# Chenshu Liu

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## Research Interests

I am interested in fostering healthcare ecosystems that combine **artificial intelligence**, **human-machine interaction**, and **wearable technologies** that empower people's health autonomy, involving the following research topics:

- **Descriptive**: Conduct continuous and unobtrusive health status monitoring and interpretation using advanced wearable technologies, telecommunications, and multimodal AI.
- **Empathic**: Develop affective AI systems that can perceive human emotion, provide patient-centric decision support, and dynamically respond to the conscious needs of individuals.
- **Interpretive**: Enhance the reliability of AI-driven decision support systems by mitigating hallucination through integrating domain-specific knowledge graphs (KG) and retrieval-augmented generation (RAG) architectures.

## Education

**MS** **University of California, Los Angeles**, Bioengineering — Sept 2022 – Dec 2023

- **Coursework:** Computational Medical Imaging, Signal Processing, Database Management and Security, Knowledge Representation and Inference

**BS** **University of California, Los Angeles**, Dual major in Statistics and Neuroscience — Sept 2018 – March 2022

- **Coursework:** Linear Models, Data Mining, Optimization, Monte Carlo Methods, Computational Statistics and Consulting, Neuroanatomy, Cell and Systems Neuroscience, Molecular and Developmental Neuroscience, Behavioral and Cognitive Neuroscience, Neurophysiology, Neurophysics

## Publications

### 2024

**Chenshu Liu**, Pinyi Yang, Tong Zhou, Haolin Fan, Lingdi Zhao, Yiran Wang, Yangzhi Zhu, Bingbing Li. Democratizing Healthcare: The Synergy of Electronic Skin and Multidomain AI. *ACS Chemical Reviews* (**submitted**)

**Chenshu Liu**, Hyo-Jeong Choi, Chenguang Zhang, Pengrui Dang, Wangjie Chen, Yongju Lee, Bingbing Li, Meyer Dawn, Pete Kollbaum, Hyeok Kim, Ali Khademhosseini, Yangzhi Zhu. OPTMISE: Ocular Platform with Telemetric Mechano-Electro-Chromic Intelligent Sensing Ecosystem. *Nature Biomedical Engineering* (**under review**). github: github.com/OPTMISE

Haolin Fan, **Chenshu Liu**, Shijie Bian, Changyu Ma, Xuan Liu, Marshall Doyle, Thomas Lu, Lianyi Chen, Jerry Ying Hsi Fuh, Wen Feng Lu, Bingbing Li (2024). New Era Towards Autonomous Additive Manufacturing: A Review of Recent Trends and Future Perspectives. *International Journal of Extreme Manufacturing* (**accepted for publication**)

Haolin Fan, **Chenshu Liu**, Neville Elieh Janvisloo, Shijie Bian, Jerry Ying Hsi Fuh, Wen Feng Lu, Bingbing Li. MaViLa: Unlocking New Potentials in Smart Manufacturing through Vision Language Models. *Journal of Manufacturing Systems* (**under review**)

**Chenshu Liu***, Songbin Ben, Chongwen Liu, Xianchao Li, Qingxia Meng, Yilin Hao, Qian Jiao, Pinyi Yang (2024). Web-based diagnostic platform for microorganism-induced deterioration on paper-based cultural relics with iterative training from human feedback. *Heritage Science*, 12(1), 148, doi: 10.1186/s40494-024-01267-5

Yi Tang, **Chenshu Liu**, Xiang Yuan (2024). Recognition of bird species with birdsong records using machine learning methods. *Plos One*, 19(2), e0297988, doi: 10.1371/journal.pone.0297988

**Chenshu Liu***, Songbin Ben, Pinyi Yang, Jiayi Gong, Yin He (2024). A practical evaluation of online self-assisted previewing architecture on rain classroom for biochemistry lab courses. *Frontiers Education*, Vol. 9, p. 1326284, doi: 10.3389/feduc.2024.1326284

### 2023

Qingxia Meng, Xianchao Li, Junqiang Geng, **Chenshu Liu***, Songbin Ben (2023). A biological cleaning agent for removing mold stains from paper artifacts. *Heritage Science*, 11(1), 243, doi: 10.1186/s40494-023-01083-3

**Chenshu Liu**, Chongwen Liu, Allison Wall (2023). Ai-Assisted Classification of Microorganism Strains on Paper-Based Cultural Relics. *Art Bio Matters Conference* (**Oral Presentation**). Presentation abstract: artbiomatters.org/chenshu-liu

## Experience

**Terasaki Institute of Biomedical Innovation** — Los Angeles, CA
Research Intern — Dec 2022 – Present

- Supervised by Prof. Yangzhi Zhu and Prof. Chongming Jiang
- Configured triboelectric nanogenerator (TENG) -powered colorimetric sensing system in the OPTMISE lens for eyelid pressure measurement.
- Implemented real-time tracking of the colorimetric sensor on the OPTMISE lens and trained multilinear regression model to predict pressure changes according to the RGB values, achieving consistent 80%+ prediction accuracy under different ambient lighting conditions.
- Designed contact lens that delivers endogenous electric field (EF) using TENG to accelerate corneal damage restoration.
- Finetuned different BERT models, including BERTrand and ProtTrans, for immunogenicity prediction for short epitope sequences.

**CSUN Autonomy Research Center for STEAHM (ARCS)** — Los Angeles, CA
Research Intern — Dec 2022 – Present

- Supervised by Prof. Bingbing Li
- Constructed domain-specific KG and implemented RAG to enable interactive technical support in Additive Manufacturing (AM) processes.
- Designed and validated a novel vision language model (VLM) specifically for manufacturing scenarios. The model consistently outperforms other benchmark models in image captioning, reasoning, and knowledge retrieval accuracy.
- Developed recurrent neural network (RNN)-based models to identify machine states by analyzing energy consumption patterns, achieving over 85% classification accuracy in complex laboratory machine systems.
- Investigated the role of reinforcement learning (RL) in enhancing the efficiency of autonomous AM tasks.

**UCLA W.M.Keck Center for Neurophysics** — Los Angeles, CA
Research Assistant — Dec 2020 - April 2022

- Supervised by Prof. Mayank Mehta.
- Designed and developed and created virtual reality mazes (8-shape, diamond, hexagon, octagon, pentagon mazes, etc.) for rats.
- Perfected C# parsing code for Unity virtual reality creating to handle the creation of a wider variety of mazes.
- Handled and trained rats to perform tasks in virtual reality environments.

**UCLA Guo's Lab** — Los Angeles, CA
Research Assistant — Dec 2019 - June 2020

- Supervised by Prof. Zhefeng Guo
- Designed DNA primer for mutagenesis and performed sequencing analysis.
- Performed protein purification, Mutagenesis, Inoculation, DNA transformation, Expression, and Electron Paramagnetic Resonance to investigate molecular mechanics for protein aggregation in neurodegenerative diseases.

## Projects

**TangibleMIDI** github.com/TangibleMIDI

- TangibleMIDI uses hand landmarks, captured by Mediapipe, to dynamically control audio data. Specifically, the musical features, including volume, pitch, and reverb, can be changed with specific intuitive gestures. Breaking the constraint from physical musical instruments.
- Tools Used: Mediapipe (motion tracking), Librosa (audio processing)

**Posture2Melody** github.com/Posture2Melody

- Posture2Melody uses GAN-Transformer-based architecture to generate melodies from human postures. The pipeline converts the human body landmarks captured in videos to output music pieces like those that are human-composed. By synchronizing bodily movement and music, Posture2Melody seeks to develop a creative technique that could be used in self-expression during emotional therapy, with the assumption that body movements are embodiments of mental states.
- Tools Used: Pytorch (modeling), Mediapipe (body landmark extraction)

**NeuroMT** github.com/NeuroMT

- NeuroMT introduces a closed-loop theranostic device combining electromyography (EMG), to detect irregularities in muscle activation associated with neurodegenerative disorders, and Transcutaneous Electrical Nerve Stimulation (TENS) unit, to restore normal neuromuscular activity in real-time. Our approach offers a novel solution for neurodegenerative patients, potentially improving mobility, reducing symptoms, and enhancing overall quality of life.
- Tools Used: Electromyography (neuromuscular signal acquisition), Transcutaneous Electrical Nerve Stimulation (treatment delivery)

## Teaching

**LS 23L** Introduction to Laboratory and Scientific Methodology — UCLA, 2023 Fall, 2024 Winter

- Course Website: LIFESCI 23L
- Instructing three three-hour lab sessions per week for biology laboratory techniques, including using polyacrylamide gel for protein subunit analysis, agarose gel electrophoresis for DNA segment analysis, bioinformatics for genotyping, epidemiology, physiology, cell biology, etc.

## Technologies

**Programming Languages:** Python, C++, C#, JavaScript, CSS, HTML

**Machine Learning Packages:** Pytorch, NumPy/SciPy, NLTK, Open-CV, Pandas, TensorFlow, Librosa, MediaPipe

**Skills:** Arduino (prototyping), Matlab (physics simulation), Adobe Illustrator (2D graphics design), Adobe Lightroom, Adobe Dimension (3D modeling), Blender (3D modeling), LaTeX(formatting)