Yu Lei

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"Carpe Diem"

Summary

Research Interests: My principal research interests lie in **machine learning**, **computer vision** and **robotics**. I am especially interested in how we humans **perceive** information in our surrounding world and subsequently **plan** and **move** accordingly. I am eager to transfer this knowledge to robots, aiming to **solve the fundamental problem of robotics-perception and build robots with intelligence that can help us explore and expand our boundaries of perception, decision and action.**

HighLight: 4 years of programming experience; 2 years of research experience with solid mathematical and theoretical background; 1 year of experience with mainstream 3D rendering software and frameworks (Blender,PyTorch3D and NerfStudio)

Relevant Courses: Linear Algebra, Advanced Mathmetics, Data Structure, Probability Statistics, Theoretical Mechanics, Methods for Mathematical Physics, Electromagnetic Field, Signal and System, Principle of Communication, Digital Signal Process

Education

Shanghai Jiao Tong University   *Shanghai, China*
B.E. IN ELECTRONIC SCIENCE AND TECHNOLOGY   *Sep. 2020 - present*
Major GPA: **3.86/4.3   90.17/100**   Ranking:**4/64**

University of California, San Diego   *San Diego, USA*
VISITING SCHOLAR IN MACHINE LEARNING, PERCEPTION, AND COGNITION LAB   *Jun. 2023 - present*
Advisor: Prof.Zhuowen Tu

Publications(* equal contribution)

CONFERENCE PROCEEDINGS

[C3]Bayesian Diffusion Model for Single View 3D Shape Reconstruction
Yu Lei*, Haiyang Xu*, Zeyuan Chen, Xiang Zhang, Yue Zhao, Yilin Wang, Zhuowen Tu
CVPR, 2024
•**TL;DR:** BDM leverages 3D prior knowledge from generative model to tackle hallucinations in single-view reconstruction.

[C2]Bayesian Exloration of Pre-trained Models for Low-shot Image Classification
Yibo Miao, **Yu Lei**, Feng Zhou, Zhijie Deng
CVPR, 2024
•**TL;DR:** We introduce a new way to assemble pre-trained models by Gaussian Process for low-shot image classification.

[C1]FocalDreamer: Text-driven 3D Editing via Focal-fusion Assembly
Yuhan Li, Yishun Dou, Yue Shi, **Yu Lei**, Xuanhong Chen, Yi Zhang, Peng Zhou, BingBing Ni
AAAI, 2024 [project website] [paper]
•**TL;DR:** FocalDreamer is the first user-friendly component-based editing method with separable learnable parts.

Research Experience

University of California, San Diego   *San Diego, USA*
RESEARCH INTERN AT MACHINE LEARNING, PERCEPTION AND COGNITION LAB   ADVISOR:PROF.ZHUOWEN TU   *Jun. 2023 - present*

- **Research Topics:** Single-view object reconstruction, 3D generation, diffusion models
- **Motivation:** Single-view reconstruction faces challenges yet boasts a wide range of applications in autonomous driving, robots navigation and manipulation. Moreover, 3D generative models rapidly evolve, we seek to illuminate how we can leverage it for other future tasks.
- **Method:** Beginning with Conditional Random Fields, we proposed a new class of diffusion model, "Bayesian Diffusion Model", which combines at least two diffusion models trained on different tasks separately using classic Bayesian rules. Given the power of ControlNet, we designed a small and adaptable network module that fuses features of a reconstruction model and a generative model, which mitigates hallucination problems greatly. We also proposed a plug-and-play interaction method between diffusion models, which saves time and cost after establishing pre-trained models, and explored a possible solution of few-shot learning problems in 3D reconstruction domain. This project is now accepted by CVPR2024 [C3].

Qing Yuan Research Institute
Shanghai, China

Research Intern at Qing Yuan Research Institute   Advisor: Prof.Zhijie Deng
Feb. 2023 - Aug. 2023

- **Research Topics:**Bayesian Inference, few-shot learning, image classification
- **Motivation:** Most existing methods often overfit few-shot training data and struggle to reliably estimate predictive uncertainty due to their deterministic nature.
- **Method:** We proposed a simple and effective probabilistic framework for low-shot image classification based on Gaussian processes (GPs), combining the deep kernels defined with various pre-trained models to specify the GP covariance and set the GP mean to off-the shelf well-performing zero-shot predictors. The uncertainty estimated by our method enables a variety of intriguing applications, including rejective classification, out- of-distribution detection and active learning. This project is accepted by CVPR2024 [C2].

Shanghai Jiao Tong University
Shanghai, China

Research Assistant at SJTU Vision and Learning Lab   Advisor:Prof.Bingbing Ni
Jan. 2023 - Jul. 2023

- **Research Topics:**3D object editing, 3D generation, diffusion models
- **Motivation:** While text-3D editing has made significant strides in leveraging score distillation sampling, emerging approaches still fall short in delivering separable, precise and consistent outcomes that are vital to content creation.
- **Method:** We developed a user-friendly framework named "FocalDreamer" that merges base shapes with editable parts according to text prompts for fine- grained editing within desired regions, constituting the first component-based editing method with separable learnable parts to our knowledge. By equipping FocalDreamer with geometry union and dual-path rendering to assemble independent 3D parts, we facilitated instance reuse and part-wise control. We proposed geometric focal loss and style consistency regularization, which encourages focal fusion and congruent overall appearance. This project is accepted by AAAI2024 [C1].

Honors & Awards (selected)

2022	**First Prize**, TI Cup National College Students Electronic Design Competition
2022	**Second Prize**, China Undergraduate Mathematical Contest in Modeling
2022	**Huawei Scholarship**, Shanghai Jiao Tong University
2022	**Excellent B Scholarships for Undergraduate Students**, Shanghai Jiao Tong University
2021	**Excellent B Scholarships for Undergraduate Students**, Shanghai Jiao Tong University
2021	**First Prize**, China College Students Mathematics Competition
2021	**Third Prize**, China Undergraduate Mathematical Contest in Modeling
2019	**Second Prize**, Chinese High School Students Biology Olympiad
2019	**Third Prize**, Chinese High School Students Chemistry Olympiad
2018	**Second Prize**, Chinese High School Students Math Olympiad

Skills and Others (selected)

Programming Language	C/C++, Python, Matlab, LaTeX
Programming Frameworks	PyTorch, Tensorflow, NumPy, Git, OpenCV, PyTorch3D, Detectron2
3D Rendering Softwares	Blender, MeshLab, OpenGL, NerfStudio, Unity3D