# XIAOJIAN (JASON) SUN

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## RESEARCH INTERESTS

My research focuses on human-centered multimodal AI—systems that listen as carefully as they compute. I develop (1) LLM-integrated assistive tools that provide empathetic, context-aware support across cultural and cognitive diversity, and (2) expert-augmented AI systems that embed domain reasoning into foundation models to enhance real-world decision-making. Across applications in sports analytics, surgical robotics, and embodied intelligence, my goal is to build AI that learns not only from human data, but with human reasoning—interpreting expertise, culture, and comfort as intrinsic parts of intelligence.

## EDUCATION

**Johns Hopkins University** — Baltimore, MD
*Master of Science in Engineering, Robotics* — *Expected: May 2026*

**University of California, Berkeley** — Berkeley, CA
*B.A. Computer Science (Honors), B.A. Economics, B.A. Music* — *Aug. 2020 - May 2024*

## RESEARCH EXPERIENCE

**JHU Center for Language and Speech Processing (CLSP)** — Baltimore, MD
*Graduate Research Assistant | Advisors: Dr. Kenton Murray, Prof. Ziang Xiao* — *Apr. 2025 - Present*

- Led coding, inference, and evaluation infrastructure investigating **multilingual cultural alignment** in vision-language models for contested topics where pluralistic narratives exist. Examined how prompt language resource level, native versus foreign cultural perspectives, and model characteristics (training regime, scale, multilinguality) affect cultural alignment in text-to-image generation. Developed systematic pipelines to quantify cultural bias across model families, assessing whether models respect diverse perspectives or default to dominant cultural viewpoints.

**JHU Sports Analytics Research Group (SARG)** — Baltimore, MD
*Research Lead | Advisor: Prof. Anton Dahbura* — *Aug. 2024 - Present*

- In partnership with an NFL pro football team and RotoWire, directed development of an on-premise LLM agentic system combining **RAG and text-to-SQL** for NFL decision support, processing 40,000+ RotoWire articles covering 2,000 prospects. The system automates information retrieval while preserving analyst judgment for strategic decisions, validated against professional ground truth from NFL team scouting department. **[1]**
- Developed BatVision, a smartphone-based computer vision system for the Baltimore Orioles that transforms how teams analyze baseball equipment. Built a single-camera pipeline that achieves 0.148mm accuracy (99.8% within ±0.5mm) while running **180× faster** and collecting **50× more data** than traditional methods, making professional-grade equipment analysis accessible to coaches and players through their phones. Featured in CBS News, ABC News, NY Times Podcast, JHU Hub. **[2]**
- Developing computer vision system for ski resort safety operations in partnership with local resorts and major ski resort company, on track for pilot deployment to augment lift operators through automated incident detection. Engineered multi-person pose tracking pipeline using **BoT-SORT with per-person MediaPipe estimators**, achieving **95% tracking accuracy** in challenging snow conditions through CLAHE preprocessing and adaptive bounding box padding strategies. System designed to **reduce staffing requirements by 33%** while maintaining human supervisory control, with potential to save $20M+ annually across North American ski industry. Secured JHU Whiting School Design Center funding.

**JHU Sensing, Manipulation, and Real-Time Systems Lab (SMARTS)** — Baltimore, MD
*Graduate Research Assistant | Advisors: Prof. Peter Kazanzides, Dr. Adnan Munawar* — *Jan. 2025 - Present*

- Conducted controlled human-subject experiments (8 participants, 72 trials each) on **da Vinci Research Kit (DVRK)** characterizing sensorimotor constraints in surgical teleoperation across MSFs 0.5-2.0. Discovered that operators achieve only **29.1% of expected velocity adjustments**, following universal bimodal patterns ($\alpha$=0.446±0.08) with adaptation converging within 2.8±0.9 seconds across all participants in experimental trials.
- Determined that motion scaling explains **47.6% of performance variance** ($\eta_p^2$=0.476, p<0.001), with trajectory discontinuities inducing 77% velocity reductions independent of scaling factor. Findings provide foundations for designing intelligent teleoperation systems that adapt to human sensorimotor capabilities and compensate for incomplete human adaptation. **[3]**

**JHU Intuitive Computing Lab** — Baltimore, MD
*Graduate Research Assistant | Advisor: Prof. Chien-Ming Huang* — *Jan. 2025 - Present*

- Developed **GUIDES (Guidance Using Instructor-Distilled Embeddings)**, a framework that transfers human knowledge to robot policies through VLM guidance and demonstration learning. The system grounds a VLM "Instructor" in human demonstrations while an LLM "Reflector" maintains transparency, achieving +**33.8% improvement for trans-**

formers and **+106% for diffusion policies**. [4]

- Led investigation of LLM-based voice-controlled home robot failures for elderly populations requiring voice interfaces for independent living. Identified **11 failure modes** across two critical layers: ASR layer where speech-to-text accuracy degrades with elderly voices, and understanding layer where LLMs misinterpret correctly transcribed elderly speech patterns.
- Designed **IRB-approved experimental benchmark** that evaluates out-of-the-box systems on natural elderly speech to validate failure modes and establish first standardized framework measuring deployment readiness of voice-enabled assistive robots.

**UC Berkeley Artificial Intelligence Research Lab (BAIR)** Berkeley, CA
*Undergraduate Research Assistant | Advisors: Prof. S. Shankar Sastry, Prof. Somil Bansal (USC)* *Apr. 2023 - Jan. 2024*

- Integrated end-to-end learning-based perception with model-based planning for autonomous navigation, implementing **CNN perception module with DAgger** and temporal frame stacking to learn from expert demonstrations. Prototyped Learning-Based Waypoint Navigation with visual SLAM, bridging learned human demonstrations with structured planning methods for robust navigation.
- Demonstrated how leveraging human expertise enables autonomous systems to acquire generalizable navigation capabilities with improved sample efficiency, validating hybrid learning-planning approach across novel environments through systematic experimental evaluation and performance benchmarking.

**UC Berkeley Biomimetic Millisystems Lab** Berkeley, CA
*Undergraduate Research Assistant | Advisor: Prof. Ronald S. Fearing* *Apr. 2023 - May 2024*

- Developed multi-agent collaborative system for legged millirobots to integrate computer vision with **model-predictive control and model-based RL** for autonomous navigation and cooperative manipulation. Enabled 2-3 robots to coordinate on towing and pushing tasks through real-time feedback control, using MPPI for precise multi-robot coordination and task execution.
- Achieved **4cm positioning error with only 9 training samples (15 minutes)**, demonstrating **100x sample efficiency improvement** over actor-critic and meta-RL baselines through model-based approaches that leverage structured priors and physical constraints rather than pure data-driven learning.

**UC Berkeley Center for New Music and Audio Technologies (CNMAT)** Berkeley, CA
*Research Assistant | Advisor: Prof. Edmund Campion* *Aug. 2023 - Dec. 2023*

- Pioneered audio-conditioned video generation pipeline using **Stable Diffusion** with music feature extraction, for synchronized audio-visual content. Presented work at live Berkeley concert, demonstrating real-time creative collaboration between human composers and generative AI systems for live performance.
- Designed **LSTM-RNN** for Traditional Irish music generation, achieving **90% rhythmic accuracy**, with controllable temperature and length parameters. Explored how AI can provide meaningful creative control while maintaining cultural authenticity and stylistic coherence in generated musical outputs.

# INDUSTRY EXPERIENCE

**Baltimore Ravens** Baltimore, MD
*LLM Research Intern | Department of R&D* *Aug. 2025 - Present*

- Engineered **LLM-powered prospect intelligence system** processing 15,000+ player profiles and 50,000+ articles to automate information synthesis for NFL scouting operations, enabling scouts to focus on talent evaluation rather than data gathering and aggregation. System adapts to organizational priorities through user feedback, **reducing research time by 90%** while maintaining decision quality.
- Developed automated scout report and analytical report generation pipeline that preserves expert voice while eliminating documentation overhead. Deployed system across scouting and analytics departments, **increasing player evaluation capacity by 40%** and freeing personnel to focus on strategic football decisions and talent assessment.

**DecentraML** Berkeley, CA
*Co-Founder & Technical Lead | Berkeley SkyDeck Batch 16* *Jan. 2023 - Dec. 2023*

- Co-founded privacy-preserving federated learning platform through Berkeley SkyDeck Batch 16, enabling **50+ enterprises** to train models on **10K+ edge devices** without centralizing sensitive data. Developed distributed training infrastructure supporting **LLM fine-tuning** at edge with **3.5x faster convergence** versus centralized approaches, **reducing deployment costs by 60%** while maintaining GDPR and healthcare regulatory compliance.
- Led technical development and go-to-market strategy, securing **$100K pre-seed funding** by demonstrating how federated learning unlocks previously inaccessible enterprise data for model training. Platform positioned at intersection of LLM deployment challenges and enterprise privacy requirements, bridging technical innovation with business value proposition.

**Alibaba Group** Beijing, CN
*Software Engineer Intern | Electric Energy Team, Alibaba Cloud* *May 2021 - Jul. 2021*

- Architected Java backend infrastructure for AI-driven robotics vision platform, enabling real-time computer vision processing in industrial environments. Optimized data pipelines and refactored legacy codebase, **reducing latency by 30%,**

**increasing performance by 50%**, and improving human-robot collaboration responsiveness.
- Scaled platform from prototype to production deployment across **12 industrial facilities**, enabling operators to interact with robotic systems through intuitive visual interfaces while maintaining supervisory control over precision manufacturing tasks.

## PATENTS

**BatVision: Regression-Calibrated Single-View Computer Vision Pipeline for Precise Equipment Analysis and Quality Control**

**Xiaojian Sun**, Junlin Wu, Anton Dahbura. *Provisional Patent, Johns Hopkins University (2025).* [Patent Link]

## PUBLICATIONS & MANUSCRIPTS

**[1] From Chaos to Clarity: AI-Driven News Intelligence for NFL Front Offices**
**Xiaojian Sun\***, Siva Indukuri, Nahuel Albayrak, Joyce Chen, Kenton Murray, Anton Dahbura, Tad Berkery. *MIT SSAC 2026 (Abstract Accepted).*

**[2] BatVision: Regression-Calibrated Single-View Computer Vision Pipeline for Precise Baseball Bat Analysis and Quality Control**
Junlin Wu\*, **Xiaojian Sun\***, Anton Dahbura. *MIT SSAC 2026 (Abstract Accepted).*

**[3] Adaptive Teleoperation Motion Scaling Based on Human Performance Characterization**
**Xiaojian Sun\***, Kaichen Yu\*, Peter Kazanzides, Adnan Munawar. *ICRA 2026 (Under Review).*

**[4] GUIDES: Guidance Using Instructor-Distilled Embeddings for Robot Policy Enhancement**
Minquan Gao\*, Xinyi Li\*, Qing Yan\*, **Xiaojian Sun**, Xiaopan Zhang, Jiachen Li, Chien-Ming Huang. *Accepted by IROS 2025 Workshop WIR-M.*

## SELECTED MEDIA COVERAGE

**CBS News Baltimore**, "Johns Hopkins, Orioles Partner on AI Bat Analysis," 2025.
**ABC News (WMAR-2)**, "Johns Hopkins Student Researchers Partner with Orioles to Analyze Bats with AI," 2025.
**The New York Times Podcast**, "Is Hitting Catching Up to Pitching?" *The Athletic Baseball Show*, 2025.
**Johns Hopkins Hub**, "Baltimore Orioles Tap Johns Hopkins Students for Bat Design Analysis," 2025.

## TALKS & PRESENTATIONS

**Beyond the Field: Revolutionizing Football News Analytics with a Multi-Stage NLP Pipeline Integrating RAG and TEXT2SQL** — April 2025
*Mid-Atlantic Student Colloquium on Speech, Language and Learning (MASC-SLL)*
Penn State University

**Baltimore Orioles Baseball Bat Size Estimation Using Computer Vision** — March 2025
*Mid-Atlantic Research Exchange (MATRX)*
Johns Hopkins University

## HONORS & AWARDS

**Student Initiatives Fund (Dean's Initiative Fund)** — 2025
*Johns Hopkins University*

## TEACHING EXPERIENCE

**Structure and Interpretation of Computer Programs (CS 61A)** — UC Berkeley
*Course Staff* — *Jan. 2022 - May 2022*

**Data Structures (CS 61B)** — UC Berkeley
*Course Staff* — *Jan. 2022 - May 2022*

**Discrete Math & Probability Theory (CS 70)** — UC Berkeley
*Course Staff* — *Jan. 2022 - Aug. 2022*

## SERVICE

**Reviewer:** ACL 2025, AAAI 2026, ICRA 2026

## TECHNICAL SKILLS

**ML & AI:** PyTorch, TensorFlow, Langchain, LlamaIndex, vLLM, Scikit-Learn, Transformers, Diffusion Models
**CV & Robotics:** OpenCV, ROS, CARLA, SUMO, OpenCDA, Trajectron
**Programming & Systems:** Python, C++, C, CUDA, MATLAB, Java, SQL, Bash, RISC-V, Max MSP, Strudel
**Data Science & Tools:** Pandas, Numpy, Matplotlib, Git, Docker, Kubernetes, Linux, Raspberry Pi, Arduino