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Research Agenda

My research explores **embodied AI in wearable form factors**, building context-aware assistants that act proactively or share initiative with the user. Specifically, I:

- build wearable multimodal sensing systems (e.g., EIT and IMUs) to infer user and environmental states.
- formalize when and how to take initiative as a decision-making problem, with models of human behavior as priors.
- design on-body haptics (e.g., EMS and vibration) that deliver assistance decisions as physical interventions.

KEYWORDS | **Embodied AI** · **Wearables** · **Multimodal sensing** · **Mixed-initiative assistants** · **Haptics**

Education

Northwestern University | Ph.D. Student in Computer Science
GPA: 3.90/4.00 | Advisor: Jessica Hullman
Evanston, IL, USA
Sep 2025 – Present

University of Pennsylvania | M.S.E. in Robotics
GPA: 4.00/4.00 | Advisor: Mark Yim
Philadelphia, PA, USA
Sep 2023 – May 2025

Xi'an Jiaotong University | B.E. in Industrial Design
GPA: 3.86/4.30 | Advisor: Teng Han
Xi'an, Shaanxi, China
Sep 2019 – Jul 2023

Exchange: University of Pennsylvania, Fall 2021 | GPA: 3.93/4.00

Honors Thesis: Smart Textile Interfaces Integrating Touch Sensing & Electrotactile Stimulation

Publications

An asterisk (*) denotes equal contribution.

[C4] EITWatch: Smartwatch-Integrated Planar Electrical Impedance Tomography for Hand Gesture Recognition
Xuanyou Liu*, Novel Alam*, Karan Ahuja
ACM Symposium on User Interface Software and Technology (UIST), 2026. | Open hardware | DOI

[C3] MARIO: Motion-Augmented Real-Time Multi-Sensor Inertial Odometry
Yiquan Li*, Taeyoung Yeon*, Chenfeng Gao, Vasco Xu, **Xuanyou Liu**, Karan Ahuja
Findings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR Findings), 2026. | DOI

[C2] Seeing with the Hands: A Sensory Substitution That Supports Manual Interactions
Shan-Yuan Teng*, Gene S-H Kim*, **Xuanyou Liu***, Pedro Lopes
ACM Conference on Human Factors in Computing Systems (CHI), 2025. | Open hardware | DOI

[C1] TacTex: A Textile Interface with Seamlessly-Integrated Electrodes for High-Resolution Electrotactile Stimulation
Hongnan Lin, **Xuanyou Liu**, Shengsheng Jiang, Qi Wang, Ye Tao, Guanyun Wang, Wei Sun, Teng Han, Feng Tian
ACM Conference on Human Factors in Computing Systems (CHI), 2024. | DOI

Manuscripts & Submissions

[C5] Learning Checklists to Reduce Lottery Effects in Scientific Peer Review

Xuanyou Liu, Ziyang Guo, Jason Hartline, Jessica Hullman

In submission to the International Conference on Learning Representations (ICLR), 2027. Full version of [W1]. | arXiv:2610.28666

[R1] Decision and Support Mechanisms under Platform Information Overload

Tingyu Dai*, **Xuanyou Liu***

*Team SocioLogic. Research report, **Oral presentation**, AI Social Scientist Research Challenge, Tsinghua University, 2026.*

Workshops & Demonstrations

[W1] Learning Automated Checklists to Reduce Lottery Effects in Scientific Peer Review

***Best Paper Honorable Mention**, **Oral presentation**, NeurIPS 2026 Workshop on AI-Native Academia, 2026*

[D2] EITWatch: Smartwatch-Integrated Planar EIT for Hand Gesture Recognition

Interactive demonstration, ACM Symposium on User Interface Software and Technology (UIST), 2026

[D1] Seeing with the Hands: A Sensory Substitution That Supports Manual Interactions

Interactive demonstration, ACM Conference on Human Factors in Computing Systems (CHI), 2025

Research Experience

Epistemic Decision Lab, Northwestern University | Graduate Researcher *May 2026 – Present*

Advisor: Jessica Hullman · Topics: Peer review, decision-making

- Built an LLM-assisted pipeline that learns review checklists from past peer-review data to reduce reviewer-lottery variance *(NeurIPS 2026 workshop oral, Best Paper Honorable Mention; ICLR 2027, under review)*.
- Formalized checklist learning as maximizing expected correlated agreement (ECA).
- Cut simulated committee error by 58% (NeurIPS) and 21% (ICLR), and ranking error from 0.48 to 0.22 with 20 people.

SPICE Lab, Northwestern University | Graduate Researcher *Sep 2025 – May 2026*

Advisor: Karan Ahuja · Topics: Wearable sensing, on-body tracking

- Built the analog front end, 6-layer PCB, and ESP32-S3 firmware for *EITWatch (UIST 2026)*, a smartwatch planar-EIT system recognizing hand gestures camera-free at 92.5% / 91.5% accuracy on macro / micro gestures.
- Designed the multimodal AR glasses and sensor rig for *MARIO (CVPR 2026 Findings)*, a camera-free tracking system that cuts inertial-odometry drift by up to 42% using a learned pose prior with auxiliary sensors.

HC-Integration Lab, University of Chicago | Visiting Researcher *May 2024 – Sep 2024*

Advisor: Pedro Lopes · Topics: Wearable haptics, sensory substitution

- Built the 5×6 flexible-PCB electrotactile system and real-time mapping pipeline for *Seeing with the Hands (CHI 2025)*, rendering a hand-perspective image onto the back of the hand as haptic stimulation for complex manual tasks.
- Co-ran a study with sighted and blind or low-vision participants: hand and head perspectives performed comparably in manipulation tasks, and participants preferred the hand's flexibility for more ergonomic grasping.

ModLab, University of Pennsylvania | Graduate Researcher *Nov 2023 – May 2024*

Advisor: Mark Yim · Topics: Compliant mechanisms, modular robots

- Ran the finite-element analysis for a compliant spherical joint that lets a *Variable Topology Truss (VTT)* disconnect members without collapsing mid-reconfiguration; the design was published at *ReMAR 2024 (not an author)*.

ISCAS, Chinese Academy of Sciences | Research Assistant *Sep 2022 – Sep 2023*

Advisor: Teng Han · Topics: Smart textile, electrotactile stimulation

- Co-designed the textile electrode structure and high-voltage driving circuit for electrotactile stimulation in *TacTex (CHI 2024)*, a 512×512 electrotactile and touch-sensing textile at 2 mm pitch.
- Evaluated TacTex with 12 participants: 78.1% balanced accuracy for sensation, 87.9% for static patterns, 74.9% for dynamic patterns.

Invited Talks

- **EIT for Hand Sensing** | HCI Open House, University of Michigan; hosted by Ke Sun *2026*
- **Embodied AI in Wearables** | Computer-Enabled Abilities Lab, Columbia University; hosted by Brian Smith *2026*
- **AI with Complementarity** | HCI Seminar, UIUC; hosted by Craig Shultz *2026*
- **Multimodal Body Tracking** | Perceptual Engineering Lab, MIT; hosted by Jas Brooks *2026*
- **Sensing the Hand from the Wrist** | HC-Integration Lab, University of Chicago; hosted by Pedro Lopes *2026*
- **Beyond Screens** | TIDAL Lab, Northwestern University; hosted by Michael Horn *2025*
- **From Industrial Design to HCI** | XJTU–POLIMI Joint School; hosted by Hongwei Li *2024*

Awards & Fellowships

- **Best Paper Honorable Mention** | NeurIPS 2026 Workshop on AI-Native Academia *2026*
- **Conference Travel Grants** | TGS and Computer Science Dept., Northwestern University *2026*
- **TGS First-Year Fellowship** | The Graduate School, Northwestern University *2025*
- **GAPSA Professional Student Travel Award** | University of Pennsylvania *2024*
- **Outstanding Graduate** | Xi'an Jiaotong University *2023*
- **Outstanding Student Leader** | Xi'an Jiaotong University *2023*
- **Dean's List** | Xi'an Jiaotong University, all 8 semesters *2020 – 2023*
- **Most Innovative Design Award** | RCA-Imperial Design for Global Challenges Competition *2021*

Teaching & Academic Service

- **GradMAPS Mentor** | The Graduate School, Northwestern University *2026 – Present*
- **Reviewer** | ACM CHI (Human Factors in Computing Systems) *2027*
- **Reviewer** | ACM IUI (Intelligent User Interfaces) *2027*
- **Reviewer** | ACM IMWUT (Interactive, Mobile, Wearable and Ubiquitous Technologies) *2026*
- **Teaching Assistant** | ESE5190 Smart Devices (graduate), University of Pennsylvania *2024*
- **Code Instructor** | Python & Arduino for middle-school students, Fife-Penn CS Academy *2024*

Research Mentoring

- **Novel Alam** | Northwestern University | Now: Firmware engineer at SpaceX *2025 – 2026*
- **Zhuohao Chen** | Purdue University | Now: Ph.D. student in CS at University of British Columbia *2025 – 2026*
- **Ruoyan Liu** | Chinese Academy of Sciences | Now: Research assistant at Tsinghua University *2023 – 2024*

Outreach

- **Science Communicator** | Public HCI writing on LinkedIn and RedNote; 5,000+ followers *2019 – Present*
- **Volunteer & Fundraiser** | United Nations Children's Fund (UNICEF) *2020 – 2025*
- **Student Volunteer** | Xi'an Jiaotong University *2019 – 2023*
- **Student Representative** | ILO Global Youth Forum, International Labour Organization *2021*

Selected Press

- **Northwestern Now** | Smartwatch tech from Northwestern's SPICE Lab could help control prosthetic hands *2026*
- **Hackster.io** | Smartwatches Can Now Read Your Hand Gestures *2026*
- **CNX Software** | EITWatch open-source ESP32-S3 smartwatch implements planar EIT *2026*
- **Machine Learning @ UChicago** | Hands-On Vision: How a Wrist Camera Can Expand the World for All Users *2025*
- **Hackaday** | Sensory Substitution Device Tingles Back of Your Hand *2025*
- **GIGAZINE** | A wearable device that allows you to see things with your hands is developed *2025*

Industry Experience

Chinese Mechanical Engineering Society | **Web Engineering Intern** *Sep 2022 – Jul 2023*

Supervisor: Hongwei Li

- Maintained the society's website day to day, including regular content updates.
- Optimized the website's front end and back end to improve SEO, raising monthly visits by 23%.

Luxottica Tristar (Dongguan) Optical | **Design and R&D Intern** *Jul 2020 – Sep 2021*

Supervisor: Jiming Chen

- Contributed to the Smart-Waxing Line automation project at the company's component factory, which went live.
- Optimized the production line's PLC ladder-logic programs in STEP 7-Micro/WIN, cutting the false-alarm rate by 60%.

Skills

Programming	Python, C/C++, MATLAB
ML / Vision	PyTorch, TensorFlow, NumPy, pandas, OpenCV
Embedded Systems	ESP32, STM32, Arduino, FreeRTOS
Electronics / CAD	Altium Designer, KiCad, Fusion 360, SolidWorks
XR / Tracking	Unity, Meta Quest, HTC Vive, OptiTrack
Development Tools	Git, Jupyter, CMake, LaTeX
Languages	Mandarin (native), English (proficient), Cantonese (fluent)

References

Jessica Hullman | Ginni Rometty Professor of Computer Science

Northwestern University | Current advisor, Epistemic Decision Lab | jhullman@northwestern.edu

Karan Ahuja | Lisa Wissner-Slivka and Benjamin Slivka Assistant Professor of Computer Science

Northwestern University | Research advisor, Sep 2025 to May 2026 | kahuja@northwestern.edu

Pedro Lopes | Associate Professor, Computer Science

University of Chicago | Research advisor, May 2024 to Sep 2024 | pedrolopes@uchicago.edu

Nicholas McGill-Gardner | Senior Lecturer, Electrical and Systems Engineering

University of Pennsylvania | Independent study advisor | nmcgill@seas.upenn.edu

Teng Han | Professor, Institute of Software

Chinese Academy of Sciences | Research advisor, Sep 2022 to Sep 2023 | hanteng@iscas.ac.cn