Zhitong Gao

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Summary

I am a final-year master's student in Computer Science at ShanghaiTech University, supervised by Prof. Xuming He. My research focuses primarily on Computer Vision and Deep Learning, where I concentrate on developing robust and safe dense prediction models under uncertainty, specializing in areas like learning with noisy labels, uncertainty estimation, out-of-distribution detection, domain generalization and test-time adaptation.

Education

ShanghaiTech University — Shanghai, China
M.S. in Computer Science, supervised by Xuming He; — *Sep. 2021 – Jun. 2024 (Expected)*
*Cumulative GPA: **3.87/4.00**; Major GPA: **3.94/4.00**;*

École Polytechnique Fédérale de Lausanne (EPFL) — Lausanne, Switzerland
Visiting Scholar at CV Lab, supervised by Mathieu Salzmann; — *Sep. 2023 – Apr. 2024 (Expected)*

ShanghaiTech University — Shanghai, China
*B.E. in Computer Science; GPA: **3.62/4.00**;* — *Sep. 2017 – Jun. 2021*

University of California, Berkeley — Berkeley, USA
Participant in Summer School Session E; — *Summer 2019*

Publications

- **Zhitong Gao**, Shipeng Yan, Xuming He. "ATTA: Anomaly-aware Test-Time Adaptation for Out-of-Distribution Detection in Segmentation." Conference on Neural Information Processing Systems (NeurIPS), 2023. [Paper] [Code]
- Bingnan Li, **Zhitong Gao**, Xuming He. "Gradient-Map-Guided Adaptive Domain Generalization for Cross Modality MRI Segmentation" Proceedings of Machine Learning for Health (ML4H), 2023. [Paper] [Code]
- **Zhitong Gao**, Yucong Chen, Chuyu Zhang, Xuming He. "Modeling Multimodal Aleatoric Uncertainty in Segmentation with Mixture of Stochastic Experts." International Conference on Learning Representations (ICLR), 2023. [Paper] [Code]
- Chuanyang Hu, Shipeng Yan, **Zhitong Gao**, Xuming He. "MILD: Modeling the Instance Learning Dynamics for Learning with Noisy Labels." International Joint Conference on Artificial Intelligence (IJCAI), 2023. [Paper] [Code]
- Shuailin Li*, **Zhitong Gao***, Xuming He. "Superpixel-guided Iterative Learning from Noisy Labels for Medical Image Segmentation." International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI), 2021. (* indicates equal contribution.) [Paper] [Code]

Research Experience

Dense Out-of-Distribution Detection with Domain Shift.

Advisor: Mathieu Salzmann, Xuming He — *2023 – Present*

- Distinguish domain-level and semantic-level distribution shifts.
- Jointly study out-of-distribution detection and domain generalization.

Test-Time Adaptation for Dense Out-of-Distribution Detection.

Advisor: Xuming He — *2022 – 2023*

- Propose a dual-level OOD detection framework that addresses both domain shift and semantic shift in real-world cenarios, improving the accuracy of existing OOD detection models.
- Validate the effectiveness of the proposed method on multiple OOD segmentation benchmarks, including those with significant domain shifts and those without, demonstrating consistent performance gains.
- The relevant paper has been accepted in NeurIPS 2023.

Aleatoric Uncertainty in Segmentation

Advisor: Xuming He — *2021 – 2022*

- Explicitly model the multimodal characteristic of aleatoric uncertainty in segmentation in a form of mixture of stochastic experts. Each expert encodes a distinct mode and its weight represents the mode probability.
- Formulate the model learning as an Optimal-Transport problem and design a Wasserstein-like loss that directly minimizes the distribution distance between the model and ground truth annotations.
- The relevant paper has been accepted in ICLR 2023.

Segmentation of Myocardial Infarction Area from a single T2-STIR MRI image.

Advisor: Xuming He, Lianming Wu *2021 – 2022*

- Design an automatic cross-modal segmentation system capable of predicting chronic myocardial infarction (MI) regions marked in LGE images based on the corresponding non-enhanced cardiac MRI images. This system needs to cope with the misalignment between the two modalities.
- The proposed model shows satisfactory performance in MI area prediction and provides a calibrated uncertainty score map that facilitates interpreting the reliability of predictions in practice.
- In submission to European Heart Journal.

Learning Dynamics for noisy labels

Advisor: Xuming He *2021 – 2022*

- Propose a novel selection metric based on the learning dynamics of each data instance. This metric provides a more robust reference for label uncertainty than small-loss trick, as it collects information across various training stages.
- Achieve the state of the art on five popular noisy image classification benchmarks including synthetic noisy datasets and real-world web data.
- The relevant paper has been accepted in IJCAI 2023.

Learning with noisy labels in Segmentation

Advisor: Xuming He *2020 – 2021*

- Adopt a superpixel representation and develop a robust iterative learning strategy that combines noise-aware training of segmentation network and noisy label refinement, both guided by the superpixels.
- This design enables us to exploit the structural constraints in segmentation labels and effectively mitigate the impact of label noise in learning.
- The relevant paper has been accepted in MICCAI 2021.

Challenges and Selected Course Projects

Robust Energy Score for MUAD Challenge | Paper
- MUAD Uncertainty Estimation for Semantic Segmentation Challenge, ICCV Workshop, 2023.
- Adaptively adjust Batch Normalization layers to enable robust OOD detection with various weather conditions.

Bilayer Ensemble Semantic Segmentation for QUBIQ Challenge | Poster
- Quantification of Uncertainties in Biomedical Image Quantification (QUBIQ) Challenge 2021.
- We propose an ensemble of raters, each of whom is trained individually with corresponding experts, thereby enabling them to learn specific characteristics.

Generalized DUQ: Generalized Deterministic Uncertainty Quantification | Report
- Final Project of CS282 Machine Learning, ShanghaiTech University
- We proposed an extension to DUQ, called Generalized DUQ, that expands the original uncertainty estimation from using only its nearest centroid, to using the nearest 'k' centroids.

Seek Common while Shelving Differences: A New Way for dealing with Noisy Labels | Report
- Final Project of CS280 Deep Learning, ShanghaiTech University
- We proposed SCSD, a tri-net framework that combines the benefits of 'cross training' and 'agreement', offering a novel approach to handling noisy labels.

Awards & Achievements

National Scholarship for Graduate Excellence (2023), ShanghaiTech University Outstanding Student (2020), ShanghaiTech University Merit Student (2019).

Relevant Coursework

Deep Learning A+, Computer Vision II A+, Optimization and Machine Learning A+, Online learning and Optimization A+, Natual Language Processing A, Digital Image Analysis A, Probability and Statistics A.

Professional Service

Peer Reviewer for CVPR 2023, NeurIPS 2023, CVPR 2024; Teaching Assistant for CS280 Deep Learning, 2022 Fall.