Siyuan Peng

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EDUCATION

The University of Maryland, College Park (UMD), MD September 2018-May 2022
- Bachelor of Science in Computer Science, Machine Learning — Expected in May 2022
- Bachelor of Science in Math-Statistics — Expected in May 2022
- Overall GPA: 3.62/4.0
- Dean's List for Fall 2018 and Spring 2021

SPECIALIZED SKILLS

- Programming Languages: Advanced: Python; Intermediate: Java, C, HTML; Beginners: SQL, Javascript;
- Software and Libraries: TensorFlow, Pytorch, Matplotlib, OpenCV, Jupyter Notebook, Anaconda, Docker
- Bilingual: Proficient in Chinese (native) and English

RELEVANT COURSES

FIRE: Capital One Machine Learning	Spring, Fall 2019; Spring, Fall 2020, Spring 2021	A
Introduction to Data Science	Fall 2020	A
Introduction to Computer Vision	Fall 2020	A
Introduction to Machine Learning	Spring 2021	A
Introduction to Deep Learning	Spring 2021	A
Introduction to Artificial Intelligence	Fall 2021	Expecting A
Classical and Deep Learning Approaches for Geometric Computer Vision (Graduate Course)	Spring 2022	Future Course

RESEARCH EXPERIENCES

***Undergraduate Research Assistant, Peer Research Mentor,* University of Maryland** June 2019-present

Project: 3D Object Orientation Learning
Advisor: Dr. Raymond H. Tu
Research Aim For Stage 1: Aim to recognize the position, orientation, scale of 3D objects on the road by using only one RGB camera in the field of autonomous vehicles and achieve stated-of-the-art accuracy

Approach:
- Adopted the VGG16 [6] as the model backbone
- Combined 2D boxes, optical flow, depth-map, and instance segmentation to predict objects 3D bounding box
- Predicted 3D bounding box's location, orientation, and scale separately and then reconstructed it

Contribution:
- Wrote the data preprocessor,
- Modified Struct2Depth [1], a depth map prediction model, to generate depth map in advance
- Deployed and monitored the model on the cloud

Results:
- Achieved Average Angular Error (AAE) of 14.215 degrees compared to state-of-the-art [1] 13.73 degrees at the time.
- Project: https://go.umd.edu/3d_detection

Research Aim For Stage 2: Aim to classify vehicle orientation prediction methods and seek for new methods

Approach:
- Adopted Xception [2] as the model backbone, as it achieves a balance between accuracy and number of parameters
- Compared effects of two representations of prediction angles, rotation-y and alpha, on accuracy
- Compared six different orientation prediction methods accuracy
- Compared effects of extra inputs, such as depth map and positional encoding, on accuracy
- Compared different effects of two loss functions, such as l2 loss and angular loss, on prediction accuracy

Contribution:
- Designed a novel method called Tricosine within the N-D Affinity Bin category under the advice of research educator
- Added extra inputs, including positional encoder and depth map, to network and test its influence on the accuracy
- Wrote model training script: cmd argument processing, training loop, weights save and load, Tensorboard records
- Modified image feature extraction backbone, Exception, to fit in the model
- Performed integrated testing and fixed any errors/bugs that happened during the training
- Managed remote instances, performed 18 experiments on six models, and reported the result to the entire group
- Collected, cleaned, visualized, and presented training results
- Wrote related work, experiment result, and conclusion section of the paper, *SoK: A Survey of Vehicle Orientation Representations for Deep Rotation Estimation*, as the second author, while the first author is my research advisor
- Project: https://go.umd.edu/orientation_learning; ArXiv Paper Link: https://go.umd.edu/siyuan_paper

Results:
- Achieved 94.38% Average Orientation Similarity (AOS) for the Tricosine method compared to the state-of-the-art accuracy of 94.81%
- Resolved discontinuity and ambiguous problem in angle prediction by using SingleBin(cos + sin) prediction method
- Statistically significant difference between alpha and rotation y representation was not found (RQ1)
- Prediction accuracy improvement by adding extra positional or depth information was not found (RQ2)

***Undergraduate Research Assistant,* University of Maryland, College Park** November 2020-present

Project: 3D Instrument Detection

Advisor: Dr. Cornelia Fermuller and Snehesh Shrestha

Research Aim: Estimate violin's Oriented 3D Bounding Box given an RGB image

Approach:

- Build dataset through Blender simulation due to lack of 3D violin datasets
- Using real2sim with GANs to fine-tune with actual data

Contribution:

- Conducted literature survey including reproducing their work on the University GPU cluster
- Developed automated Blender scenes generation with human model performing musical activities
- Created a synthetic dataset with three hundred million RGB images, depth-maps, and instances segmentation
- Produced corresponding training labels, including 2D and 3D location, dimension, and orientation information
- Developed a 3D violin pose detection network inspired by SMOKE [4], an existing 3D detection network for road object
- Redesigned loss function and 3D bounding box construction algorithms to account for more rotational degrees of freedom

Results:

- Manuscript in preparation for March ECCV 2022
- Was featured in UMD's University Newspaper on Sep 17. and Oct 4. 2021
- News link: https://go.umd.edu/violin_news1 and https://go.umd.edu/violin_news2

PAID POSITION

***FIRE Summer Fellowship,* University of Maryland, College Park** June 2019-August 2019

- Analyzed state-of-the-art techniques from scholarly papers and open-source repositories of similar application
- Performed data preprocessing, training, optimization, and evaluation of deep learning framework
- Collaborated with the research leader and a team of student researchers to design and implement a deep learning model for real-world usage

***Peer Mentor Lead,* University of Maryland, College Park** January 2022-May 2022

- Help the professor prepare for teaching materials
- Offer guidance to undergraduate students on academic problems and assist them in finishing course projects
- Make presentations in class to help students understand complex knowledge points

ACADEMIC PROJECTS

***Member,* Genetic Algorithm Schedule Planner** October 2021-December 2021

- Worked within a team of five students to implement a Genetic Algorithm to build a schedule planner
- Implemented core Genetic Algorithms independently to generate a group of schedules with the highest fitness score
- Used Population-Group-Chromosome structure instead of classical Population-Chromosome
- Project Link: https://go.umd.edu/schedule_planner

***Member,* Rocket League Reinforcement Learning** March 2021-May 2021

- Used Bakkes, 3rd-party plug-in, to communicate/control in-game information and action
- Modified proximal policy optimization algorithm using stable-baseline package
- Trained a single agent to kick a ball into the goal
- Project Link: https://go.umd.edu/RL_AI

***Individual Project,* On-Screen Object Detector** January 2021-March2021

- Created a screen-overlay that detects objects and places bounding boxes around them
- Used Yolo [5] and Detectron2 [8] as detection network, which can be expanded to other detection models
- Project Link: https://go.umd.edu/on_screen_detect

***Group Leader,* Gaming Sell Prediction** September 2020-December 2020

- Served as the team leader of three students, responsible for coordinating and supervising team member's work and managing the project progress
- Collected, cleaned, and organized data collected from online resources
- Implemented classical machine learning methods such as random forest and K nearest neighbor to predict sell number
- Visualized and presented all experiment results
- Project Link: https://go.umd.edu/game_sale_analysis

***Individual Project,* Instance Segmentation Using UNet** April 2021

- Optimized UNet by adding skip connections as the networks goes deeper, inspired by Deep Learning Aggregation [9]
- Ranked number 4 in validation accuracy in class
- Project Link: https://go.umd.edu/unet_project

REFERENCE

[1] Casser, V., Pirk, S., Mahjourian, R., & Angelova, A. (2019, July). Depth prediction without the sensors: Leveraging structure for unsupervised learning from monocular videos. In Proceedings of the AAAI conference on artificial intelligence (Vol. 33, No. 01, pp. 8001-8008).

[2] Chollet, F. (2017). Xception: Deep learning with depthwise separable convolutions. In Proceedings of the IEEE conference on computer vision and pattern recognition (pp. 1251-1258).

[3] Kundu, A., Li, Y., & Rehg, J. M. (2018). 3D-RCNN: Instance-level 3d object reconstruction via render-and-compare. In Proceedings of the IEEE conference on computer vision and pattern recognition (pp. 3559-3568).

[4] Liu, Z., Wu, Z., & Tóth, R. (2020). Smoke: Single-stage monocular 3d object detection via keypoint estimation. In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops (pp. 996-997).

[5] Redmon, J., & Farhadi, A. (2018). Yolov3: An incremental improvement. arXiv preprint arXiv:1804.02767.

[6] Ronneberger, O., Fischer, P., & Brox, T. (2015, October). U-net: Convolutional networks for biomedical image segmentation. In International Conference on Medical image computing and computer-assisted intervention (pp. 234-241). Springer, Cham.

[7] Simonyan, K., & Zisserman, A. (2014). Very deep convolutional networks for large-scale image recognition. arXiv preprint arXiv:1409.1556.

[8] Wu, Y.,Kirillov, A.,Massa, F., Lo, W. & Girshick, R., (2019). Detectron2. https://github.com/facebookresearch/detectron2.

[9] Yu, F., Wang, D., Shelhamer, E., & Darrell, T. (2018). Deep layer aggregation. In Proceedings of the IEEE conference on computer vision and pattern recognition (pp. 2403-2412).