Sai Ganesh Swaminathan

PhD Student
Human-Computer Interaction Institute
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RESEARCH MISSION

The key idea of ubiquitous computing is that as computers get miniaturized and powerful, they can be applied cheaply to digitize the physical infrastructure such as rooms, buildings, bridges, structures, neighborhoods, and cities into cyberspace. Unfortunately, this vision is not entirely realized due to the **end of Moore's law and Dennard scaling**. As a result, our devices remain power-hungry, are not seamlessly integrated, and continue to be manufactured using yesterday's design ideas and technology. We need to rethink how computing devices are manufactured.

My research introduces **computational material devices** that are manufactured to be power-savvy, deployable at a large scale, **are made with the typical materials (concrete, wood, etc.)** we see in our built environment. These computational material devices enable **low-power, integrated sensing, and actuation with the networked physical infrastructure (buildings, structures, bridges, etc.) in our built environment**. This effort is a highly interdisciplinary endeavor spanning collaborators from ECE, CEE, ME across institutions.

Topics: *Human-Computer Interaction, Ubiquitous Computing, Computational Material Devices, Cyber-Physical Human Systems, Cyber-Manufacturing, Advanced Manufacturing*

EDUCATION

Carnegie Mellon University, Pittsburgh, PA USA
Ph.D. in Human-Computer Interaction
School of Computer Science Expected May 2022

Dissertation: *Interactive Computational Materials for the Networked Built Environment* GPA: 3.94/4.0
Advisor: Scott Hudson
Committee: Lining Yao (CMU HCII), Mayank Goel (CMU HCII), Gregory Abowd (Northeastern, ECE), Haeyoung Noh (Stanford, CEE)

Technische Universität Berlin, BB, Germany

Université Paris-Sud Xi, Paris, France
Dual Degree, Masters in Human-Computer Interaction and Design Dec 2014

Thesis: *LineSpace: Repurposing 3D printers as output devices for blind and visually impaired users*
Advisor: Stefanie Mueller and Patrick Baudisch

SASTRA University, TN, India
B.Tech., Computer Science & Engineering July 2012

ETH Zürich, Zurich, Switzerland
Visiting Student at Department of Computer Science 2011

EMPLOYMENT

SUMMER 2019 **Oakridge National Lab, Oak Ridge, US**
– Advanced short term research opportunity (ASTRO) Intern, Manufacturing Science Group,
– Material Science and Technology Division
– Worked with *Dr. Vlastimil Kunc, Dr. Lonnie Love and Dr. Pooran Joshi*

Investigated the development of electronics embedded in large-area (16′ x 8′) thermoset 3D printed polymer objects. These manufactured objects are multifunctional such that they self-monitor cure shrinkage in thermoset polymers leveraging a novel embedded, cheap, battery-free RF sensors that are remotely monitored.

FALL 2016 TO DATE **Carnegie Mellon University, Pittsburgh, US**
Graduate Researcher, Human-Computer Interaction Institute
Worked with Prof. Scott Hudson (advisor), Prof. Jeff Bigham, Prof. Patrick Carrington, Prof. Carmel Majidi (ME) and Prof. Hae Young Noh (CEE)

2015 TO 2016 **Microsoft Research, Bangalore, India**
Research Fellow, Technology for Emerging Markets group
Worked with Dr. Bill Thies (mentor), Dr. Indrani Thies and Dr. Ed Cutrell

FALL 2014 **Hasso Plattner Institut, Berlin, Germany**
Research Intern, Human-Computer Interaction group
Worked with Dr. Patrick Baudisch and Dr. Stefanie Mueller

SUMMER 2014 **Xerox Research Europe Centre, Grenoble, France**
Research Intern, Work Practice Technology group
Worked with Dr. Ben Hanrahan and Dr. David Martin

SUMMER 2014 **INRIA, Paris, France**
Research Intern, Analysis and Visualization (Aviz) research group
Worked with Dr. Pierre Dragicevic, Dr. Yvonne Jansen, and Dr. Jean-Daniel Fekete.

AWARDS AND FELLOWSHIP

- Selected for the CMU NSF I-Corps entrepreneurship program, 2020 ($2,500).
- Best Paper Honorable Mention Award, CSCW (2019), Awarded to top 5% of the paper submitted.
- W4A 2017 Best Paper Nomination Apr 2017
- Scholarship from Hasso Plattner Institut for completing masters thesis, 2015 ($6000)
- Numerous travel support awards from research organizations – INRIA, HPI, etc. to attend conferences and present research.
- European Institute of Technology (EIT) Excellence Nominee includes a stipend, tuition fee waiver, and travel support for graduate school, 2012-2014 ($30,000).
- Desh-Videsh scholarship and travel far for study abroad awarded ($1700).
- Scholarship awarded by Global information systems group, for research at ETH Zürich ($6,000)

PUBLICATIONS

Under Review

[19] Yu Jiang, Zhipeng Li, Abdelkareem Bedri, Steve Hodges, Sai Ganesh Swaminathan, Scott E Hudson. A Low-Cost Surface Acoustic Wave Sensor for Classifying Biomaterials and Other Ubicomp Applications. Under Review at *ACM Conference on Interactive, Mobile, Wearable and Ubiquitous Tech-nologies (UbiComp 2022)*

[18] Dingtian Zhang, Canek Fuentes-Hernandez, Raaghesh Vijayan, Yang Zhang, Yunzhi Li, Jung Wook Park, Yiyang Wang, Yuhui Zhao, Youngwook Do, Tingyu Cheng, Nivedita Arora, Ali Mirzazadeh, **Saiganesh Swaminathan**, Trisha Andrew, Thad Starner, Gregory D Abowd. Flexible Computational Photodetectors for Self-Powered Activity Sensing. Under Review at *Nature partner journal Flexible Electronics*

Peer-reviewed Journal and Conference Publications

[17] Tingyu Cheng, Bu Li, Yang Zhang, Yunzhi Li, Charles Ramey, Eui Min Jung, Yepu Cui, Youngwook Do, **Saiganesh Swaminathan**, Manos Tentzeris, Gregory D. Abowd, HyunJoo Oh Duco: Autonomous Large-Scale Direct-Circuit-Writing (DCW) on Vertical Everyday Surfaces Using A Scalable Hanging Plotter. *In Proceedings of ACM Conference on Interactive, Mobile, Wearable and Ubiquitous Technologies (UbiComp 2021).*

[16] **Saiganesh Swaminathan**, Yellina Yim, Scott E. Hudson, Cynthia L. Bennett, Patrick Carrington. From Tactile to NavTile: Opportunities and Challenges with Multi-Modal Feedback for Guiding Surfaces during Non-Visual Navigation.*In Proceedings of the 34th Annual ACM Conference on Human Factors in Computing Systems (CHI 2021), Tokyo, Japan*

[15] **Saiganesh Swaminathan**, Jonathon Fagert, Michael L. Rivera, Andrew Cao, Gierad Laput, Hae Young Noh, Scott E. Hudson: OptiStructures: Fabrication of Room-Scale Interactive Structures with Embedded Fiber Bragg Grating Optical Sensors and Displays. *In Proceedings of the ACM Conference on Interactive, Mobile, Wearable and Ubiquitous Technologies (UbiComp 2020). Cancun, Mexico* **Accepted on initial submission (top 4%)**

[14] **Saiganesh Swaminathan**, Kadri Bugra Ozutemiz, Carmel Majidi, Scott E. Hudson. FiberPrint: 3D Printing Mechanically Strong, Lightweight Carbon-Fiber Composite Devices with Embedded Electronic Function. *In Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (CHI 2019), Glasgow, United Kingdom*

[13] **Saiganesh Swaminathan**, Mike Rivera, Runchang Kang, Zheng Luo, Kadri Bugra Ozutemiz, Scott E Hudson. Input, Output and Construction Methods for Custom Fabrication of Room-Scale Deployable Pneumatic Structures. *In Proceedings of the ACM Conference on Interactive, Mobile, Wearable and Ubiquitous Technologies (UbiComp 2019). London, United Kingdom*

[12] **Saiganesh Swaminathan**, Indrani Medhi Thies, Devansh Mehta, Ed Cutrell, Amit Sharma, and Bill Thies. Learn2Earn: Using Mobile Airtime Incentives to Bolster Public Awareness Campaigns *In Proceedings of the ACM Human-Computer Interaction (CSCW 2019), Austin, United States.*
Best Paper Honorable Mention Award, Top 5%

[11] **Saiganesh Swaminathan**, Raymond Fok, Fanglin Chen, Ting-Hao Kenneth Huang, Irene Lin, Rohan Jadvani, Walter S. Lasecki, and Jeffrey P. Bigham. WearMail: On-the-Go Access to Information in Your Email with a Privacy-Preserving Human Computation Workflow. *In Proceedings of the 30th Annual ACM Conference on User Interface Software and Technology (UIST 2017), Montreal, Canada.*:

[10] **Saiganesh Swaminathan**, Kotaro Hara, and Jeffrey P. Bigham. The Crowd Work Accessibility Problem *In Proceedings of the 14th Annual ACM International Web for All Conference (W4A '17), Perth, Australia.*
Best Paper Nomination

[9] **Saiganesh Swaminathan**, Thijs Roumen, Robert Kovacs, David Stangl, Stefanie Mueller, and Patrick Baudisch. Linespace: A Sensemaking Platform for the Blind. *In Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (CHI 2016), San Jose, United States.*

[8] Benjamin V. Hanrahan, Jutta K. Willamowski, **Saiganesh Swaminathan**, David B. Martin. TurkBench: Rendering the Market for Turkers *In Proceedings of the 32nd Annual ACM Conference on Human Factors in Computing Systems (CHI 2015), Seoul, South Korea.*

[7] **Saiganesh Swaminathan**, Conglei Shi, Yvonne Jansen, Pierre Dragicevic, Lora Oehlberg, Jean-Daniel Fekete. Supporting The Design and Fabrication of Physical Visualizations. *In Proceedings of the 31st Annual ACM Conference on Human Factors in Computing Systems (CHI 2014), Toronto, Canada.*

Posters, Demos, Extended Abstracts (Peer Reviewed)

[6] **Saiganesh Swaminathan**, Bill Thies, Amit Sharma, Devansh Mehta, Alok Sharma. Learn2Earn: Enabling Mass Awareness through Financial Incentives. In adjunct Proceedings of 10th International Conference of Information and Communication Technologies on Development 2019, Jan 2019
.

[5] Ting-Hao Kenneth Huang and Joseph Chee Chang and **Saiganesh Swaminathan** and Jeffrey P. Bigham. Evorus: A Crowd-powered Conversational Assistant That Automates Itself Over Time. *In Adjunct Proceedings of the 30th Annual ACM Conference on User Interface Software and Technology (UIST 2017), Montreal, Canada.*

[4] **Saiganesh Swaminathan**, Conglei Shi, Yvonne Jansen, Pierre Dragicevic, Lora Oehlberg, Jean-Daniel Fekete. Creating Physical Visualizations With MakerVis. Interactivity Demo at CHI'14. *In Proc. of CHI'14 EA*: ACM, pages 543-546, April 2014.

Workshop Proceedings (Lightly Peer Reviewed)

[3] **Saiganesh Swaminathan**, Scott Hudson and Steve Hodges Using Surface Acoustic Wave Devices for Self-powered Sensing & Interaction. In the Workshop on self-powered sustainable interfaces and interactions at the 34th ACM CHI, 2020.

[2] **Saiganesh Swaminathan**, Stephanie Valencia, Patrick Carrington. An Approach to Last Meter Problem: Designing and Deploying Low-Cost, Custom Fabricated Interactive Tactile Tiles for Navigation and Spatial Awareness. In the Hacking Blind Navigation Workshop at the 33rd ACM CHI, 2019.

[1] **Saiganesh Swaminathan**, Ting-Hao K. Huang, Irene Lin, Anhong Guo, Gierad Laput, and Jeffrey P. Bigham. (2017) Epistemo: A Crowd-Powered Conversational Search Interface. In the Talking with Conversational Agents in Collaborative Action Workshop at the 20th ACM CSCW, Feb 2017.

PATENTS

- **Saiganesh Swaminathan**, Jonathan Fagert, Scott Hudson, Haeyoung Noh, Michael Rivera, Gierad Laput, Andrew Cao. System and Method for OptiStructures: Fabrication of Room-Scale Interactive Structures with Embedded Fiber Bragg Grating Optical Sensors and Displays. U.S. Patent Application. Filed November 14, 2020.
- **Saiganaesh Swaminathan**, Scott Hudson, Carmel Majidi and Kadri B. Ozutemiz. System and Method for 3D printed Continuous Carbon Fiber Composite Objects with Embedded Circuitry and Sensors. Filed January 29, 2020.

GRANTS

- Manufacturing PA Innovation Program
  Project: "Enabling Functional Conductive Elements Embedded inside Composites"
  Amount: $70000, Status: Under Review
  Duration: 12 months
  Role: Assisted preparation with Prof. Scott Hudson
- CMU summer undergraduate research funding (SURF):
  Project: "Using Surface Acoustic Wave Devices for Self-powered Sensing & Interaction."
  Recipient: Yu Jiang
  Amount: $3500, Status: Awarded
  Duration: 3 months
  Role: Wrote proposal for the undergraduate student directly working with me and co-advised with Prof. Scott Hudson
- CMU summer undergraduate research funding (SURF) proposal:
  Project: "Navtiles: Making tactile guidance surfaces more accessing through printed electronics."
  Recipient: Nali Hyunh
  Amount: $3500, Status: Awarded
  Duration: 3 months
  Role: Wrote proposal for the undergraduate student directly working with me and co-advised with Prof. Patrick Carrington
- CMU summer undergraduate research funding (SURF):
  Project: "Fabricating Interactive output devices with Magnetorheological fluids"
  Recipient: Shiva Peri
  Amount: $3500. Status: Awarded
  Duration: 3 months
  Role: Wrote proposal for the undergraduate student directly working with me and co-advised with Prof. Scott Hudson

TEACHING EXPERIENCE

Head Teaching Assistant, Carnegie Mellon University

- **HCII 05391: Designing Human-Centered Systems** **Spring 2021**
  School of Computer Science, Carnegie Mellon University
  - Managed and mentored other Teaching Assistants.
  - Facilitated proctoring and grading of exams.

Teaching Assistant, Carnegie Mellon University

- **HCII (05-431 / 05-631) Programming User Interfaces** **Fall 2019**
  School of Computer Science, Carnegie Mellon University

– Co-Instructor – weekly Recitation of course where I was responsible for giving weekly lectures, designing assignments, and providing direct feedback to 20-30 students.

Guest Lecturer

- "Interfaces for Blind and Visually Impaired Users" Future Interactive Technologies, Hasso Plattner Institut Fall 2015

Teaching Development

- **Future Faculty Program, Eberly Center Teaching Excellence and Education Innovation, Carnegie Mellon University** **Summer 2021**
  - Attended Workshop on Teaching Inclusively: Centering DEI in Course Design
    Focused on addressing DEI issues through teaching and exploring the role of teaching.
  - Attended Workshop Designing Effective Assessments: Multiple-Choice Questions, Explored best design assessments for capturing student's understanding.

Student Mentoring

Remote peer-mentoring

- Tingyu Cheng - Ph.D. Human-Centered Computing, Georgia Tech, *Computational Materials for the Built Environment*

Direct Student Mentoring

* Denotes co-authors on research papers

[19] Tim Neumann - B.S Computer Science, Hasso Plattner Institut, Germany

[18] David Stangl* - B.S Computer Science, Hasso Plattner Institut, Germany

[17] Raymond Fok* - B.S. Computer Science, University of Michigan, Currently PhD student at UW

[16] Rohan Jadvani* - B.S. Computer Science, Currently Software Engineer at Iron Fish

[15] Sanjana Pruthi - B.S Computer Science, Currently Senior at Carnegie Mellon University

[14] Yu Jiang - B.S Computer Science, currently at MS in HCI at Georgia tech.

[13] Nali Hyunh - B.S Computer Science, Carnegie Mellon University, currently rising Junior.

[12] Shreya Bahl - B.S Computer Science, Carnegie Mellon University, currently rising Junior.

[11] Shiva Peri - B.S. Computer Science and Art, Carnegie Mellon University, currently a sophomore.

[10] Andrew Cao* - B.S Civil and Environmental Engineering, Currently at Amtrak

[9] Emily Wu - B.S. Mechanical Engineering at Carnegie Mellon University, currently UX designer at Exxon.

[8] Elena Deng - B.S Design, currently UX designer at Amazon

[7] Yellina Yim* - B.S Psychology, Currently at Delloite

[6] Irene Lin* - B.S Electrical and Computer Engineering, Carnegie Mellon University

[5] Amal Jafrani - B.S in Architecture, Carnegie Mellon University

[4] Simran Jobaputra, M.S. in HCI, Carnegie Mellon University, currently senior Product Designer at Sight Machine

[3] Runchang Kang* - M.S Architecture, Currently at Apple as a hardware engineer

[2] Zheng Luo* - M.S. in Computational Design in School of Architecture, Currently at Amazon as a software engineer

[1] Wei Wei Chi - M.S. in Computational Design in School of Architecture, Currently PhD student at the University of Maryland.

ACADEMIC SERVICE & MENTORING

Program Committee

- ACM MUM 2021
- Associate Chair Late-Breaking Work ACM CHI 2021
- Associate Chair Late-Breaking Work ACM CHI 2020

Organizing Committee

- Registration Chair, UIST 2021
- Registration Chair, UIST 2020

Session Chair

- Designing the Things in IoT, ACM CHI 2019

Conference & Journal Reviewing

- Special Recognition for Outstanding Review, ACM CHI 2021
- IMWUT/UbiComp 2021
- TEI 2021
- CHI 2015, 2016, 2019, 2020, 2021
- UIST 2018,2019, 2020, 2021
- CSCW 2020
- ISS 2018, 2019.
- SCF 2018
- TEI 2019, 2021

Department Service

- PhD Admissions Committee, Human-Computer Interaction Institute, Spring 2021
- Faculty Hiring Committee, Human-Computer Interaction Institute, Carnegie Mellon University, Spring 2020
- Elected PhD student Department Ombudsman, HCII, Carnegie Mellon University, 2019-2021
- Dean's Social Connectedness working group, School of Computer Science, Carnegie Mellon University, Fall 2020
- Crowdsourcing Lunch Co-organizer, 2016

Additional Conference Service

- Program Committee Meeting, Student Volunteer UIST 2017
- Conference Student Volunteer, UIST 2017

SELECTED INVITED TALKS

[5] "Interactive Computational Materials for the Networked Built Environment", COSMOS Seminar, Ubiquitous computing lab, Georgia Tech, Host: Prof. Gregory Abowd

[4] "Interactive Computational Materials for the Networked Built Environment", Advance Infrastructure Systems group, Civil and Environmental Engineering, CMU, Host: Prof. Matteo Pozzi

[3] "Lear2Earn: Incentivizing public awareness campaigns with mobile airtime rewards", Microsoft Research India, Host: Bill Thies

[2] "Designing Physical Visualizations", Hasso Plattner Institut, Host: Stefanie Mueller

[1] "Designing Physical Visualizations", Paris visualization meetup

SELECTED PRESS COVERAGE

- HacksterIO *Staring at the Wall for Fun* (2020)
- New Scientist, *3D-printed display lets blind people explore images by touch* (2016)
- Makezine *This Robot Prints Tactile Maps for the Blind* (2016)
- Tech. Times *3D-Printed Display Could Help Blind People Explore Maps And Images* (2016)
- 3Ders *3D printed 'Linespace' display lets blind people explore images & maps by touch* (2016)
- 3D printing from Scratch *Visually Impaired People Interact with Diagrams Through 3D Printed Linespace* (2016)

REFERENCES

Scott Hudson
Professor
Human-Computer Interaction Institute
School of Computer Science
Carnegie Mellon University

Gregory Abowd
Dean of the College of Engineering, Office of the Dean
Professor, Electrical and Computer Engineering
Northeastern University

Patrick Carrington
Assistant Professor
Human-Computer Interaction Institute
School of Computer Science
Carnegie Mellon University

Carmel Majidi
Clarence H. Adamson Professor
Mechanical Engineering
Carnegie Mellon University

Haeyoung Noh
Associate Professor
School of Civil and Environmental Engineering
Stanford University

Thad Starner
Professor and Staff research scientist at Google
College of Computing
Georgia Institute of Technology

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