

Ce Zhang

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Education

- **Carnegie Mellon University, Pittsburgh, United States** Aug 2023 - Present
M.Sc. in Machine Learning, Machine Learning Department, School of Computer Science GPA: 3.89/4.00
Courses: Introduction to Machine Learning, Convex Optimization, Probability Graphical Models, Probability and Mathematical Statistics, Machine Learning in Practice, Intermediate Deep Learning, Independent Research.
- **Southern University of Science and Technology (SUSTech), Shenzhen, China** Aug 2019 - Jun 2023
B.Eng. in Communication Engineering (Summa Cum Laude), College of Engineering GPA: 3.91/4.00 Rank: 1/33
Selected Courses: Data Structures and Algorithm Analysis (100), Linear Algebra (100), Artificial Intelligence (96).

Selected Publications

- **Ce Zhang**, Simon Stepputtis, Katia Sycara, Yaqi Xie. Dual Prototype Evolving for Test-Time Generalization of Vision-Language Models. Submitted to *Conference on Neural Information Processing Systems (NeurIPS)*, 2024.
- **Ce Zhang**, Simon Stepputtis, Katia Sycara, Yaqi Xie. Enhancing Vision-Language Few-Shot Adaptation with Negative Learning. Submitted to *Conference on Neural Information Processing Systems (NeurIPS)*, 2024. Also presented at *ICLR 2024 Workshop on Mathematical and Empirical Understanding of Foundation Models*. [PDF] [Code]
- **Ce Zhang**, Zifu Wan, Simon Stepputtis, Katia Sycara, Yaqi Xie. Spectral-Aware Global Fusion for RGB-Thermal Semantic Segmentation. Submitted to *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2024.
- **Ce Zhang**, Simon Stepputtis, Joseph Campbell, Katia Sycara, Yaqi Xie. HiKER-SGG: Hierarchical Knowledge Enhanced Robust Scene Graph Generation. In *IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, 2024. Also presented at *NeurIPS 2023 New Frontiers in Graph Learning Workshop*. [PDF] [Project] [Code]
- **Ce Zhang**, Kailiang Wu, and Zhihai He. Critical Sampling for Robust Evolution Operator Learning of Unknown Dynamical Systems. *IEEE Transactions on Artificial Intelligence (IEEE TAI)*, 2023. Also presented at *First Workshop on Out-of-Distribution Generalization in Robotics at CoRL 2023*. [PDF]
- Yi Zhang*, **Ce Zhang*** (co-first author), Zihan Liao, Yushun Tang, and Zhihai He. BDC-Adapter: Brownian Distance Covariance for Better Vision-Language Reasoning. In *British Machine Vision Conference (BMVC)*, 2023. [PDF] [Project]
- Yushun Tang, **Ce Zhang**, Heng Xu, Shuoshuo Chen, Jie Cheng, Luziwei Leng, *et al.* Neuro-Modulated Hebbian Learning for Fully Test-Time Adaptation. In *IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, 2023. [PDF]
- Xueting Hu, **Ce Zhang**, Yi Zhang, Bowen Hai, Ke Yu, and Zhihai He. Learning to Adapt CLIP for Few-Shot Monocular Depth Estimation. In *IEEE/CVF Winter Conference on Applications of Computer Vision (WACV)*, 2024. [PDF]
- Yi Zhang, **Ce Zhang**, Ke Yu, Yushun Tang, Zhihai He. Concept-Guided Prompt Learning for Generalization in Vision-Language Models. In *AAAI Conference on Artificial Intelligence (AAAI)*, 2024. [PDF]
- Zhehan Kan, Shuoshuo Chen, **Ce Zhang**, Yushun Tang, *et al.* Self-Correctable and Adaptable Inference for Generalizable Human Pose Estimation. In *IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, 2023. [PDF]

Work Experience

Research Assistant at Advanced Agent Robotics Technology Lab, Carnegie Mellon University Aug 2023 - Present
Advisor: Prof. Katia Sycara, IEEE/AAAI Fellow Pittsburgh, United States

- My main duty is to develop generalizable and robust visual perception systems for practical robotics applications.
- Enhanced vision-language models to generalize to out-of-distribution domains through few-shot/test-time adaptation.
- Designed a hierarchical inference approach for accurate scene graph generation under real-world corruptions.
- Enabled effective fusion of RGB and Thermal modalities for real-time segmentation for autonomous vehicles.

Research Experience

- #1. Dual Prototype Evolving for Test-Time Generalization of Vision-Language Models** Feb 2024 - May 2024
 - Proposed Dual Prototype Evolving (DPE) that effectively accumulates task-specific knowledge from multi-modalities.
 - Introduce and optimized learnable residuals for each test sample to align the prototypes across modalities.
 - Outperformed state-of-the-art methods across 15 datasets while maintaining competitive computational efficiency.
- #2. Enhancing Vision-Language Few-Shot Adaptation with Negative Learning** Dec 2023 - Apr 2024
 - Explored the negative inference capabilities of VLMs, and introduced a unique dual-path adaptation approach for CLIP.
 - Proposed a plug-and-play instance reweighting technique to mitigate the impact of noisy samples.
 - Outperformed other methods in both adaptation performance and generalizability across 15 diverse recognition tasks.
- #3. Spectral-Aware Global Fusion for RGB-Thermal Semantic Segmentation** Nov 2023 - Feb 2024
 - Designed a spectral-aware method for RGB-T segmentation to enforce the integration of high-frequency components.
 - Introduced a global cross-attention module to capture long-range spatial dependencies between modalities.

- › Outperformed the baseline methods by 1.2% and 0.97% mIoU on the MFNet and PST900 datasets, respectively.

#4. HiKER-SGG: Hierarchical Knowledge Enhanced Robust Scene Graph Generation Aug 2023 - Nov 2023

- › Proposed a novel method for generating scene graphs through a hierarchical inference approach over structured domain knowledge, allowing it to gradually specify increasingly granular classifications through iterative sub-selection.
- › Introduced a new synthetic VG-C benchmark for practical SGG, containing 20 challenging image corruptions.
- › Outperformed SOTA methods on SGG tasks, while providing a zero-shot baseline for SGG from corrupted images.

#5. Concept-Guided Prompt Learning for Generalization in Vision-Language Models May 2023 - Sep 2023

- › Created a low-level visual concept cache to enable concept-guided prompting for vision-language models.
- › Incorporated rich multi-level visual semantics to optimize the textual features using a vision-to-language projector.
- › Verified the effectiveness on base-to-novel generalization, cross-dataset transfer, and domain generalization tasks.

#6. Learning to Adapt CLIP for Few-Shot Monocular Depth Estimation Mar 2022 - Jul 2023

- › Explored the monocular depth estimation task using vision-language models in a new few-shot setting.
- › Designed learnable prompts and learnable depth codebooks to adapt the CLIP model for different scenes effectively.
- › Outperformed the previous SOTA by 10.6% MARE and achieved performance comparable to fully-supervised methods.

#7. BDC-Adapter: Brownian Distance Covariance for Better Vision-Language Reasoning Feb 2023 - Jun 2023

- › Introduced BDC to vision-language reasoning to provide a more robust metric for measuring feature dependence.
- › Integrated BDC prototype similarity reasoning and multi-modal reasoning network prediction to adapt CLIP efficiently.
- › Achieved SOTA performance on CLIP-based few-shot learning, domain generalization, and visual reasoning tasks.

#8. Neuro-Modulated Hebbian Learning for Fully Test-Time Adaptation May 2022 - Nov 2022

- › Explored neurobiology-inspired Hebbian learning for effective early-layer representations for test-time adaptation.
- › Combined unsupervised Hebbian learning with a learned neuro-modulator to capture feedback from external responses.
- › Outperformed the previous state-of-the-art by 1.4%, 2.4%, 2.3% on CIFAR10-C, CIFAR100-C and ImageNet-C datasets.

#9. Critical Sampling for Robust Evolution Behavior Learning of Unknown Dynamical Systems Jan 2022 - Oct 2022

- › Introduced a joint spatial-temporal evolution network for robust learning the evolution operator with very few samples.
- › Discovered new locations adaptively to collect most critical samples based on multi-step reciprocal prediction error.
- › Reduced the numbers of samples needed for robust learning of evolution behaviors of PDE systems by up to 100 times.

#10. Self-Correctable and Adaptive Inference for Generalizable Human Pose Estimation Feb 2022 - Aug 2022

- › Designed a self-supervised prediction-feedback-correction scheme to adjust the prediction results during test-time.
- › Introduced a self-supervised feedback error to perform quick adaptation of the correction network during inference.
- › Achieved state-of-the-art performance on public MS COCO test-dev dataset, with average precision gain of 1.4%.

Project Experience

#1. Empirical Analysis of Deep Learning Models on Neural Machine Translation | Python Oct 2023 - Dec 2023

- › Implemented recurrent neural network and Transformer with second-order AdaHessian optimizer from scratch.
- › Adopted Llama-2-7B and Llama-2-70B models for translation tasks via in-context learning and low-rank fine-tuning.
- › Achieved a BLEU score of 41.06 using our implemented Transformer and 20.49 BLEU with a fine-tuned Llama-2 model.

#2. Calculator and Music Player Applications Design | Kotlin, Android Studio Feb 2022 - Jun 2022

- › Designed numerical and operational buttons and supported advanced mathematical operations (e.g. factorial, square root). Designed seek bar, song list, functional buttons, and supported page jumping for the music player application.
- › Developed light and dark mode user interfaces for both applications. Adapted to different real mobile devices.

Honors and Awards

- › *Top 10 Summa Cum Laude Graduates* (highest distinction, top 1%), SUSTech Jun 2023
- › *Top 10 Undergraduate Graduates* (top 2%), College of Engineering, SUSTech May 2023
- › *National Scholarship* (top 0.2%), Ministry of Education of the People's Republic of China Nov 2022
- › *School Motto Scholarship Special Award* (top 1%), SUSTech Nov 2022
- › *Outstanding Teaching Award*, SUSTech Jan 2022 & Jun 2022
- › *The First Prize of Outstanding Student Scholarship* (top 5%), SUSTech Nov 2020 & Nov 2021 & Nov 2022

Academic Service

- › Journal Reviewer, *IEEE Transactions on Circuits and Systems for Video Technology (IEEE TCSVT)*
- › Journal Reviewer, *IEEE Transactions on Artificial Intelligence (IEEE TAI)*
- › Conference Reviewer, *British Machine Vision Conference (BMVC 2024)*
- › Conference Reviewer, *IEEE International Conference on Multimedia and Expo (ICME 2024)*
- › Teaching Assistant, *Linear Algebra @ SUSTech for 3 semesters (Fall 2021, Spring 2022, Fall 2022)*