

Zhengfa Liu

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As a doctoral candidate majoring in Energy and Environmental Protection in the School of Automotive Engineering at Tongji University, I am completing the last half year of my Ph.D. degree application. Specializing in the study of perception algorithms in new and unseen domains and expertise in domain adaptation. Passionate about new technology learning, exploration and engineering with great working team skills and auto didactic tendencies. I am seeking and maintaining a full-time position that offers professional challenges utilizing my technical skills, excellent time management and problem-solving skills. Job seeker with strong technical, creative, and interpersonal skills looking for an entry-level research position as a "young teacher" at a university. I am seeking the position of Software Engineer for Giant Industrial Corporation reference #1234 Pre-Final year B. Tech student at LNMIIT. Inquisitive, hard-working and consistent. Looking for internship opportunities at Microsoft where I can apply my skills and contribute to real-world projects

EDUATIONS

- **Ph.D, Doctor of Engineering, Vehicle Engineering** **2018-2023**
Tongji University, Shanghai, P.R.
Advisor: Prf. Guang Chen
Research: Machine Learning, Domain Adaptation,
Honors: Outstanding Student (2023).
Related Coursework: Artificial Intelligence, Algorithm Complexity Analysis, and Automotive Electronic Control Technology.
Programming Languages: C/C++, Python, and Matlab.
- **M.En, Master of Engineering, Electronics and Communication Engineering** **2015-2018**
National Space Science Center, CAS, Beijing, P.R.
Honors: Outstanding Student (2016).
Related Coursework: VLSI Fundamentals, Digital Integrated System Design, and Digital Image Processing and Analysis.
Programming Languages: VHDL, Verilog, LabView, and PCB Design.
- **B.En, Bachelor of Engineering, Automation** **2011-2015**
Henan University, Kaifeng, P.R.
Honors: National Encouragement Scholarships (2011-2015), Outstanding Graduate (2015), No. 1 in the Majors (2011-2015).
Related Coursework: Digital/Analog Circuit, Signal and System, Single-chip Microcomputer Programming, Automatic Control Theory, Modern Control System, and Computer Network.

ACADEMIC PROJECTS

- **Doctor's Project :** *"Research on key perception algorithms in new visual domains of autonomous driving"*
This is the major project I've been working on for my Ph.D. degree from 2018 until now. Here is the background of this project: For training, deep learning models largely rely on large-scale annotated datasets. Unfortunately, labeling data is an expensive and time-consuming effort, and datasets are incapable of capturing the infinite variety of the real world. Thus, deep neural networks are fundamentally constrained

by the limited visual and semantic data in their training set. In this project, we argue that it's crucial to develop deep neural networks capable of operating in new visual domains and recognizing novel semantic concepts. In particular, we extend the effectiveness of deep architectures to visual domains and semantic concepts not seen in the initial training set, with the long-term goal of building visual recognition systems capable of recognizing new semantic concepts in new visual domains. This project mainly focuses on:

- the study of the problem of domain distribution matching in object detection in order to build a model that can detect images of seen concepts in seen domains where few or no labeled data are available. (Closed-Set Domain Adaptation, CSDA)
- the study of the problem of out-of-distribution (OOD) in image recognition in order to build a model that can recognize images of unknown concepts in seen domains where few or no labeled data are available. (Open-Set Domain Adaptation, OPDA)
- the study of the problem of representation disentanglement learning in image recognition in order to build a model that can recognize images of seen concepts in unseen domains. (Domain Generalization, DG)
- the study of the problem of incremental class learning in image recognition in order to build a model that can recognize images of unseen concepts in unseen domains. (Predictive Domain Adaptation, PDA)
- **Master's Project** : *"The Design of Data Transmission Test Equipment System for Multi-Factor Space Environment Monitoring Payload System"*

This was the major project of my M.Eng. degree in 2016–2018. This project was done at the National Space Science Center. This project aims to realize the data transmission of the Manned Space Station Payload, which mainly focuses on:

- the designs of schematic diagrams and PCB boards—a 6-layer board in the “mother board + daughter board” way for the BU-61580, APA600 (Actel FPGA), CY7C68013A, RS422, LVDS and peripheral circuits.
- the communications between USB 2.0, 1553B, and RS422 with the PC using a main FPGA chip, APA600.
- the implementation of the host computer interface software using MFC and LabVIEW for data activities such as receiving, displaying, saving, drawing, and playing back.

RESEARCH AND ANALYTICAL EXPERIENCES

○ **Cross-Domain Pedestrian Trajectory Prediction**

Research Leader

September 2022 - March 2023

Existing cross-domain pedestrian trajectory prediction methods usually focus on learning entangled spatial-temporal domain-invariant features, while ignoring the different contributions of spatial and temporal shifts to the prediction model. To address this issue, in this research, we propose CD3MN (gate-Calibrated Double Disentangled Distribution Matching Network) to model domain-invariant features across trajectories as a calibrated gated-fusion of disentangled domain-invariant features at the temporal and spatial levels. The key points are:

- introduce a spatial-temporal disentanglement module to disentangle the spatial-temporal properties of pedestrian trajectories from the spatial-level and temporal-level.
- design a domain-invariant disentanglement module for learning domain-invariant sample-level transferable feature representations at the spatial and temporal levels.
- design a calibrated gated-fusion module where both inter-level and intra-level knowledge are introduced to calibrate the fusion gate.

○ **Closed-Set Recognition in the Unseen Domain**

Personal Research

October 2021 - November 2022

Existing domain-invariant feature learning methods for domain generalization typically learn entangled representations, limiting their capacity to generalize to the distribution-shifted target domain. To address this issue, in this research, we propose novel Disentangled Domain-Invariant Feature Learning Networks (D²IFLN) to realize feature disentanglement and facilitate domain-invariant feature learning. The key points are:

- designed a dual classifier network to learn robust domain-invariant features at the feature and model levels.
- designed a semantic disentanglement network and a domain disentanglement network to disentangle the original learned domain-invariant features from both domain-specific class-irrelevant features and domain-invariant features to enhance the discriminability of these features.

○ **Open-Set Recognition under Domain Shift**

Personal Research

October 2020 - January 2022

Most existing methods identify all unknown instances with only one additional class in open-set recognition, failing to explore unknown class categories. To address this issue, in this research, we propose a novel Prototype-based Shared-Dummy Classifier (PSDC) for open-set domain adaptation. The key points are:

- introduced an auxiliary dummy classifier to the source classifier to calibrate the conventional open-set classifier for adaptively outputting class-specific thresholds to distinguish between shared and unknown classes.
- developed a weighted adaptation procedure to align class-wise prototypes of shared classes for transferring discriminative category information to the target domain.
- proposed a pseudo-unknown learning algorithm to further reduce the open-set risk.

○ **Close-Set Object Detection under Domain Shift**

Personal Research

May 2020 - September 2020

Most existing works investigate cross-domain matching by evaluating feature or label distributions independently, ignoring the fact that they contribute differently to domain shift. To address this issue, in this research, we propose a novel Feature and Label Distribution Matching Networks (FLDMN) to explicitly match domain distributions on both feature and label levels simultaneously. The key points are:

- introduced an image-level categorical embedding module to enhance global feature transferability and discriminability with the categorical perception pretext task.
- designed class-wise domain discriminators to align the multi-mode structure between domains.
- designed an augmentation consistency regularization to match region-based label distributions.

○ **Daytime Preceding Vehicle Taillight Signal Measurement System**

Personal Research

October 2019 - July 2020

In contrast to most existing work, which relies solely on standard frame-based cameras for taillight signal measurement, in this research, we present a novel vision-based measurement (VBM) system that is an event-driven solution for measuring vehicle taillight signals using an event-based neuromorphic vision sensor. The key points are:

- Extracted the frequency features of each taillight region using DVS events.
- Designed a thresholding algorithm and a learned AdaBoost classifier to jointly measure taillight signals.

○ **Event-based Abnormal Event Detection**

Main Participant

February 2019 - September 2019

Existing methods usually rely on standard frame-based cameras to record the data and process them with computer vision technologies. In contrast, in this research, we present a novel neuromorphic vision based abnormal event detection system. As the main participant in this research, my main works are:

- Recorded and published the first event-based abnormal event detection dataset, *NeuroAED*.
- Built sparse representation models (e.g., SR (k-LIMPAS)+K-SVD and SR (LASSO)+ODL) for detection.

PROJECTS

○ Brain-like Intelligent Perception System

Project Manager and Technical Lead

November 2018 - May 2022

This research aims to explore and study the application of event-based visual sensors in driver assistance and automatic driving systems. It provides a typical case for the combination of brain-like systems and the field of autonomous driving. As project manager and technical lead, my main responsibilities are:

Management:

- Reasonable Personnel Allocation, Effective Supervision of Work Progress, and Timely Solutions
- Organized and completed the work progress summary and defense of weekly/quarterly/mid-term reports.

Technically:

- Completed the technical scheme design for building the hardware platform, including the selection of sensors, the mechanical structure design scheme, parameter requirements, etc.
- Completed the technical solution for the software platform, which included synchronous data processing and calibration from a multi-sensor group (2*VLP-16, 2*acA1920-50gc, 2*DAVIS346, and 1*MTi-300AHS).
- Completed the collection of datasets for the brain-like intelligent perception system in various scenarios.

PUBLICATIONS

○ Most Closely Related

Published:

- **Zhengfa Liu**, Guang Chen, Zhijun Li, Yubing Kang, Sanqing Qu and Changjun Jiang. "PSDC: A Prototype-Based Shared-Dummy Classifier Model for Open-Set Domain Adaptation." *IEEE Transactions on Cybernetics* (2022).
- **Zhengfa Liu**, G. Chen, Ya Wu, Jiatong Du, Jörg Conradt and Alois Knoll. "Mixed Event-Frame Vision System for Daytime Preceding Vehicle Taillight Signal Measurement Using Event-Based Neuromorphic Vision Sensor." *Journal of Advanced Transportation* (2022).
- Guang Chen, Peigen Liu, **Zhengfa Liu**, Huajin Tang, Lin Hong, Jinhu Dong, Jörg Conradt and Alois Knoll. "NeuroAED: Towards Efficient Abnormal Event Detection in Visual Surveillance With Neuromorphic Vision Sensor." *IEEE Transactions on Information Forensics and Security* 16 (2021): 923-936.

In Review:

- **Zhengfa Liu**, Guang Chen, Zhijun Li, Sanqing Qu, Alois Knoll and Changjun Jiang. "D²IFLN: Disentangled Domain-Invariant Feature Learning Networks for Domain Generalization." [Revise and Resubmit at *IEEE Transactions on Cognitive and Developmental Systems*]
- **Zhengfa Liu**, Ya Wu, Shihang Du, Boyang Peng, Zhijun Li, Guang Chen, Changjun jiang. "Gate-Calibrated Double Disentangled Distribution Matching Network for Cross-Domain Trajectory Prediction." [In Review at ICCV 2023]
- **Zhengfa Liu**, Guang Chen, Zhijun Li, Sanqing Qu, Alois Knoll and Changjun Jiang. "FLDMN: Feature and Label Distributions Matching Networks for Cross-domain Object Detection." [Submit at *IEEE Transactions on Automation Science and Engineering*]

REFERENCES

- **Dr. Guang Chen**, Professor, Ph.D Advisor, College of Electronic and Information Engineering/School of Automotive Studies Tongji University, Shanghai, China; **Email:** guangchen@tongji.edu.cn/ guang@in.tum.de