIGARCH, SIGMICRO	Member	2012 - present
IEEE Computer Society	Member	2012 - present

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## Technical Tools & Languages

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**Quantum:** IBM Qiskit, Google Cirq, Microsoft ProjectQ, Scaffold

**Hardware:** SystemC, SystemVerilog, Synopsys, Cadence, Altera EDA tools for ASIC/FPGA

**Software:** Nvidia CUDA Thrust, Open MPI, Robot Operating System, C/C++, Java, Python, MATLAB, Docker