Minkyu Choi

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AI/Computational Neuroscience Ph.D. candidate with a strong focus on machine learning, experienced in developing vision foundational models and multimodal representational learning across diverse domains, including vision/language integration and medical imaging/physiological signal analysis.

Education

University of Michigan	Ann Arbor, MI
Ph.D. Candidate in Electrical & Computer Engineering, GPA: 4.0	Jan. 2020 - April 2024

Thesis: *Harmonizing Machine and Human Vision: A Deep Learning Journey from Retina to Cortical Interpretation*

Korea Advanced Institute of Science and Technology	Daejeon, Korea
M.S. in Electrical Engineering, GPA: 3.8	Sept. 2015 - Aug. 2017
Yonsei University	Seoul, Korea
B.S. in Electrical Engineering, GPA: 3.7	Mar. 2009 - Feb. 2015

Research Experience

University of Michigan   Ann Arbor, MI
Ph.D. Candidate Researcher in AI / ML   Jan. 2020 - Present

- **Built a Vision Foundational Model for Medical Image Analysis.**
  - Enhanced the accuracy of personalized traits prediction by 22% with a foundational model designed for human fMRI/physiological signals. This model successfully predicted personalized states in over 700 patients, employing human data and utilizing Pytorch and Docker.
- **Developed a Self-supervised Multimodal Learning Model on Image and Text (published at NeurIPS).**
  - Enhanced human-alignment of NLP word representations by 18%. Optimized the NLP model to more closely mirror human understanding, achieving a significant leap towards natural language comprehension in AI systems.
  - Boosted cross-modal text/image search accuracy by 15% by grounding language representations to visual data.
- **Modeled Human Visual Systems using Deep Neural Networks (published at NeurIPS).**
  - Developed a deep learning model that enhanced neural response prediction accuracy by 30%, significantly advancing knowledge in visual processing from retina to visual cortex, applicable to neural interface.
  - Boosted human visual attention prediction accuracy in a computer vision model by 14% by integrating retinal structure analysis, leading to more accurate eye-tracking prediction for AR/VR applications.
- **Focused on developing safer and low-cost computer vision models.**
  - Improved computational efficiency of deep neural networks by 30%, reducing inference costs of ML services.
  - Enhanced the security of computer vision models by 12% through innovative neural network designs.

Samsung Research America   Mountain View, CA
Research Engineer Intern   May 2022 - Aug. 2022

- **Developed AI models for human motion and facial expression synthesis.**
  - Developed a deep generative model for human motion synthesis, achieving a 15% improvement in prediction accuracy, resulting in the production of natural human motions, indistinguishable from real human movements.
  - Reduced computational costs by 10%, for deep generative models, achieving low latency for real-time ML services.

Skills

- **AI/ML Specializations**: Machine learning, Computer vision, Natural language processing, Signal processing
- **Technical Skills**: Python, C++, Pytorch, MATLAB, Linux, Git, Docker

Selected Publications

- **Choi, M**., Zhang, Y., Han, K., Wang, X., & Liu, Z. (2024). Human Eyes Inspired Recurrent Neural Networks are More Robust Against Adversarial Noises. *Neural Computation* (In Press).
- Chen, S., **Choi, M**., Han, K., Qu, Q., & Liu, Z. (2024). Uncovering Latent Dynamics: Self-Supervised Learning of Video Representation Invariant to Temporal Differentiation (Manuscript under review).
- **Choi, M**., Han, K., Wang, X., Zhang, Y., & Liu, Z. (2023). A Dual-Stream Neural Network Explains the Functional Segregation of Dorsal and Ventral Visual Pathways in Human Brains. *Advances in Neural Information Processing Systems (__NeurIPS__)*.
- Zhang, Y., **Choi, M**., Han, K., & Liu, Z. (2021). Explainable Semantic Space by Grounding Language to Vision with Cross-Modal Contrastive Learning. *Advances in Neural Information Processing Systems (__NeurIPS__)*, 34, 18513-18526.
- Kim, J. H., Zhang, Y., Han, K., Wen, Z., **Choi, M**., & Liu, Z. (2021). Representation learning of resting state fMRI with variational autoencoder. *NeuroImage*, 241, 118423.
- **Choi, M**., & Tani, J. (2018). Predictive Coding for Dynamic Visual Processing: Development of Functional Hierarchy in a Multiple Spatiotemporal Scales RNN Model. *Neural computation,* 30(1), 237-270.
- **Choi, M**., & Tani, J. (2017). Predictive coding for dynamic vision: Development of functional hierarchy in a multiple spatio-temporal scales RNN model. In 2017 *International Joint Conference on Neural Networks* (pp. 657-664). IEEE.
- For **full publication** list: Google Scholar

Talks and Presentations

- Han, K., **Choi, M**., Wang, X., Murguia, A., & Liu, Z. (2023). Individualized representation learning of resting-state fMRI. *The International Society for Magnetic Resonance in Medicine*, Toronto.
- **Choi, M**., Han, K., Wang, X., & Liu, Z. (2023). A novel deep neural network models two streams of visual processing from retina to cortex. *Computational and Systems Neuroscience*, Montreal.
- **Choi, M**., Zhang, Y., Han, K., Wang, X., & Liu, Z. (2022). Retinal Transformation and Recurrent Attention Improve Adversarial Robustness. *Collaborative Research in Computational Neuroscience*, Atlanta.
- **Choi, M**., Hwang, J., Tani, J., & Ahmadi, A. (2017). Predictive Coding for Dynamic Visual Processing: Development of Functional Hierarchy in a Multiple Spatio-Temporal Scales RNN Model. *International Conference on Intelligent Robots and Systems (IROS)*, Vancouver.
- **Choi, M**., & Tani, J. (2017). Predictive coding for dynamic vision: Development of functional hierarchy in a multiple spatio-temporal scales RNN model. *International Joint Conference on Neural Networks*, Anchorage.

Relevant Courseworks

Computer Vision,   Machine Learning,   Reinforcement Learning,   Digital Image Processing,   Digital Signal Processing,   Engineering Random Process,   Medical Imaging Systems,   Neural Networks,   Operating Systems,   Random Variables,   Statistical Learning Theory,   Theory of Brain Function

Additional Activities

Committed donor to the United Nations High Commissioner for Refugees (UNHCR) for over a decade, actively supporting global humanitarian efforts and refugee assistance programs.