Los Angeles, CA
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# Zijun Cui

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## Education

**PostDoc. Computer Science**, *University of Southern California* March, 2023 - present
**Ph.D. Computer Systems Engineering**, *Rensselaer Polytechnic Institute* Dec, 2022
**M.S. Applied Mathematics**, *Rensselaer Polytechnic Institute* Dec, 2022
**M.S. Electrical Engineering and Computer Engineering**, *Brown University* May, 2017
**B.S. Modern Physics**, *University of Science and Technology of China (USTC)* May, 2015

## Research Interests

My research interests lie in ***Real-world-oriented AI+Knowledge***. The core ethos of my research is the integration of AI with domain knowledge to tackle real-world challenges across a wide spectrum of applications, with a focus on ***computer vision***. My interdisciplinary research approach yields substantial societal impacts, particularly in the realm of ***AI for Health***.

## Engineering Research Experience

**Postdoctoral Research Fellow.** Advisor: Dr. Yan Liu. March, 2023 – Present
*Melady Lab, University of Southern California* *Los Angeles, California*

- Developing sophisticated algorithms for physics-informed deep learning using causal models and physical information. Exploring their applications in time-series forecasting, urban transportation, and health applications.
- Published papers at the top medical conference MICCAI [12], the American Medical Informatics Association (AMIA) symposium [14], and the American Urological Association (AUA) [18]. Submitted papers to the top ML conference ICML [17], and one manuscript to npj Digital Medicine.

**Research Assistant.** Advisor: Dr. Qiang Ji. August, 2017 – December, 2022
*Intelligent Systems Lab, Rensselaer Polytechnic Institute* *Troy, New York*

- Developed advanced knowledge-augmented deep learning algorithms with diverse types of domain knowledge such as biomechanics and mathematical theorems, and explored their applications in computer vision tasks.
- Developed efficient and accurate learning and inference algorithms on probabilistic graphical models and explored their applications in computer vision tasks.
- Published papers at top conferences, such as CVPR [20,10,5,4], NeurIPS [3], and ECCV [9].

**Research Assistant.** Advisor: Dr. Qiang Ji. May, 2017 – December, 2019
*Data-Driven Discovery of Models, Defense Advanced Research Projects Agency*

- Developed robust structure learning algorithms through Bayesian approaches under insufficient data.
- Contributed and maintained primitives in the D3M AutoML Ecosystem.
- Published one paper at IJCAI [7].

**Research Assistant.** Advisor: Dr. Benjamin B. Kimia May, 2016 – May, 2017
*Laboratory for Engineering Man/Machine Systems, Brown University* *Providence, Rhode Island*

- Developed an effective approach for multi-frame enrichment of motion segmentation from videos.
- Completed a Master thesis titled "Multi-Frame Enrichment of Motion Segmentation".

## Physics Research Experience

**Research Student.** Supervisor: Dr. Linfan Zhu 2014 – 2015
*National Laboratory for Physical Sciences at the Microscale, USTC* *Anhui, China*

- Improved the accuracy of the ground shape factor computation of the Carbon Monoxide based on vibration wave function.
- Completed a Bachelor thesis titled "Analyze of Electron Diffraction and its Application".

**Research Student.** Supervisor: Dr. Xiaoliang Ye 2014
*Micron-nano Functional Materials Group, Department of Physics, USTC* *Anhui, China*

- Obtained the quantum dots composite probes of urchinlike gold nanoparticles and explored its biological applications.
- Won the first prize in University Student Innovative Research Program.

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## Industry Experience

**Research Collaborator** on the Google Urban Transportation project — April, 2023 – Present
*Collaborator: Carolina Osorio* — *California*

- Developed a data-efficient physics-inspired algorithm for urban transportation application
- Introduced the work in the 2nd Sustainable Urban Mobility: Simulation and Optimization Workshop
- Submitted papers to the top ML conference ICML [16]

**Visiting Research Scholar** at IBM Thomas J.Watson Research Center — January, 2019 – August, 2019
*Collaborators: Kartik Talamadupula, Pavan Kapanipathi , Tian Gao* — *Yorktown Heights, New York*

- Developed an effective knowledge-augmented deep learning algorithm for the knowledge graph completion task.
- Published one paper at AAAI [6].

## Publication

**[21] Zijun Cui**, Runzhuo Ma, Cherine H. Yang, Anand Malpani, Timothy N. Chu, Ahmed Ghazi, John W. Davis, Brian J. Miles, Clayton Lau, Yan Liu, and Andrew J. Hung.
"Capturing Relationships between Suturing Sub-skills to Improve Automatic Suturing Assessment". *npj Digital Medicine*, 2024. [Journal Publication]

[20] Yufei Zhang, Jeffrey O. Kephart, **Zijun Cui**, and Qiang Ji.
"PhysPT: Physics-aware Pretrained Transformer for Estimating Human Dynamics from Monocular Videos". *Computer Vision and Pattern Recognition Conference (CVPR)*, 2024.

**[19] Zijun Cui**, Hanjing Wang, Tian Gao, Kartik Talamadupula, and Qiang Ji.
"Theory-guided Message Passing Neural Network for Probabilistic Inference". *Conference on Artificial Intelligence and Statistics (AISTATS)*, 2024.

**[18] Zijun Cui**, Runzhuo Ma, Cherine Yang, Yan Liu, and Andrew Hung.
"Automated Surgical Skill Assessment with Skill Inter-dependencies for Robotic Suturing". *American Urological Association (AUA)*, 2024. [Podium Session]

**[17] Zijun Cui***, Sungyong Seo*, Sam Griesemer, Joshua Hikida, and Yan Liu.
"Physics-aware Causal Graph Networks: Unveiling Causality with Physics in Dynamic Systems". *International Conference on Machine Learning (ICML)*, 2024 (Under Review. *Equal Contribution).

[16] Defu Cao, **Zijun Cui**, Sam Griesemer, Carolia Osorio, and Yan Liu.
"Physics-Aware Variational Autoencoders for Urban Travel Demand Calibration". *International Conference on Machine Learning (ICML)*, 2024 (Under Review).

**[15] Zijun Cui**.
"AI+Science: Knowledge-augmented Deep Learning". *The Workshop for Women in Machine Learning (WiML)*, 2023. [Travel Funding Award]

[14] Emily Nguyen, **Zijun Cui**, Georgia Kokaraki, Joseph Carlson, and Yan Liu.
"Transferable and Interpretable Treatment Effectiveness Prediction for Ovarian Cancer via Multimodal Deep Learning". *American Medical Informatics Association (AMIA), 2023.*

[13] Yizhou Zhang, Loc Trinh, Defu Cao, **Zijun Cui**, and Yan Liu.
"Detecting Out-of-Context Multimodal Misinformation with interpretable neural-symbolic model". *arXiv preprint arXiv:2304.07633*.

[12] Loc Trinh, Tim Chu, **Zijun Cui**, Anand Malpani, Cherine Yang, Istabraq Delieh, Alvin Hui, Oscar Gomez, Yan Liu, and Andrew Hung.
"Self-supervised Sim-to-Real Kinematics Reconstruction for Video-based Assessment of Intraoperative Suturing Skills". *The 26th International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI), 2023.* [Oral Presentation]

**[11] Zijun Cui**, Tian Gao, Kartik Talamadupula, and Qiang Ji.
"Knowledge-augmented Deep Learning and its Applications: A Survey". *IEEE Transactions on Neural Networks and Learning Systems,* 2023 [Journal Publication]

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**[10] Zijun Cui**, Chenyi Kuang, Tian Gao, Kartik Talamadupula, and Qiang Ji.
"Biomechanics-guided Facial Action Unit Detection through Force Modeling". *The IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, 2023.

[9] Chenyi Kuang, **Zijun Cui**, Jeffrey Kephart, and Qiang Ji.
"AU-aware 3D Face Reconstruction through Personalized AU-specific Blendshape Learning". *European Conference on Computer Vision (ECCV)*, 2022.

**[8] Zijun Cui**, Hanjing Wang, Tian Gao, Kartik Talamadupula, and Qiang Ji.
"Variational Message Passing Neural Network for Maximum-A-Posteriori (MAP) Inference". *38th Conference on Uncertainty in Artificial Intelligence (UAI)*, 2022. [UAI Scholarshop Award]

**[7] Zijun Cui**, Naiyu Yin, Yuru Wang, and Qiang Ji.
"Empirical Bayesian Approaches for Robust Constraint-based Causal Discovery under Insufficient Data". *31st International Joint Conference on Artificial Intelligence (IJCAI)*, 2022.

**[6] Zijun Cui**, Pavan Kapanipathi, Kartik Talamadupula, Tian Gao and Qiang Ji.
"Type-augmented Relation Prediction in Knowledge Graphs". *35th AAAI Conference on Artificial Intelligence (AAAI)*, 2021.

[5] Tengfei Song, **Zijun Cui**, Yuru Wang, Wenming Zheng, and Qiang Ji.
"Dynamic Probabilistic Graph Convolution for Facial Action Unit Intensity Estimation". *IEEE International Conference on Computer Vision and Pattern Recognition (CVPR)*, 2021.

[4] Tengfei Song, **Zijun Cui**, Wenming Zheng, and Qiang Ji.
"Hybrid Message Passing with Performance-Driven Structures for Facial Action Unit Detection". *IEEE International Conference on Computer Vision and Pattern Recognition (CVPR)*, 2021.

**[3] Zijun Cui**, Tengfei Song, Yuru Wang, and Qiang Ji.
"Knowledge Augmented Deep Neural Networks for Joint Facial Expression and Action Unit Recognition". *34th Conference on Neural Information Processing Systems (NeurIPS)*, 2020.

**[2] Zijun Cui** and Qiang Ji.
"Blendshape-augmented Facial Action Units Detection". *Workshop on Differentiable Vision, Graphics, and Physics in Machine Learning at NeurIPS*, 2020.

**[1] Zijun Cui**, Yong Zhang, and Qiang Ji.
"Label Error Correction and Generation Through Label Relationships". *34th AAAI Conference on Artificial Intelligence (AAAI)*, 2020. [Highlight Presentation]

## Award

- The Workshop for Women in Machine Learning (WiML) 2023 Travel Funding — October, 2023
- Allen B. Dumont Prize, Rensselaer Polytechnic Institute — May, 2023
- Conference on Uncertainty in Artificial Intelligence (UAI) Scholarship — June, 2022
- Rensselaer-IBM Artificial Intelligence Research Collaboration Scholarship — September, 2018 - December, 2022
- The first prize in the University Student Innovative Research Program, USTC — 2014
- The third prize for the Academic Excellent Students, USTC — 2014

## Skill

| | |
|---|---|
| **Coding Language** | Python, Matlab, C/C++, R |
| **Toolbox** | OpenCV, Bayes Net Toolbox (BNT), Bnlearn, AMPL |
| **Software** | Tensorflow, PyTorch, Visual Studio, Docker, Kubernets, Mathematica, Origin, Blender |