Lu Niu

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I am a fifth-year PhD student in Computer Science at the University of Notre Dame specializing in computer vision, machine learning, and signal processing. I have extensive experience building deep learning systems for large-scale video datasets, with applications in physiological sensing, biometric security, and trustworthy AI systems. My research also explores integrating physiological signals with blockchain-based mechanisms for secure, verifiable, and tamper-resistant biometric representation. I am passionate about applying advanced ML research and AI techniques to real-world, large-scale video understanding, recommendation, and ranking systems that serve billions of users.

EDUCATION

Ph.D. *in Computer Science and Engineering*   August 2021 - December 2026 (expected)
University of Notre Dame - Computer Vision Research Lab   Notre Dame, Indiana, USA
Advisor: Dr. Patrick Flynn

M.S. *in Applied Data Science*   May 2021
University of Southern California (USC)   Los Angeles, California, USA

M.S. *in Industrial & Systems Engineering*   December 2016
University of Southern California (USC)   Los Angeles, California, USA

B.S. *in Engineering Management*   June 2014
Beijing University of Posts and Telecommunications (BUPT)   Beijing, China

TECHNICAL SKILLS

- Programming & ML: Python, PyTorch, TensorFlow, OpenCV, Pandas, Transformer, NumPy, Scipy, CNN, Time-Series Modeling, Recommendation Systems, LLM, Supervised & Unsupervised Learning
- Signal Processing & Health Sensing: rPPG Extraction, Bandpass Filtering, HRV Analysis, Multi-Sensor Fusion, Motion Artifact Removal
- Data & Infrastructure: Apache Spark, Hadoop, Docker, Git, Linux
- Workflow: Model deployment, data pipeline design, large-scale dataset curation

PROFESSIONAL EXPERIENCES

PhD Research Intern   May 2024 - August 2024
Dolby Laboratories   Sunnyvale, California, USA

- Fine-tuned Large Language Models (**LLMs**) and integrated multiple large language/vision models for Artificial Intelligence Generated Content (**AIGC**) research.
- This work has led to a patent application currently under review, with a related publication in preparation.

Graduate Research Assistant   August 2021 - Current
University of Notre Dame   Notre Dame, Indiana, USA

- Research in remote vitals estimation using **deep learning** and **signal processing**.
- **Collected a large-scale video dataset** with simultaneous recordings of physiological signals.
- Led ML research on large-scale video datasets for signal and pattern extraction; developed deep neural network pipelines to improve prediction accuracy and runtime efficiency for real-time biometric sensing.

Graduate Research Intern   May 2020 - August 2021
Information Sciences Institute, USC   Remote (Marina del Rey, California, USA)

- **Created Breast Cancer Clinical Trial Dataset** by extracting data from published papers and clinicaltrials.gov, and developed a structured and quantitative approach for systematically comparing trials based on trial stages.

- Built a **Knowledge Graph** based on the dataset, facilitating decision support for clinicians and implemented **SPARQL** queries on the Knowledge Graph using Apache Fuseki to enable advanced querying and analysis.

PUBLICATIONS

1. **Lu Niu**, Jeremy Speth, Nathan Vance, Benjamin Sporrer, Adam Czajka, Patrick Flynn, "Full-Body Cardiovascular Sensing with Remote Photoplethysmography," *in Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshop (CVPRW) on Computer Vision for Physiological Monitoring (CVPM)*, 2023 **(Best Paper Award)**

2. Jeremy Speth, Nathan Vance, Benjamin Sporrer, **Lu Niu**, Patrick Flynn, Adam Czajka, "Hallucinated Heartbeats: Anomaly-Aware Remote Pulse Estimation," *The 16th International Joint Conference on Biomedical Engineering Systems and Technologies: BIOSIGNALS*, ISBN 978-989-758-631-6, pp. 106-117, 2023 **(shortlisted for best student paper award)**

3. Jeremy Speth, Nathan Vance, **Lu Niu**, Benjamin Sporrer, Adam Czajka, Patrick Flynn, "Mspm: A multi-site physiological monitoring dataset for remote pulse, respiration, and blood pressure estimation" *IEEE Transactions on Instrumentation and Measurement, 2024*

4. **Lu Niu**, Patrick Flynn, "BARS: A Blockchain-Anchored System for rPPG-Based Biometric Verification",(submitted to ICBC)

5. **Lu Niu**, Benjamin Sporrer, Adam Czajka, Patrick Flynn, "Spoof detection Using Remote Photoplethysmography (rPPG) Signals",(under preparation for Face Recognition)

6. **Lu Niu**, Patrick Flynn, "Can the Ear Hear the Heart?: A Comparative Study of Ear vs Face rPPG Signals.",(under preparation for CVPR)

7. **Lu Niu**, Patrick Flynn, "Twin rPPG: Hard-Impostor Representation Learning for Robust Physiological Biometrics",(under preparation for ECCV)

PATENT APPLICATIONS

- Jeremy Speth, Nathan Carpenter, Nathan Vance, **Lu Niu**, Siamul Khan, Adam Czajka, Patrick Flynn. "LIVENESS DETECTION", United States Patent Application 20240334008

- Jeremy Speth, Patrick Flynn, Adam Czajka, Benjamin Sporrer, **Lu Niu**, Nathan Carpenter, Leandro Olie, "Trustworthy Anomaly-Aware Remote Pulse Estimation," U.S. Patent Application No. 63/388,984, 2022.

RESEARCH PRESENTATIONS

- *Midwest Computer Vision Workshop*   September 2024, Bloomington, Indiana
  Presented current research on spoof detection through windshield using rPPG signals from polarimetric videos.

- *The Sixth International Workshop on Computer Vision for Physiological Measurement (CVPM) in junction of CVPR 2023*   June 2023, Vancouver, Canada
  Presented *Full-Body Cardiovascular Sensing with Remote Photoplethysmography (rPPG)* . Introduced newly collected large-scale dataset and baseline analysis using signal processing and deep learning methods to estimate pulse rate and pulse transit time from multiple body parts from video. **(best paper award)**

REVIEWS

- IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)
- IEEE/CVF Winter Conference on Applications of Computer Vision (WACV)
- IEEE International Conference on Data Mining (ICDM)
- IEEE MultiMedia
- European Conference on Information Systems (ECIS)