

# Yipeng Huang

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## Academic Appointments

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### Rutgers University

Assistant Professor

September 2020–present

### Princeton University

Postdoctoral Research Associate

Advisor: Dr. Margaret Martonosi

June 2018–August 2020

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## Education

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### Columbia University

Ph.D., computer science

2018

Dissertation: Hybrid Analog-Digital Co-Processing for Scientific Computation

Advisor: Dr. Simha Sethumadhavan

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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- IEEE Micro Top Picks from the Computer Architecture Conferences honorable mention: 2017, 2022
- Rising Stars in Computer Architecture Workshop 2019 participant (one of seven)
- Heidelberg Laureate Forum 2017 participant
- 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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#### Noisy Variational Quantum Algorithm Simulation via Knowledge Compilation for Repeated Inference

Yipeng Huang, Steven Holtzen, Todd Millstein, Guy Van den Broeck, and Margaret Martonosi

ACM International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS), Detroit, MI, 2021

Acceptance rate = 75/398  $\approx$  18.8%

IEEE Micro Top Picks from the 2021 Computer Architecture Conferences honorable mention

#### 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

Acceptance rate = 62/365  $\approx$  17.0%

### **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  
*Acceptance rate = 61/327  $\approx$  18.7%*  
*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  
*Acceptance rate = 57/291  $\approx$  19.6%*  
*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*

## 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

## Workshop Papers

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### **Logic Formulas as Program Abstractions for Quantum Circuits**

Yipeng Huang, Steven Holtzen, Todd Millstein, Guy Van den Broeck, and Margaret Martonosi  
First International Workshop on Quantum Computing Software at The International Conference for High Performance Computing, Networking, Storage, and Analysis (SC), 2020

### **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

## 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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#### **Extensions of multivalued and analog computing into the quantum realm**

Peking University Institute for Artificial Intelligence and School of Integrated Circuits, Virtual, June 2022

Host: *Zhong Sun*

#### **Graphical models and logical abstractions for quantum systems**

Princeton ACM / IEEE Computer Society Chapter, Virtual, November 2021

Host: *Brian Berenbach*

#### **Graphical models and logical abstractions for quantum systems**

UC Berkeley Challenge Institute for Quantum Information, Virtual, November 2021

Host: *John Kubitowicz*

#### **Graphical models and logical abstractions for quantum systems**

UC Santa Cruz Baskin School of Engineering Hardware Systems Collective, Virtual, October 2021

Host: *Tyler Sorensen*

#### **Logical Abstractions for Noisy Variational Quantum Algorithm Simulation**

IBM Quantum Hub at NC State Quantum Lunch Series, Virtual, April 2021

Host: *Huiyang Zhou*

#### **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**

ISCA/FCRC Quantum Resource Estimation workshop, Phoenix, AZ, June 2019

Hosts: *Alexandru Paler, Simon Devitt, and Daniel Herr*

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

PLDI/FCRC Workshop on Approximate Computing Across the Stack, 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*

## Selected Posters

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### **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

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### **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

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### **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

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<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

## Teaching Experience

<b>Role</b>	<b>Course</b>	<b>Primary instructor</b>	<b>Term</b>
Instructor	Rutgers University 16:198:672 & 16:198:583 & 16:198:443 Quantum Computing: Programs and Systems (graduate course in quantum applications and realizations)	-	Fall 2020, Fall 2021, Fall 2022
Instructor	Rutgers University 01:198:211 Computer Architecture (undergraduate course in C, architecture, and digital logic)	-	Spring 2021, Spring 2022
Teaching assistant	Columbia University EECS 4340 Computer Hardware Design (graduate course in RTL design, validation, synthesis)	Simha Sethumadhavan	Fall 2012, Fall 2014
Teaching assistant	Columbia University CSEE 3827 Fundamentals of Computer Systems (undergraduate course in logic and architecture)	Dan Rubenstein	Fall 2010
Teaching assistant	Columbia University COMS 1007 Object Oriented Design in Java	Bert Huang	Spring 2010
Mentor	Aresty Research Assistant Program	-	2021 - 2023
Mentor	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>	Margaret Martonosi	Summer 2019
Mentor	Undergraduate thesis mentor for Lois Dzebissov	Margaret Martonosi	Fall 2018
Mentor	Undergraduate research project mentor for Lusa Zhan	Simha Sethumadhavan	Fall 2016
Mentor	Masters research project mentor for Mingrui Liu	Simha Sethumadhavan	Spring 2015
Mentor	Masters research project mentor for Kenneth Harvey	Simha Sethumadhavan	Spring 2015

## Academic Service

<b>Role</b>	<b>Venue</b>	<b>Years</b>
PC	IEEE International Symposium on High Performance Computer Architecture (HPCA)	2021, 2022, 2023
PC	IEEE/ACM International Symposium on Microarchitecture (MICRO)	2020, 2021, 2022
PC	IEEE International Conference on Quantum Computing and Engineering	2021, 2022
PC	International Workshop on Quantum Software Engineering	2022
PC	Brookhaven National Laboratory New York Scientific Data Summit	2020
PC	Programming Languages and Quantum Computing workshop at POPL/PLDI	2020, 2021
ERC	ACM/IEEE International Symposium on Computer Architecture (ISCA)	2019, 2020, 2022
ERC	ACM International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS)	2019, 2020, 2021
ERC	IEEE/ACM International Symposium on Microarchitecture (MICRO)	2019
Reviewer	ACM Transactions on Quantum Computing (TQC)	2020
Reviewer	IEEE International Conference on Rebooting Computing (ICRC)	2020
Reviewer	IEEE Transactions on Circuits and Systems-I	2018, 2019, 2020
Reviewer	IEEE Computer Architecture Letters	2019
Reviewer	IEEE International Symposium on High Performance Computer Architecture (HPCA)	2015, 2019
Reviewer	IEEE Micro Magazine	2017, 2018, 2021
Reviewer	Columbia University Computer Science M.S. program admissions	2014
Registration chair	ACM/SIGARCH International Conference on Supercomputing (ICS)	2021
Session chair	IEEE International Symposium on High Performance Computer Architecture (HPCA)	2021
Session chair	IEEE/ACM International Symposium on Microarchitecture (MICRO)	2020
Dissertation committee	Mohammadreza Soltaniyeh, Rutgers University	Jul. 12, 2022
Examiner	Qualifier exam, Fei Hua, Rutgers University	Oct. 13, 2021
Examiner	Qualifier exam, Anastasios Stathopoulos, Rutgers University	April 23, 2021
Examiner	Qualifier exam, Shuchang Liu, Rutgers University	Nov. 24, 2020

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## Science Education Outreach, Leadership, and Professional Memberships

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Organization	Role	Years
Undergrad Architecture Mentoring (uArch) Workshop	Panelist	2022
Summer Science Program (high school astrophysics summer program)	Admissions committee	2019, 2020, 2021, 2022
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 the 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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## Professional Experience

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<b>Sendyne</b> Research Intern	New York, NY Summer 2017
<ul style="list-style-type: none"><li>Developed novel stochastic application-specific integrated circuit for financial modeling applications</li></ul>	
<b>Allegory Labs, LLC</b> Founder & Principal Investigator	New York, NY Nov. 2015–May 2017
<ul style="list-style-type: none"><li>Founded IP-backed startup via \$100K Small Business Technology Transfer federal government contract</li><li>Collaborated with university subcontractor to research new class of analog continuous-time numerical methods</li><li>Identified and assessed commercial potential in modern scientific computation applications</li><li>Communicated with DARPA in-person and in response to request for information, phase I, and phase II proposals</li></ul>	
<b>Boeing</b> Information Technology Career Foundation Program Participant	Seattle, WA June 2011–July 2012
<ul style="list-style-type: none"><li>Built MPI interface to parallelize computational fluid dynamics and engineering geometry applications</li></ul>	
<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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## 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