Xingjian ZHEN

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RESEARCH INTEREST

Computer Vision, Deep Learning, Statistics, and Medical Imaging

My research interest is about structured data or high-order features in Computer Vision. Since it's quite mature for Euclidean space deep learning, I would like to explore some different structured data or constrained data. The covariance matrices of the feature vectors can be viewed as the second-order features. Those high-order features are constrained by their own structure, i.e., Symmetric Positive Definite. Thus this will break the basic rules in Euclidean space. But those matrices are more robust to noise and contain more high-level information. I want to try some neural networks in Euclidean space, and extend them to those structured data.

EDUCATION

University of Wisconsin-Madison, Madison, WI, U.S. 08/2017-11/2022
Ph.D. Candidate, Department of Computer Science GPA: 3.85/4.0
Advisor: Prof. Vikas Singh
Doctoral Minor: Mathematics

Tsinghua University, Beijing, P.R. China. 08/2013-06/2017
B.E., Department of Electronic Engineering GPA: 90.9/100

PUBLICATIONS

[1] [***In Submission***] "On the Versatile Uses of Partial Distance Correlation in Deep Learning."
Zhen X., Meng Z., Chakraborty R., and Singh V.

[2] [***NAACL-MAI-Workshop, 2021***] "A First Look: Towards Explainable TextVQA Models via Visual and Textual Explanations."
Zhen X.*, Rao V.N.*, Hovsepian K., and Shen M.

[3] [***AAIC, 2021***] "Altered Structural Connectivity Detected with Dilated Convolutional Neural Network Analysis in the DIAN study and the Wisconsin Registry for Alzheimer's Prevention."
Zhen X., Chakraborty R., Vogt N., Wang R., Yang K.L., Adluru N., Gordon B., Benzinger T., Mckay N., Betthauser T., Johnson S.C., Singh V., and Bendlin B.B.

[4] [***CVPR (Oral), 2021***] "Simpler Certified Radius Maximization by Propagating Covariances."
Zhen X., Chakraborty R., and Singh V.

[5] [***AAAI, 2021***] "Flow-based Generative Models for Learning Manifold to Manifold Mappings."
Zhen X., Chakraborty R., Yang L., and Singh V.

[6] [***CVPR (Oral), 2020***] "CPR-GCN: Conditional Partial-Residual Graph Convolutional Network in Automated Anatomical Labeling of Coronary Arteries."
Zhen X.*, Yang H.*, Chi Y., Zhang L., and Hua X.S.

[7] [***ICCV, 2019***] "Dilated Convolutional Neural Networks for Sequential Manifold-valued Data."
Zhen X.*, Chakraborty R.*, Vogt N., Bendlin B.B., and Singh V.

[8] [***AAIC, 2019***] "Sequential Deep Learning Algorithms Show Structural Connectivity Differences By Amyloid Status."
Zhen X., Chakraborty C., Vogt N., Hwang S.J., Johnson S.C., Bendlin B.B., and Singh V.

[9] [***NeurIPS, 2018***] "A Statistical Recurrent Model on the Manifold of Symmetric Positive Definite Matrices."
Chakraborty R., **Zhen X.***, Yang C.H.*, Banerjee M., Archer D., Vaillancourt D., Singh V., and Vemuri B.C.

INTERN EXPERIENCES

Amazon, Pasadena, CA, U.S. 05/2021-08/2021

Applied Scientist Intern, AWS Textract

Mentor: Vijay Mahadevan, Zhuowen Tu, and Qi Dong

- Introduced transformer-based agent method that takes pair-wise input to do the co-detection
- In the small in-house dataset, our method improved F1 score 6% from the current SOTA, while in the entire dataset, it is 0.5% better
- In the MS-COCO dataset, our method beats Deformable DETR on small dataset by 4%

Amazon, Seattle, WA, U.S. 05/2020-09/2020

Applied Scientist Intern, Product Assurance Risk Security ML Group

Mentor: Karen Hovsepian, and Mingwei Shen

- Built an end-to-end three-mode model MTXNet to generate answer, textual explanation, and visual saliency explanation, with graph neural network and the noise augmentation based on M4C
- Got 1% better accuracy, 7% better textual explanation CIDEr, 2% better visual explanation IoU
- Collected a novel TextVQA-X dataset from public available TextVQA with further explanation
- Published paper [2] in NAACL-MAI-Workshop 2021, together with oral presentation internally

DAMO Academy, Alibaba, Beijing, P.R. China. 05/2019-09/2019

Research Intern, Medical AI Algorithm Research Group

Mentor: Ying Chi

- Developed automated anatomical labeling of coronary arteries via CPR-GCN
- Used 3D CNN with BiLSTM to extract the features from the CT images along branches
- Combined both image domain and position information with the partial-residual connection over GCN to achieve 95.8% mean recall, 9% improvement from baseline
- Published paper [6] with oral presentation in CVPR 2020 (5.7% acceptance rate)

RESEARCH EXPERIENCES

Partial Distance Correlation (PDC) in Deep Learning and the Benefit 12/2020-11/2021

- Introduced DC into robustness so that the transferred attack accuracy under PGD drops 9%
- Enabled training a network conditioned on another by Partial DC, and analysis ViT over ResNet
- Used DC to disentangle the latent representation, and generated SOTA manipulate image on FFHD

Certified Robustness Training via Propagating Gaussian Distribution 01/2020-11/2020

- Applied the certifiable randomized smoothing robustness without sampling with 2× faster
- Proposed a tight estimation of the channel-wise Gaussian distribution to reduce the cost from exponential to linear
- Achieved better certified accuracy and 5% larger certified radius on ImageNet and Places365
- Published paper [4] with oral presentation in CVPR 2021 (4.6% acceptance rate)

Flow-based Generative Model for Non-Euclidean Data 03/2019-12/2019

- Introduced three invertible layers on manifold-valued data whose determinant of Jacobian is simple
- Built the two-stream GLOW that can transfer information from one manifold to another
- Transferred DTI to corresponding ODF with a small reconstruction error and maintaining verifiable group difference with $p-\text{value} < 0.001$
- Published paper [5] in AAAI 2021 (21% acceptance rate)

Manifold Dilated CNN in Group Analysis of Alzheimer's Disease 08/2018-02/2021

- Used TractSeg and Tractometry to compute the average representation along 50 fiber bundles
- Introduced SPD/ S^n manifold into the Dilated CNN model to extract information from DTI/ ODF
- Sped up the training and testing 5× with a competitive number of parameters with SoTA
- Got statistically significant difference on 14 and 16 (out of 50) fiber bundles, by PiB-PET and Gene mutation carriers, on DIAN and WRAP dataset, with total 9 fiber bundles in common
- Published paper [7] in ICCV 2019 (25% acceptance rate), and also extended to [3][8]