Leo Wang

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Education

Tsinghua University *Beijing, China*

B.Eng. in Electronic Engineering, Advised by Prof. Jianyu Chen *Sep. 2020 - PRESENT*

- Research Intersts: **Roboitcs, CV, ML** Robot Learning, Manipulation, Robotic Grapsing, MLLM, Reinforcement Learning

Research Experience

Microsoft Research *Beijing, China*

Research Intern at NLC Group, advised by Shaohan Huang(Senior Researcher) *June. 2023 - Present*

- **Research Topics**: Robotic Grasping, Manipulation, Multimodal Large Language Model (MLLM) , Point Cloud.
- Proposed KOSMOS-E, a principled and universal end-to-end multimodal large language model, which achieves zero-shot robotic 6-DoF grasping. This model integrates textual, visual (images), and 3D (point clouds) features, capitalizing on the benefits of extensive pretraining with language and vision-language datasets, augmented by a comprehensive grasp pose detection dataset (GraspNet-1Billion) and a unified evaluation system.
- Expanded upon our previous work, KOSMOS-2, by developing an innovative strategy to incorporate 3D information (point clouds) into the model. This enhancement further solidifies KOSMOS-2's position as a versatile and effective general-purpose interface across a wide range of tasks, such as language, vision, and vision-language tasks.
- Proposed an approach to leverage the power of the multimodal large language model in generating novel and captivating grasping ideas. By harnessing multi-stage semantic reasoning, the model excels in discerning the optimal grasp for various objects, including delicate phones with back rings or trapezoidal-shaped items.

Tsinghua University *Beijing, China*

Research Assistant at FuRoC-Tinker *Jan. 2022 - Present*

- **Research Topics**: Home Service Robot, Robotic Grasping, Manipulation and Control.
- Developed a home service robot equipped with a mobile base and robotic manipulator, boasting a diverse range of functionalities including service guidance, objects recognition, visual grasping, speech recognition, radar positioning, and robotic arm manipulation. This robot has consistently participated in the prestigious Robocup@Home group competition.
- Achieved advancements in robotic visual grasping by implementing precise and robust 2D and 6-DoF object grasping techniques based on computer vision. Leveraging the Yolo-ROS algorithm for object recognition, GRCNN for 2D grasping, and GraspNet for 6-DoF grasping, our system accurately computes object pose and identifies optimal grasping points using RGB and depth images captured by cameras such as Realsense or Kinect. Utilizing the ROS-Moveit algorithm, we achieved the ultimate objective of reliably grasping various objects after undertaking camera calibration and hand-eye calibration processes.

Tsinghua University *Beijing, China*

Research Assistant at ISR-LAB, advised by Prof. Jianyu Chen *Sep.2021 - Sep. 2022*

- **Research Topics**: Bipedal Humanoid Robot, BLDC-FOC Driver
- Developed a bipedal humanoid robot, showcasing a remarkable combination of high performance and cost-effectiveness. The comprehensive hardware and firmware scheme comprised several key modules, including a Jetson Nano serving as the robot's central processing unit, a master board as the motor drive control center, driver boards for BLDC motor control, and an SPI2CAN STM32 board facilitating communication between the master board and the driver boards.
- Developed a BLDC-FOC (Brushless DC Motor - Field-Oriented Control) driver board featuring a robust closed-loop PID control system. This design incorporated three distinct closed-loop controllers: the speed loop regulator, enabling precise motor speed control; the angle loop regulator, facilitating accurate motor position control; and the current loop regulator, ensuring precise motor torque control. Notably, the successful simulation of this driver board on the Matlab-Simulink platform further validated its performance and functionality.

Projects Portfolio

Image&Sensor-Based EIS Virtual Gimbal Embedded in SD Card *Beijing,China*

Founder & Developer [Code] *Nov. 2021 - May. 2022*

- **Project Topics**:Video Stabilization, Electric Image Stabilization(EIS),SD Card, IMU, Optical Flow
- Developed a novel solution that achieves video stabilization and eliminates the undesired jelly effect by leveraging a specially designed SD Card and EIS technique. This unique SD Card integrates essential components such as an IMU (Inertial Measurement Unit), MCU (Microcontroller Unit), Flash memory, and TFCard, enabling the simultaneous recording of video footage and jitter data from the IMU.
- Utilizing the recorded IMU jitter data alongside the original vi deo's optical flow, obtained through the advanced FlowNet2 algorithm, we achieved robust and effective video stabilization. By fusing these two motion sources within a powerful Deep Neural Network (DNN) framework, our approach emulates the functionality of a physical gimbal, ensuring smooth and steady video footage.

Intelligent Aelos Robot *Beijing,China*

Core Member & Developer [Code] *Jul. 2021 - Dec. 2021*

- **Project Topics**: Robotics, Manipulation, Computer Vision, Apriltag
- Developed an advanced intelligent Aelos robot by harnessing the power of PYNQ(Python productivity for ZYNQ), which boasts a wide range of functionalities, including robust obstacle avoidance utilizing RGBD sensing, efficient motion planning algorithms, precise self-positioning achieved through Apriltag detection, and object identification leveraging deep learning techniques.

Industry Experience

EncoSmart Technology (Beijing) Co., LTD. *Beijing,China*

Robotics and Computer Vison Intern. [Code] *Apr. 2023 - Jul. 2023*

- **Project Topics**: Hand-Eye Calibration, Manipulation, Robotic Grasping
- Developed an advanced tool leveraging Python and OpenCV for automatic and highly precise camera parameter calibration, hand-eye calibration, and offset calibration. This versatile tool achieves a remarkable precision of less than 1mm. Its applicability extends to various manipulators and diverse operational scenarios..
- Accomplished several complex tasks on FR5, demonstrating problem-solving abilities. Notably, achieved precise magnet suction based on Apriltag, a challenging task requiring meticulous control and perception capabilities. Additionally, successfully performed hand-eye calibration in the presence of a mobile manipulator base, overcoming the associated complexities. Furthermore, excelled in robotic visual grasping, showcasing the ability to handle a wide range of objects with good accuracy and dexterity.

Robotics Competitions

RoboCup 2023 (Robot World Cup) *Bordeaux, France*

RoboCup Humanoid KidSize League Team - TH-MOS. *2023.7*

- Developed a highly capable KidSize humanoid soccer robot, standing at approximately 50cm tall. Leveraging a movable camera mounted on its head and a meticulously crafted motion planning algorithm, our robot exhibited exceptional prowess on the soccer field. Our team achieved a 4th place finish. (3 %)

EDC 2021 (Electronic Design Competition) *Beijing, China*

Intelligent Robot Team - Tank. [Code] *Sep.2021 - Dec. 2021*

- Designed an intelligent and agile robot named Tank with omnidirectional motion capabilities. Through seamless communication with the host computer via Zigbee technology, Tank achieves precise self-localization, enhancing its overall performance on the field. Stability in motion planning and control is ensured through the implementation of a FOC-PID closed-loop design, complemented by the utilization of Kalman filtering techniques. Our team won the winner price.(5 %)

Teaching Experience

2022	**Teaching Assistant,** THU 40231212:Intelligent Robots Design and Implementation	*Beijing,China*
2021	**Teaching Assistant,** THU 20230292:Project Design and Making of Electronic System	*Beijing,China*
2021	**Teaching Assistant,** THU 01550013:Synthetical Practice of Electronics System Design	*Beijing,China*

Honors & Awards

Jul. 2023	**Fourth Place,** RoboCup 2023 Humanoid KidSize League(3 %)	*Bordeaux,France*
Oct. 2021	**Tsinghua University Scholarship,** Science and Technology Innovation Scholarship(1 %)	*Beijing,China*
Apr. 2021	**Third Prize,** The 4th Tsinghua University Software Design Competition (5 %)	*Beijing,China*
Apr. 2021	**Third Prize,** The 4th Tsinghua University Artificial Intelligence Challenge (5 %)	*Beijing,China*
Dec. 2021	**Winner Price,** The 23rd Electronic Design Competition of Tsinghua University (5 %)	*Beijing,China*
Jul. 2020	**National College Entrance Examination,** Ranked 59^{th} out of 1 million people with a score of 702/750 (0.0059 %)	*Puyang,China*

Skills

Programming	Python, C/C++, Linux, MATLAB
Robotics	ROS, Gazebo, Arduino, STM32, ESP32, FPGA
Machine Learning	PyTorch, NumPy, OpenCV, Git, Anaconda, Docker
Languages	English, Chinese(Native),German(Limited)