

# S. Sandra Bae

ATLAS Institute  
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## RESEARCH INTEREST

My research spans across human-computer interaction (HCI), data visualization, and computational fabrication. My research focuses on developing systematic toolkits for interactive physicalizations and exploring how tangible interactions can help people understand complex ideas when analyzing data in its physical form.

**Keywords:** Human-Computer Interaction, Data Visualization, Computational Fabrication, Tangible Interactions

*Last Updated (July 2024)*

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## EDUCATION

- |                |   |
|----------------|---|
| 2020 - PRESENT | <b>University of Colorado, Boulder</b><br><i>Ph.D. in Creative Technology &amp; Design</i><br>Advisor: Ellen Do, Danielle Szafir, & Michael Rivera   ACME Lab, VisuaLab, & Utility Lab                |
| 2018 - 2020    | <b>University of California, Davis</b><br><i>M.S. in Computer Science</i><br>A Visual Analytics Approach to Debugging Cooperative, Multi-Robot Systems' Worldviews<br>Advisor: Kwan-Liu Ma   ViDi Lab |
| 2014 - 2018    | <b>University of California, Davis</b><br><i>B.A. in Human-Computer Interaction</i><br><i>Minor in Education</i>  |

## RESEARCH EXPERIENCE

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|---------------------------|---|
| WINTER 2024 - PRESENT     | <b>National Renewable Energy Lab (NREL)   Golden, CO</b><br><i>Graduate Research Assistant</i><br>Research with Kenny Gruchalla and Kristi Potter.<br>Analytical decision-making for developing wind blades using trajectories in high-dimensional spaces.                                |
| FALL 2020 - PRESENT       | <b>University of Colorado, Boulder   Boulder, CO</b><br><i>Graduate Research Assistant &amp; Teaching Assistant</i><br>Research with Danielle Szafir, Ellen Do, and Michael Rivera.<br>Teaching assistant for Daniel Leithinger, Laura Devendorf in ATLAS.                                |
| SUMMER 2020               | <b>Stanford University   Palo Alto, CA (Remote)</b><br><i>HCI Research Intern</i><br>Research with James Landay and Elizabeth Murnane.<br>Identifying and building family-centered, in-car technology to support collaborative learning.  |
| SUMMER 2019 - SUMMER 2020 | <b>NASA Jet Propulsion Lab   Pasadena, CA</b><br><i>University Researcher</i><br>Research with Federico Rossi, Scott Davidoff, and Joshua Vander Hook.<br>Working as a NASA JPL Master's Thesis Fellow to expand Summer 2019's project.   |
| SUMMER 2019               | <b>NASA Jet Propulsion Lab   Pasadena, CA</b><br><i>Data Visualization / HCI Research Intern</i><br>Research with Hillary Mushkin, Santiago Lambledya, Maggie Hendrie, Scott Davidoff.<br>Developed a visual analytics systems to analyze scheduling coordination for multi-robot systems |

SUMMER 2019 -  
SPRING 2020

University of California, Davis | Davis, CA

Undergraduate / Graduate Student Research Assistant & Teaching Assistant

Research with Kwan-Liu Ma.

Teaching assistant for Kwan-Liu Ma, Hao-Chuan Wang, and Nina Amenta in Computer Science.

## REFEREED PUBLICATIONS

### CONDITIONAL ACCEPTANCE

- 1 R. Sorenson-Graff, S. S. Bae, and J. Wirfs-Brock. "Integrating Annotations for Sonifications and Physicalizations". In: St. Pete Beach, Florida, 2024, *Submitted to Proceedings of the IEEE VIS 2024*.

### JOURNAL ARTICLES

- 1 S. S. Bae, T. Fujiwara, A. Ynnerman, E. Y.-L. Do, M. Rivera, and D. A. Szafrir. "A Computational Design Pipeline to Fabricate Sensing Network Physicalizations". In: *IEEE Transactions on Visualization and Computer Graphics (also proc. IEEE VIS 2023)*. Melbourne, Australia, 2023, Acceptance rate: 24.7% (133/539)  
\* **Best Paper Honorable Mention (Top 5%)**.
- 2 S. S. Bae, R. Vanukuru, R. Yang, P. Gyory, R. Zhou, E. Y.-L. Do, and D. A. Szafrir. "Cultivating Visualization Literacy for Children Through Curiosity and Play". In: *IEEE Transactions on Visualization and Computer Graphics (also proc. IEEE VIS 2022)*. 2022, Acceptance rate: 26.5% (122/460).
- 3 R. Woollands, F. Rossi, T. S. Vaquero, M. S. Net, S. S. Bae, V. Bickel, and J. V. Hook. "Maximizing Dust Devil Follow-Up Observations on Mars Using Cubesats and On-board Scheduling". In: *Journal of Astronautical Sciences*. 2022.

### CONFERENCE ARTICLES

- 1 P. Gyory, S. S. Bae, R. Yang, E. Y.-L. Do, and C. Zheng. "Marking Material Interactions with Computer Vision". In: *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*. Hamburg, Germany, 2023, Acceptance rate: 28.39% (880/3182).
- 2 M. Rivera, S. S. Bae, and S. Hudson. "Exploring Spent Coffee Grounds as a Sustainable Material for Prototyping with 3D Printing". In: *Proceedings of the 2023 on Designing Interactive Systems Conference*. Pittsburg, PA, USA, 2023, Acceptance rate: 24.1% (174/726).
- 3 S. S. Bae, D. A. Szafrir, and E. Y.-L. Do. "Exploring the Benefits and Challenges of Data Physicalization". In: *Proceedings of the Fourth European Tangible Interaction Studio (ETIS' 22)*. 2022, Acceptance rate: 88% (5/17).
- 4 S. S. Bae, C. Zheng, M. E. West, E. Y.-L. Do, S. Huron, and D. A. Szafrir. "Making Data Tangible: A Cross-disciplinary Design Space for Data Physicalization". In: *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems*. New Orleans, Louisiana, 2022, Acceptance rate: 23% (4590/19964).
- 5 S. S. Bae, F. Rossi, J. V. Hook, S. Davidoff, and K.-L. Ma. "A Visual Analytics Approach to Debugging Cooperative, Autonomous Multi-Robot Systems' Worldviews". In: *Proceedings of the IEEE Visual Analytics Science and Technology (VAST) 2020*. Salt Lake City, Utah (Virtual), 2020, Acceptance rate: 24.8% (52/210).
- 6 S. S. Bae\*, O.-H. Kwon\*, S. Chandrasegaran, and K.-L. Ma. "Spinneret: Aiding Creative Ideation through Non-Obvious Concept Associations". In: *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. Honolulu, Hawaii (Virtual), 2020, (\*equally contributed), Acceptance rate: 24.31% (760/3126).

### POSTERS & DEMOS

- 1 S. S. Bae, T. Fujiwara, D. A. Szafrir, E. Y.-L. Do, and M. L. Rivera. "3D printed multi-point capacitive touch sensor". In: *Symposium on Computational Fabrication*. SCF '24. Aarhus, Denmark: Association for Computing Machinery, 2024.
- 2 E. Johnson, S. S. Bae, and E. Y.-L. Do. "Supporting Data Visualization Literacy through Embodied Interactions". In: *Proceedings of the Fifteenth International Conference on Creativity & Cognition (C&C '22)*. Gathertown (Remote): Association for Computing Machinery, 2023.

- 3 S. S. Bae. "Towards a Deeper Understanding of Data and Materiality". In: *Proceedings of the Fourteenth International Conference on Creativity & Cognition (C&C '22)*. Venice, Italy: Association for Computing Machinery, 2022.
- 4 S. S. Bae, R. Yang, P. Gyory, J. Uhr, D. A. Szafir, and E. Y.-L. Do. "Touching Information with DIY Paper Charts & AR Markers". In: *Interaction Design and Children*. IDC '21. Athens, Greece (Virtual): Association for Computing Machinery, 2021, Acceptance rate: 27% (136/501).
- 5 S. S. Bae\* and M. E. West\*. "Cyborg Crafts: Second SKIN (Soft Keen INteraction)". In: *Proceedings of the Fifteenth International Conference on Tangible, Embedded, and Embodied Interaction (TEI '21)*. Salzburg, Austria (Virtual): Association for Computing Machinery, 2021, (\*equally contributed).

## TECH REPORTS

- 1 R. Woollands, F. Rossi, T. S. Vaquero, M. S. Net, S. S. Bae, V. Bickel, and J. V. Hook. "Maximizing Dust Devil Follow-Up Observations on Mars Using Cubesats and On-board Scheduling". In: *Proceedings of the 43rd Annual AAS Guidance & Control Conference, Breckenridge, CO*. 2021.

## BOOK CHAPTERS

- 1 T. Hopkins, S. S. Bae, J. Uhr, C. Zheng, A. Bani, and E. Y.-L. Do. "User Interfaces in Smart Cities". In: *Handbook of Smart Cities*. Ed. by J. C. Augusto. Springer International Publishing, 2021.

## FUNDING (Total \$561K)

\*co-authored to funded grants

Human-Computer Interaction Techniques for Large-Scale Data Analysis\*

Amount: \$231,000

Agency: Alliance Partner University Program (APUP) with National Renewable Energy Laboratory (NREL)

Principal Investigator: Michael Rivera, CU Boulder

Co-Principal Investigator: Kenny Gruchulla, NREL

Duration: Jan 2024 - May 2026

Supporting Explainable AI for Future Analysts with Interactive Physicalizations\*

Amount: \$30,000

Agency: CU Boulder Seed Grant (Engineering Education and AI-Augmented IRT)

Principal Investigator: Michael Rivera, CU Boulder

Co-Principal Investigator: Ellen Do, CU Boulder

External Co-Principal Investigator: Danielle Albers Szafir, UNC-Chapel Hill

Duration: Sept 2023 - Dec 2023

EAGER: Home-Based DIY Interactive Information Physicalization for Young Children and their Parents\*

Amount: \$300,000

Agency: National Science Foundation

Principal Investigator: Ellen Do, CU Boulder

Co-Principal Investigator: Danielle Albers Szafir, CU Boulder

Duration: Oct 2020 - Sep 2022

## PATENTS

### NON-PROVISIONAL PATENT APPLICATION

Bae, S. S, Fujiwara, T., Rivera, M., Szafir, D.A., Do., E.Y.D (2023). Systems and Methods for Touching Sensing Based on Resistor-Capacitor Delays. *U.S. Patent Application 63/497,594*, filed April 21, 2023. Pending non-provisional patent application.

## TALKS

*All first-author conference papers listed above were also given as presentations at their respective conferences and are not listed again in this section.*

### INVITED GUEST LECTURER

**Expanding your Interactive Toolkit: Computer Vision Markers and 3D Printed Capacitive Sensors**

Georgia Tech, *Prototyping Interactive Systems*, November 7, 2023 (hosted by Hyunjoo Oh)

**Using Computational Fabrication for Data Physicalization**

UNC-Chapel Hill, *Information Professionals in the Makerspace*, October 17, 2023 (hosted by Maggie Melo)

**Computational Fabrication for Electronics**

CU Boulder, *Computational Fabrication*, October 16, 2023 (hosted by Michael Rivera)

**The Value of Design: Empowering Humans through Human-Centered Thinking**

CU Boulder, *Information Visualization*, March 18, 2021 (hosted by Danielle Szafir)

**The Value of Design: Empowering Humans through Human-Centered Thinking**

UC Davis, *Android Development*, January 14, 2021 (hosted by Nina Amenta)

### INVITED TALKS

**Pushing Visualizations Beyond the Desktop with Everyday Devices and Novel Interfaces**

University of Iowa, November 17, 2023 (hosted by Juan Pablo Hourcade)

**Pushing Visualizations Beyond the Desktop with Everyday Devices and Novel Interfaces**

Emory University, November 8, 2023 (hosted by Emily Wall)

**Pushing Visualizations Beyond the Desktop with Everyday Devices and Novel Interfaces**

Georgia Tech, November 8, 2023 (hosted by Yalong Yang)

**Using Network Science to Reimagine Everyday Objects as Future Computers**

TTI Vanguard, September 13, 2023 (hosted by Nancy Kleinrock)

**Towards “Best of Both Worlds”: Bridging Digital and Physical Representations in Visualization Research**

Linköping University, January 9, 2023 (hosted by Miriah Meyer)

**Debugging Multi-Robot Autonomous System Anomalies**

CU Boulder ATLAS Seminar, October 6, 2020 (hosted by Ellen Do)

**Debugging Multi-Robot Autonomous System Anomalies**

NASA-JPL, August 27, 2020 (hosted by Scott Davidoff)

## TEACHING AND MENTORING

### TEACHING EXPERIENCE

*\* indicates the instructor of the course*

Term	Institute	Subject Title	Role	Enrolled	Evals
SUMMER 2024	MIT	Web Development (Brave Behind Bars <sup>1</sup> )	Teaching assistance	54	No
SPRING 2022	CU Boulder	ATLAS3300: Object (Physical Computing)	Teaching assistance Laura Devendorf*	37	No

<sup>1</sup>Brave Behind Bars is a college-accredited introductory computer science and career-readiness program for incarcerated people.  
<https://bravebehindbars.org/>

SPRING 2021	CU Boulder	ATLAS3300: Object (Physical Computing)	Teaching assistance Daniel Leithinger*	36	No
SPRING 2020	UC Davis	ECS162: Web Programming	Teaching assistance Nina Amenta*	122	Yes
WINTER 2020	UC Davis	ECS164: Intro to Human- Computer Interaction	Teaching assistance Hao-Chuan Wang*	59	Yes
WINTER 2019	UC Davis	ECS164: Intro to Human- Computer Interaction	Teaching assistance Hao-Chuan Wang*	63	Yes
SUMMER 2018	UC Davis	ECS163: Information Visualization	Teaching assistance Kwan-Liu Ma*	23	No

## MENTORING

Name	Degree	Project Description	Year
Ada Zhao	M.S. in CTD (CU Boulder)	Capacitive Sensing VR Controller	2024
Carson Kohlbrenner	B.S. in Aerospace Engineering (CU Boulder)	Robotic Skin	2023- 2024
Noah Liska	B.S. in Computer Science (CU Boulder)	Robotic Skin	2023- 2024
Caleb Kumar	B.S. in Computer Science (CU Boulder)	Robotic Skin	2023- 2024
Rhys Sorenson-Graff	B.A. in Computer Science (Whitman College)	Annotation Methods for Physicalizations and Sonifications	2023- 2024
Eloise Yalovitser	B.F.A. in Design and Technology (Parson School of Design)	Fabricating multi-touch capacitive sensors	2023
Antonio (Zhixing) Li	B.S. in Mech. Engineering (CU Boulder)	CU Boulder SPUR (Sustainable Nudging)	2023
Elise Johnson	B.S. in Mech. Engineering (CU Boulder)	Discovery Learning Apprenticeship (EAGER project)	2022
Vy Thai	B.S. in Comp. Science (Stanford University)	Design probes for family-centered, in-car technology	2020
Ashleigh Thomas	M.S. in Comp. Science (UC Davis)	N/A (Graduate mentor through CS department)	2019
Lovpret Kaur	B.S. in Comp. Science (UC Davis)	N/A (Undergraduate mentor through UC Davis' Women in Computer Science (WiCS))	2019

## ACADEMIC SERVICE

### Program Committee

ACM Creativity & Cognition 2021

ACM Tangible and Embedded Interaction (TEI) 2024

### Organizing Committee

IEEE VIS 2022, 2024 BELIV Workshop (Social Media and Web Chair)

### Invited Conference Reviewer

ACM Symposium on User Interface Software and Technology (UIST) 2021

ACM Interaction Design and Children (IDC) 2023

ACM Designing Interactive Systems (DIS) 2021–2024

ACM Conference on Human Factors in Computing Systems (CHI) 2021–2024

ACM Tangible and Embedded Interaction (TEI) 2022–2024

ACM Creative & Cognition (CC) 2021–2022

EG/VGTC EuroVis 2022

NordicCHI 2024

SIGGRAPH Asia 2024

### Invited Journal Reviewer

IEEE Transactions on Visualization and Computer Graphics (TVCG) 2022–2024

International Journal of Child-Computer Interaction 2022

Behaviour & Information Technology 2023

IS&T Journal of Perceptual Imaging 2024

### Invited Book Chapter Reviewer

“Visualization Psychology” published by Springer Nature. Editors: Danielle Albers Szafir, Rita Borgo, Min Chen, Darren J. Edwards, Brian Fisher, & Lace Padilla

### Special Recognition as a Reviewer

2023 ACM Tangible and Embedded Interaction (TEI)

2023 ACM Conference on Human Factors in Computing Systems (CHI) x2

2024 ACM Conference on Human Factors in Computing Systems (CHI) x2

### Institutional Service

Ph.D. Open House Organizer 2021, ATLAS Institute, CU Boulder

Faculty Candidate Student Host 2021, 2024 ATLAS Institute, CU Boulder

Ph.D. Graduate Application Support Program Founder 2022, 2023, ATLAS Institute, CU Boulder

### Tutoring

Coding tutor, Women’s Resources and Research Center UC Davis, UC Davis (2016-2018)

## DESIGN EXHIBITIONS

2019 **Sit On Data** | Imagining America’s 20th Anniversary National Gathering

A data-driven parametric-bench where users can feel the data by sitting. Developing using Python, CNC routing, Laser cutting.

2017 **BENEATH** | SOFA Chicago 2017

An immersive installation conveying California’s land subsidence. Presented at SOFA Chicago 2017. Built motion graphics and projection using Processing.

2017 **OneClimate: Prototyping Climate Change** | Exploratorium Museum (SF)

A multisensory exhibition conveying the impact of climate change sponsored by the John Muir Institute of the Environment. Featured at the Exploratorium in San Francisco for the OneClimate event, AIGA & ISAD - San Francisco, and IA’s 2017 National Gathering. Designed the scientific narrative and constructed the exhibit using woodshop skills.

## SELECTED MEDIA COVERAGE

2023 **Yahoo Finance** | First-of-its-kind study combines common household waste product with 3D printing — here are the results

<https://finance.yahoo.com/news/first-kind-study-combines-common>

2023 **Ars Technica** | Don't throw out those used coffee grounds—use them for 3D printing instead

<https://arstechnica.com/science/2023/09/dont-throw-out-those-used-coffee-grounds-use-them-for-3d-printing-instead/>

2023 **TechBriefs** | Using Coffee to Reduce Waste from 3D Printing

<https://www.techbriefs.com/component/content/article/tb/stories/blog/49103>

2023 **Daily camera (Boulder)** | CU Boulder professor creates 3D printing paste with coffee grounds

<https://www.dailycamera.com/2023/09/20/cu-boulder-professor-creates-3d-printing-paste-with-coffee-grounds/>

2023 **CNC Kitchen (Youtube)** | 3D Printing Resistors, Fibers & Coffee - Utility Research Lab

[https://youtu.be/Oeqvo2c28\\_c](https://youtu.be/Oeqvo2c28_c)

2023 **Make Magazine** | Rocky Mountain RepRap Fest: All The Cool 3D Printing Stuff

<https://makezine.com/article/digital-fabrication/3d-printing-workshop/3d-printing-festival-loveland-colorado/>

2023 **Meltzone Podcast** | Rocky Mountain RepRap Festival & Prusa MK4

<https://youtu.be/NkgOXFn55cM?t=1041>

2023 **CU Boulder** | ATLAS Innovators Win Big at RepRap Festival

<https://www.colorado.edu/atlas/2023/05/08/atlas-innovators-win-big-reprap-festival>

2023 **CU Boulder** | New seed grants from the Engineering Education and AI-Augmented Learning research theme will support range of topics

<https://www.colorado.edu/irt/engineering-education-ai/2023/05/19/new-seed-grants-engineering-education-and-ai-augmented-learning-research-theme-will>

2021 **CU Boulder** | Sandra Bae receives ARCS and KASF scholarship

<https://www.colorado.edu/atlas/2021/09/08/sandra-bae-receives-arcs-and-kasf-scholarships>

2017 **CONNECT EXPO** | SOFA CHICAGO 2017 Exhibition

Printing Press: Chubb (pg. 10-11).

2017 **AIGA and IDSA** | Better Together Design Exhibition

Printing Press: AIGA (pg. 8-9).

2017 **UC Davis** | 'OneClimate' a Call to Arms

<https://www.ucdavis.edu/news/oneclimate-call-arms>