

# 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. 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** and **Amazon S3**, **Automatic Sound Recognition API**, **EC2**, **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