

Statement of purpose

Date: 2023/06/09

Name in English: CHOU, YU-LUN

Name in Chinese / Kanji: 周佑綸

University (to be) graduated: National Taiwan University

Please write a statement of your academic purpose in the space provided below (in Japanese or English).

Describe in your statement of purpose:

1) personal statement

I'm CHOU, YU-LUN, a student who graduated from National Taiwan University (NTU) in Mechanical Engineering. I aim to research Robotics at Systems Science, Graduate School of Informatics, Kyoto University. My ambition is to influence the Robot industry in Taiwan. Then, enhance our competitiveness in this field.

2) your motivation for applying for your prospective supervisor or graduate study at Kyoto University

There are mainly three reasons for choosing Kyoto University, the country, the school, and the faculties. For all motivations below, I apply my Master's degree at Kyoto University.

First, I would like to explain why applying to Graduate school in Japan. Most of my clever friends at NTU go to the top university in the US directly after graduating. Considering the resources in the US, I also want to go there for research or work. However, I'm still young, naive, and eager to try something new.

Tired of following the trend, I want to create my own way and become more competitive. After finishing my exchange student program in Japan, I determined to stay out of my comfort zone, e.g., countries speaking Chinese and English. Also, I like Japanese creativity. Studying in Japan would be a valued experience that makes me different or even stand out from other people if I go to the US in the future.

Secondly, the school motto of Kyoto University is Freedom of academic culture. I believe the Course for Systems Science at Kyoto University aligns with my goal and value because it is one of the leading institutes in Asia. Also, for researchers in Robotics, we need to think outside the box to develop user-friendly robots to improve our society.

Most importantly, many laboratories in the System science course fit into my field of interest, including Swarm Intelligence, Formation control, Robotics, and Machine Learning. Living in the Artificial Intelligence (AI) era, I aim to integrate this AI into Robotics to make robots cleverer, then coexist with all creatures, not just humans.

3) your past research /study

The past research I've done at National Taiwan University (NTU) included Autonomous Mobile Robots (AMR), Unmanned Aerial Vehicles (UAVs), Propeller-Powered vehicles, and Billiard Cars. Besides, the contents below are in a time order starting with the latest.

1. **Autonomous and Soft Robotics LAB (ASR)** - ME Dept. at NTU, Mar. 2023-Present

As I did in the former lab, I'm also researching AMR in ASR. Compared to one year ago, I have a deeper understanding of AMR, e.g., the concept of Simultaneous Localization and Mapping (SLAM), relative algorithms, and theories such as those for path planning, localization, and navigation.

Basically, I'm trying to move the current packages in the architecture of the Robot Operating System (ROS) to the new version ROS2. Since it's complicated for a beginner like me to overthrow the whole structure of ROS I just learned, it's still in progress.

2. **Intelligent Robot and Automation Lab (IR)** - EE Dept. at NTU, Mar. 2022-Aug. 2022:

IR lab is my enlightenment in Robotics. I was mainly responsible for mechanical design in previous projects before joining the lab. Therefore, algorithms, software, and operating systems were new to me. I feel very thankful to my supervisor Prof. Li-Chen, Fu. I regard him as my future example, for he devoted his life to Taiwan's Robotics research and education.

Moreover, I knew nothing about the SLAM algorithms, Raspberry Pi (RPI), and Linux (Ubuntu), so it was challenging to research them. At that time, I spent months understanding the working principle of RPI and Ubuntu and how to integrate them. Moreover, it was my first time developing a robot from scratch alone, including hardware, assembling, sensor, software, and OS.

Despite the process being so tough, I realized that it's exciting to learn new things every day, which is also one motivation that drives me to dedicate my future to studying Robotics.

3. **2021 Taiwan TDK 25th Robocon UAV group** – at NTU, Jul. 2021- Dec. 2021

In the summer of 2021, we spent days testing our drone and iterating the design during the two-month vacation. It's difficult for drones to fly automatically along the black line on the ground. If there's any derivation with the line, a UAV adjusts its orientation to follow one. The second difficulty is recognizing the light transforming different colors randomly to determine whether to stop or go.

Although we did simulations then, the actual result was always stochastic, thus different from what the simulations predicted. So, the robot might sprint because of overshooting of the motors, and it was DANGEROUS.

In the team, I was responsible for designing the structure of drones and communicating with manufacturers for some parts made of Aluminum. Fortunately, we won the Championship eventually. We really earned that honor with our blood, sweat, and tears. The prize in the competition acknowledged our effort and encouraged me to chase my dream on a rather challenging road.

4) your research proposal at Kyoto University

As I mentioned before, I want to integrate Robotics with AI. Thus, I choose to research the Quadruped robot as a quadruped can move to terrain that an AMR cannot do. To my knowledge, some institutions work well on quadrupeds. For instance, Spot and Mini Cheetah belong to Boston Dynamics and MIT CSAIL, respectively. Below I consider some advantages of Mini Cheetah and propose my plan for Quadruped, including its methodology, utilizations, and how to help us improve our societies, which will be invaluable to my research and future applications.

To start with, MIT showcased the learning-based method that outperformed the previous human-designed one. To my knowledge, the lab of Prof. Jun Morimoto for the Graduate School of Informatics is also working on reinforcement learning for Quadruped, which is appealing to me.

There is a comparison of the learned controller and the human-designed one in the demo of Mini Cheetah. The learned controller can adapt the system behavior to diverse fields, such as gravelly hills or slippery ice, to prevent the robot from stumbling in those challenging terrain.

For methodology, we can use a simple neural network as the controller. Then, let the robot learn to run in a simulator and realistically overcome trouble in those situations. However, this technique isn't exclusive to Quadruped. AI can also apply to other robots, such as automobiles with swarm intelligence (AZUMA Laboratory) and formation control (Ohtsuka Laboratory).

Concerning an application for the robot, it can use as a rescue robot, which would play an important role in countries near seismic zone like Japan, Taiwan, and Turkey. In detail, integrating components with the robot, including thermal, temperature sensors, and manipulators, to support the rescue team's search for survivors under quake rubble within a crucial 72 hours.

In conclusion, following my statement at first, I'm intent on combining Robotics and AI to make robots work better and benefit the world ultimately.

5) your future career plans

My final goal is to impact the Robotics field in Taiwan. Therefore, I regard Prof. Li-Chen, Fu as my example. He's the supervisor of my first lab, the IR lab, who devoted his life to Taiwan's Robotics research and education. I'm thankful and perceive him as my target to chase or beyond. I want to become influential in my expertise in Taiwan and even the world someday.

To fulfill my ambition, I will study and work in the US after I graduate from Japan. If possible, I would directly work there for five years or more to save 1-2 years for study. I want to work in a company such as Boston Dynamics or iRobot for tasks related to Robotics. After getting enough experience, I'll bring back knowledge and technique to Taiwan, then positively impact the Robotics industry, research, and even education in Taiwan.

For industry and research, instead of working on robots like manipulators, which is just the big trend in Taiwan, I aim to find my unique way and think of other robots that are also useful in my country. I dream that when it comes to Taiwan, people won't just know about our semiconductors or bubble tea.

In education, I don't want to teach students in person. Alternatively, it'll be more efficient and prevalent for the public to get information from the Internet in this generation. Through Youtube or other platforms, I aim to convey engineering education to make more people in Taiwan interested in Robotics. I can also affect the audience and let them know what I think about the industry or education, so the possibility is infinite.

Above is the short-term goal I want to achieve in 10-15 years. In the long-term one, I hope to connect the world with Taiwan.

For instance, I'll know people from Japan or America after I finish my study and work there. Likewise, I still want to learn more such as German, even though I know three languages. Accordingly, I can know more expertise in Mechanical Engineering from different countries. At that time, I might have the ability and property to cofound a Robotics company that gathers expertise from the world.