

S. Sandra Bae

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RESEARCH INTEREST

My research lies at the intersection where computers meet the physical world, spanning across human-computer interaction (HCI), tangible user interfaces (TUIs), data visualization, and digital fabrication. My goal is to explore how tangible interactions can help people understand complex ideas when analyzing data in its physical form.

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

EDUCATION

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

RESEARCH EXPERIENCE

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|------------------------------|---|
| FALL 2020 - PRESENT | University of Colorado, Boulder Boulder, CO <i>Graduate Research Assistant & Teaching Assistant</i> Research with Danielle Szafir, Ellen Do, and Michael Rivera. Teaching assistant for Daniel Leithinger, Laura Devendorf in ATLAS. |
| SUMMER 2020 | Stanford University Palo Alto, CA (Remote) <i>HCI Research Intern</i> Research with James Landay and Elizabeth Murnane. Identifying and building family-centered, in-car technology to support collaborative learning. |
| SUMMER 2019 - SUMMER 2020 | NASA Jet Propulsion Lab Pasadena, CA <i>University Researcher</i> Research with Federico Rossi, Scott Davidoff, and Joshua Vander Hook. Working as a NASA JPL Master's Thesis Fellow to expand Summer 2019's project with further iterations and design considerations. |
| SUMMER 2019 | NASA Jet Propulsion Lab Pasadena, CA <i>Data Visualization / HCI Research Intern</i> Research with Hillary Mushkin, Santiago Lambledya, Maggie Hendrie, Scott Davidoff. Identified JPL roboticists' visualization needs and implemented a system determined by design iterations. |
| SUMMER 2019 - SPRING 2020 | University of California, Davis Davis, CA <i>Undergraduate / Graduate Student Research Assistant & Teaching Assistant</i> 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 S. S. Bae, T. Fujiwara, A. Ynnerman, E. Do, M. Rivera, and D. Szafir. "A Computational Design Pipeline for Sensing Network Physicalizations". In: *IEEE Transactions on Visualization and Computer Graphics (also proc. IEEE VIS 2023)*. Melbourne, Australia, 2023, Acceptance rate: 25.8% (139/539).

JOURNAL ARTICLES

- 1 S. S. Bae, R. Vanukuru, R. Yang, P. Gyory, R. Zhou, E. Do, and D. Szafir. "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).
- 2 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. 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% (174/726).
- 3 S. S. Bae, D. Szafir, and E. 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. Do, S. Huron, and D. Szafir. "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 E. Johnson, S. S. Bae, and E. 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.
- 2 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.
- 3 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).
- 4 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.

AWARDS AND DISTINCTION

- 2023 Rocky Mountain RepRap Festival, Most Functional/Useful, *Sensing Networks*
- 2023 Rocky Mountain RepRap Festival, Most Innovative, *Coffee Ground Filament*
- 2023 Achievement Reward for College Scientists (\$6,500)
- 2022 Achievement Reward for College Scientists (\$7,500)
- 2022 Korean American Scholarship Foundation (\$3,000)
- 2022 David T. Spalding Graduate Teaching Fund Fellowship (\$1000)
- 2021 Korean American Scholarship Foundation (\$2,000)
- 2021 CU Boulder Travel Grant (\$500)
- 2021 Honorable Mention, IEEE World Haptics Student Design Competition
- 2021 CRA-WP Grad Cohort for Women
- 2021 Ada Lovelace Fellow, Open Hardware Summit
- 2021 Craft Award, ACM TEI Student Design Competition.
- 2021 Achievement Reward for College Scientists (\$6,500)
- 2019 Richard C. and Joy Dorf Engineering Graduate Fellowship (\$1,000)
- 2019 NASA JPL Master's Thesis Educational Fellow (\$30,000)
- 2018 NSF's Preparing Engineering Graduate Students for the 21st Century Fellow (\$10,000).
- 2018 Honorable Mention Visual Storytelling Award, IEEE Pacific Visualization Symposium.
- 2017 Beneath (CONNECT EXPO 2017) - Judge's Honorable Mention.
- 2017 UC Davis Organizational Research Expo.
- 2017 Better Together - AIGA and IDSA.

FUNDING

**co-authored to funded grants*

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

INVITED GUEST LECTURER

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

CU Boulder Information Visualization Class, Boulder, CO, 18 March 2021 (hosted by Danielle Szafrir).

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

UC Davis Android Development Class, Davis, CA, 14 January 2021 (hosted by Nina Amenta).

INVITED TALKS

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

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

Debugging Multi-Robot Autonomous System Anomalies

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

Debugging Multi-Robot Autonomous System Anomalies

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

TEACHING AND MENTORING

TEACHING EXPERIENCE

** indicates the instructor of the course*

| Term | Institute | Subject Title | Role | Enrolled | Evals |
|----------------|------------|---|---|----------|-------|
| SPRING 2022 | CU Boulder | ATLAS3300: Object | Teaching assistance Laura Devendorf* | 37 | No |
| SPRING 2021 | CU Boulder | ATLAS3300: Object | 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 |
|----------------------|--|---|------|
| 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

Organizing Committee

IEEE VIS 2022 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) 2021–2023

ACM Conference on Human Factors in Computing Systems (CHI) 2021–2023

ACM Tangible and Embedded Interaction (TEI) 2022–2023

ACM Creative & Cognition (CC) 2021–2022

EG/VGTC EuroVis 2022

Invited Journal Reviewer

IEEE Transactions on Visualization and Computer Graphics (TVCG) 2022–2023

International Journal of Child-Computer Interaction 2022

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

Institutional Service

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

Faculty Candidate Student Host 2021, 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 CNC Kitchen (Youtube) | 3D Printing Resistors, Fibers & Coffee - Utility Research Lab

https://youtu.be/Oeqvo2c28_c

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>