

Joshua(Yuchen) Cao

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⚙️ SKILLS

Programming C++, Python, C#, JavaScript, HTML/CSS, Matlab, Swift, SQL
Key Knowledge SLAM, Generative AI, NeRF, 3D Vision, NLP, Distributed System, Database, CG
Develop Tools Pytorch, OpenCV, OpenGL, AWS, ROS, SwiftUI, React.js, DynamoDB, CUDA, Docker, Git, Spark, k8s

🎓 EDUCATION

Carnegie Mellon University Sep 2021 - Now
MS. in Computational Design(Computer Vision Track) Pittsburgh, PA
University of Chinese Academy of Sciences Sep 2016 - July 2020
MS. in Computer Science Shanghai, China

💼 EXPERIENCE

APEX(EzPT) July 2022 - Aug 2022
Computer Vision Engineer & iOS Developer, Intern Remote, USA

- Experimented pose estimation **OpenPose** and **Google MediaPipe**, and a **KNN** method for pose classification and rep counting in **Colab**.
- Replanted above algorithms in an iOS app, configured with **Firebase** and **Google Function**, to work in real-time with phone camera.
- Built dataset and groundTruth pipeline with **OpenCV** and **PyTorch**, accelerated the process for producing new dataset and exercises.

Robot Labs, Carnegie Mellon University Sep 2021 - Now
Research Assistant, Advisor: Prof. Daniel Cardoso Llach and Prof. Katerina Fragkiadaki Pittsburgh, PA

- Used customized dataset to train **T5**, **Retro** language models, and **MaskRCNN** vision model, to enable **Alexa Virtual Assistant** to parse co-referred language prompts into API-level machine instructions in a simulated virtual household environment.
- Built **Husky ground-robot** system with Velodyne-16 and XSens-IMU, configured onboard **ROS system** with 2D **Gmapping** and 3D **LIO-SAM** visual-odometry, **Dijkstra*** and **DWA** path planner packages to enable self-navigation and object avoidance.
- Constructed a simulated environment with **Nvidia Isaac Sim** and **Blender** for both pedestrian detection and RL training.

Mobile Perception Lab, ShanghaiTech University Sep 2016 - Dec 2020
Research Assistant, Advisor: Prof. Laurent Kneip Shanghai, China

- Developed an On-board ROS-like intermediate **OS** between **UAV SDK** and RGB sensor, to run computer vision algorithm.
- Built a simplified SLAM system with **SIFT & Harris Feature Extraction**, **7/8 Points Matching**, and **LevenBerg-Marquardt Optimization**.
- Revised **Particle & Kalman filter** and **MaskRCNN** to relocate pose with semantic information under a robot hijack case.
- Modelled **Camera Optical Algorithm** to synthesize realistic and semantic SLAM dataset with ground truth and criterion benchmark.
- Developed a **Variational Auto-Encoder** with **RGBD SLAM** to generate complete models from partial continuous observation.

💡 SELECTED PROJECTS

Computer Science projects website: <https://caoyuchen.github.io/cs/>

Amazon Alexa Prize: SimBot Challenge / Computer Vision & NLP, Human-robot Interaction Jan 2023 - Now
• Implemented a Weakly supervised object detection model built on **AlexNet with SSP and NMS**, and a **Transformer-based VQA**.
• Enabled the virtual assistant robot with visual navigation, voice-to-instruction and interaction abilities by **CloudWatch**, **Amazon S3**, **Automatic Sound Recognition API**, **EC2** and **DynamoDB**. Improved language parsing ability with NLP models.

NeRF-based 3D Style Transfer / Computer Vision & Graphics, Deep Learning April 2022 - Jan 2023
• Built **Poisson Blending** and **Neural Style Transfer** to stylize image, Revised **CycleGAN & StyleGAN** to synthesize content-aware image.
• Experimented **NeRF-W**, **Mip-NeRF** and CUDA-based **Instant-ngp**, researched **Artistic Radiance Fields** with 3D style transfer.

📖 PUBLICATIONS

Incremental Semantic Localization using Hierarchical Clustering of Object Association Sets ACCV 2022
Lan Hu, Zhongwei Luo, Runze Yuan, Yuchen Cao <https://arxiv.org/abs/2208.13210> Sep 2022
Representations and Benchmarking of Modern Visual SLAM Systems Sensors Journal
Yuchen Cao, Lan Hu and Laurent Kneip. <https://www.mdpi.com/1424-8220/20/9/2572> Mar 2020
Dense Object Reconstruction from RGBD Images with Embedded Deep Shape Representations ACCV Workshop
Hu, Lan, Yuchen Cao, Peng Wu and Laurent Kneip. <https://arxiv.org/abs/1810.04891> Oct 2018