Overseas Summer Undergraduate Research Opportunities Programme in Science (UROPS) at Shanghai Jiao Tong University (SJTU) 2024 (in-person)

Programme Overview

Shanghai Jiao Tong University is offering Overseas Summer Undergraduate Research Opportunities Programme in Science (UROPS).

Location

The programme takes place in Shanghai, China.

Dates

The programme takes place from **13 May 2024 to 02 August 2024.** (Special Term Part 1 & 2, 12 weeks)

Credit Transfer

Students will be assessed according to SJTU's assessment criteria and receive a transcript issued by the institution.

This programme can be mapped to a 4 units Science dummy exchange course code counting towards unrestricted elective.

For mapping to the UROPS course code, Life Sciences and Physics majors can map to LSM3288 and PC3288 respectively. For all other majors, please do check with the respective departments' UROPS Coordinators.

Do note that additional assessment may be required from the student by the NUS department for transferring of credits to a UROPS course. Not all UROPS course code can be counted towards major requirements. Please check what requirements the UROPS will count towards and if you are unsure, please check with your department.

Students can transfer a total of 12 units from a maximum of 2 overseas summer/winter programmes without having to pay tuition at NUS during their course of study. Any additional units mapped will be subjected to NUS Special Term fees.

Course mapping and credit transfer for online summer programmes is not allowed.

Eligibility Criteria

NUS students must:

- Be a full-time Faculty of Science student.
- Have a clean disciplinary record.
- All Year 2 and Year 3 students may apply
- Minimum GPA of 3.75
- Be fully vaccinated
- Not intending to graduate at the end of AY23/24 Semester 2
- Not be National Servicemen who are called up for In-Camp Training (ICT). Deferment letter will not be provided.

Shortlisted candidates may be required to attend an interview at the Science Dean's Office. Interview details will be provided at a later date. After accepting the internal offer, you will be informed further on subsequent steps and project requirements.

An internal offer does not guarantee your placement in the programme. Your admission outcome is up to the discretion of the partner institution.

Number of Places

There are 4 places available.

Programme Cost

Students do not need to pay NUS Special Term fees or tuition fees to SJTU if they do not exceed the credits transfer limit stated under the section "Credit Transfer" above. However, students are responsible for their own airfare, accommodation, meals, personal expenses, etc.

Estimated cost (*Please note that the figures provided are only estimates*)

Item	Cost
Return Airfare	SGD500
Accommodation	SGD3,000
Food and Transport	SGD2,000/month

Financial Assistance

Click here to find out more about the various financial assistance schemes offered by NUS.

Programme Application Procedure and Deadline

Login to Education Records System (EduRec) and submit your application under External Study Type "Research Attachment/Internship/Industrial Attachment", External Study Setup ID: **02629**. Please refer to Guide for Student Programme Application BEFORE your application. You will need to log on to NUS WebVPN before accessing the Guide and EduRec.

Application Deadline: **21 December 2023, 11:59pm Singapore Time**

Documents required (upload into your online application in EduRec):

1. Latest NUS unofficial transcript (downloadable from EduRec).
2. Curriculum Vitae. Highlight any prior research experience that you may have to support your application.
3. 1 page personal statement, including your area of research interest/project, why you are interested in the mentioned area/project, name of supervisor you wish to work with, etc. Please indicate clearly the project you are interested in.
4. **Copy of GCE 'A' Level Certificate or Qualifying English Test (QET) result.**

Note:

- Admission into the programme is at the discretion of Shanghai Jiao Tong University
- Allocation of project is done by SJTU

If you face difficulties uploading the documents, email the required documents to SCI SAP Team (scisap@nus.edu.sg) instead by **21 December 2023, 11:59pm Singapore Time**.

Applications would be deemed incomplete even after submission if the required documents are not received by the stipulated deadline, and therefore disqualified from the application.

To be fair to students who abide by the deadline, incomplete or late application will strictly not be considered.

Insurance

All students travelling overseas for activities or purposes approved, endorsed, organised, sponsored or authorised by NUS will be covered by the NUS Student Travel Insurance Policy. Click here for more information.

Exclusions to the NUS Student Travel Insurance may apply. Students are to ensure that they have sufficient travel insurance coverage, and may consider purchasing additional travel insurance if required.

Contact Details

If you have any questions, please submit your enquiry via the MS Form here.

List of available projects

You are encouraged to personally contact the STJU supervisor via email, and attach your CV or Personal Statement.

1			
Name	Sihua Hou	**Email**	housihua@sjtu.edu.cn
Department	School of Pharmacy		
Project Title	Total Synthesis of bioactive natural products		
Project Description	This project will focus on total synthesis of three polycyclic natural products based on the tandem reaction. This Project will be finished in 3 months.		
Pre-requisites	Undergraduates should have organic synthesis experimental skills.		
Field of Research	Organic Synthesis		

2			
Name	Peng Wang	**Email**	wangpeng605@sjtu.edu.cn
Department	Automation		
Project Title	Trustworthy AI for Decarbonization of Power Grids		
Project Description	We will investigate using trustworthy AI to solve problems in power systems with high penetration of renewable energies, such as power balancing, ancillary services, etc.		
Pre-requisites	The student should know the basics of AI and power systems		
Field of Research	AI, power systems, control and automation		

3			
Name	Shu Li	**Email**	shuli@sjtu.edu.cn
Department	Tsung-Dao Lee Institute		
Project Title	The God Particle Higgs Boson as a Probe of the new physics beyond the Standard Model		
Project Description	Utilizing the data collected by the Large Hadron Collider at CERN, the project focus on simulation and data analysis at LHC-ATLAS experiment to search for beyond Standard Model new physics with the Higgs boson being the key portal		
Pre-requisites	basic computing and programming skills (C++, Python, ...), basic knowledge about Particle Physics and/or the detector techniques		
Field of Research	High Energy Physics, Particle Physics, Beyond Standard Model, Higgs Physics, Electroweak		

4			
Name	Yiping Cao	**Email**	caoyiping@sjtu.edu.cn
Department	Food Science & Technology		
Project Title	Fibrillization of food proteins for improved functionalities		
Project Description	Amyloid fibrils have traditionally been considered only as pathological aggregates in human neurodegenerative diseases, but it is increasingly becoming clear that the propensity to form amyloid fibrils is a generic property for all proteins, including food proteins. Differently from the pathological amyloid fibrils, those derived from food proteins can be used as advanced materials in biomedicine, tissue engineering, environmental science, nanotechnology, material science as well as in food science, owing to a combination of highly desirable feature such as extreme aspect ratios, outstanding stiffness and a broad availability of functional groups on their surfaces. The current project will focus on the fibrillization of blood-based proteins, a large waste product from livestock processing, and explore their functional properties for a sustainable development.		
Pre-requisites	1. Have a basic knowledge of food proteins 2.Know how to balance life and research		
Field of Research	Food protein structure and functions		

5			
Name	Hua Wu	**Email**	hua.wu@sjtu.edu.cn
Department	School of Pharmacy		
Project Title	Cyclizative rearrangement for the molecule editing		
Project Description	Development of new and efficient cyclizative 1,2-rearrangement for the important heterocycles synthesis.		
Pre-requisites	Good background in organic synthesis		
Field of Research	organic synthesis, asymmetric catalysis		

6			
Name	Miaomiao Zhu	**Email**	mizhu@sjtu.edu.cn
Department	School of Mathematical Sciences		
Project Title	Qualitative analysis for elliptic systems		
Project Description	The main goal of this project is to investigate some qualitative analysis for solutions of elliptic systems arising naturally in geometry and physics.		
Pre-requisites	Real analysis, functional analysis, a little knowledge about differential geometry and PDE would be better.		
Field of Research	Differential Geometry, Geometric Analysis, Nonlinear Partial Differential Equations, Mathematical Physics		

7			
Name	Siheng Chen	**Email**	sihengc@sjtu.edu.cn
Department	School of Electronic, Information and Electrical Engineering		
Project Title	Data Simulation Platform of Autonomous Driving		
Project Description	In recent years, with the rapid advancement of autonomous driving technology, the need for a highly realistic and customizable simulation testing environment has become increasingly urgent. Conducting real-vehicle tests under real-world conditions is not only costly but also poses significant risks. This project is dedicated to developing an advanced autonomous driving data simulation platform, aimed at accurately simulating complex traffic conditions and varying driving scenarios to comprehensively and effectively test autonomous driving systems. The platform will replicate real road conditions, traffic patterns, various vehicle behaviors, and multiple sensor inputs, providing researchers and developers with an ideal environment to evaluate and validate their autonomous driving algorithms and strategies, and to test their performance and reliability under diverse conditions. Additionally, it will provide valuable data resources and reference standards for future research work, driving forward the advancement of autonomous driving technology.		
Pre-requisites	1. Excellent communication and collaboration skills; 2. Strong fundamentals in mathematics and physics; 3. Basic programming skills (Python).		
Field of Research	Artificial Intelligence, Physics Engine		

8			
Name	Gang Chen	**Email**	gchen2018@sjtu.edu.cn
Department	Department of chemistry and chemical engneering		
Project Title	Aassociate Professor		
Project Description	1. Biomimetic synthesis of nucleoside natural products using radical approach, and further study the antibacterial activities of these natural products and analogues; 2. late-stage functionalization of nucleoside/tide and RNA/DNA oligonucleotides for biomedical application.		
Pre-requisites	organic chemistry; research time: 9AM-9PM		
Field of Research	natural product; organic synthesis; nucleic acid chemistry		

9			
Name	Xinshu Zhang	**Email**	xinshuz@sjtu.edu.cn
Department	Naval Architecture and Ocean Engineering		
Project Title	Floating solar energy in ocean		
Project Description	Investigation on the dynamics of floating solar platform in waves		
Pre-requisites	familiar with fluid dynamics, and calculas		
Field of Research	Mathematics, fluid mechanics, ocean engineering		

10			
Name	Hong Zhu	**Email**	hong.zhu@sjtu.edu.cn
Department	UM-SJTU Joint Institute		
Project Title	Halide solid electrolyte design through machine learning		
Project Description	All-solid-state-lithium-ion-batteries (ASSLIBs) have risen dramatic interest in next generation lithium-ion batteries (LIBs) design. Without liquid material like organic electrolyte of traditional LIBs, ASSLIBs can prevent firing caused by the burning of such flammable electrolyte. Replacing liquid state electrolytes with solid state electrolytes (SSE) also lead to reducing of Li-ion conductivity, for generally, SSE perform much lower Li-ion conductivity than liquid state electrolytes. Among different kinds of SSE, halide SSE (compounds containing halide elements like fluorine, chlorine and iodine, also with transition metal elements as part of crystal lattice matrix, such as Li3YCl6, LiAlCl4, Li7P2S8I) shows advantages in ionic conductivity. Many efforts put into discovering halide SSE with higher ionic conductivity and analyzing the origin of its high conductivity. Some research work demonstrates that mixing halide elements in halide SSE rises the ionic conductivity due to higher disorder. However, what is the specific composition making such compounds can perform best need further research.Based on the mechanism of ionic diffusion in halide SSE, we try to design a halide SSE in the composition form like Li3[MaMb][XαXβXγ] (Ma,Mb is transition metal elements and Xα, Xβ, Xγ is halide elements, where a+b=1 and α+β+γ=6) to reach high ionic conductivity with the aid of machine learning model.		
Pre-requisites	Highly motivated with the research topic; With solid background from physics, chemistry, materials science and engineering or computer science for interdisciplinary research.		
Field of Research	Materials design, condensed physics, physical chemistry		

11			
Name	Kun Qian	**Email**	k.qian@sjtu.edu.cn
Department	School of Biomedical Engineering		
Project Title	Design of new metabolic platforms for in vitro diagnostics		
Project Description	In this project, in order to obtain the parallel fingerprints of multi-molecule groups of clinical biofluids, we intend to design and prepare series of mass spectrometry (MS) nano-devices to comprehensively and quickly analyze the proteome, peptides and metabolome of clinical samples based on the advanced techniques in combination of nanotechnology and artificial intelligence.		
Pre-requisites	Work with strong responsibility and seriousness		
Field of Research	Material, Medical, Biological and Computer Science		

12			
Name	Zhe Liu	**Email**	liuzhesjtu@sjtu.edu.cn
Department	School of Electronic, Information and Electrical Engineering		
Project Title	Memory-based multi-robot navigation		
Project Description	Memory is very important for our human to achieve the navigation task, however, memory has not been well exploited in robot navigation scenarios. Both the environment and strategy memories are very important to improve the navigation efficiency and performance. In this project, we will study how to build memory and how to use memory for multi-robot systems. Robots can share memory, read memory and update memory, thus finishing the task bettter and better.		
Pre-requisites	We hope the candidate has some background knowledges about learning-based approaches and robot navigation models, but not necessary.		
Field of Research	Robotics		

13			
Name	Ruohe Yin	**Email**	ruohe.yin@sjtu.edu.cn
Department	School of Agriculture and Biology		
Project Title	Investigating the vision of plants: Photoreceptor UVR8 enables plants to see the invisible light UV-B		
Project Description	UV-B light is invisible to human beings, but visible to plants. Plants and green algae contain UV-B photoreceptor UVR8 that enable them to sense UV-B light. In this project, the students will participate in the functional characterization of photoreceptor UVR8 in plants (Arabidopsis and tomato).		
Pre-requisites	Interested in plant biology.		
Field of Research	Plant Photobiology, light signaling.		

14			
Name	Xiaoli Xue	**Email**	xlxue@sjtu.edu.cn
Department	School of Life Sciences		
Project Title	Constructing artificial LUCA cells to explore the evolution of early life forms		
Project Description	Using synthetic biology and genome assembly techniques to construct artificial LUCA（Last Universal Common Ancestor，LUCA） cells. The genomes of early microbial life forms (including extremophiles archaea and bacteria which evolutionary position close to the root of life) will be redesigned and synthesized. By systematically altering simulated cultivation conditions of the artificial LUCA cells, the functional succession of archaea and bacteria during environmental changes will be monitored. Through sequence, protein, structural, metabolic, and evolutionary analysis, key principles of the origin and evolution of life will be explored.		
Pre-requisites	Priority is given to majors in biotechnology and bioinformatics		
Field of Research	Synthetic biology, synthetic genome, artificial life construction		

15			
Name	Xiaodong Zhuang	**Email**	zhuang@sjtu.edu.cn
Department	School of Chemistry and Chemical Engineering		
Project Title	Rational synthesis of 2D Polymers		
Project Description	2D polymers and polymer films have shown great potential in bothe science and industry communities. We aim to develop new 2D polymers based on new buliding blocks and linkages for energy storage and conversion.		
Pre-requisites	self-motivated		
Field of Research	Materials for Energy Storage and Conversion		

16			
Name	Hui Lu	**Email**	huilu@sjtu.edu.cn
Department	School of Life Sciences and Biotechnology		
Project Title	儿童罕见疾病的多模态知识图谱构建		
Project Description	基于罕见病的临床路径、文献、临床指南，构建多模态复合知识图谱，并用于指导临床辅助诊断软件的构建。		
Pre-requisites	编程语言，大学统计课程		
Field of Research	生物医学数据分析		

17			
Name	Quanshi Zhang	**Email**	zqs1022@sjtu.edu.cn
Department	School of Electronic, Information and Electrical Engineering		
Project Title	Explanability of Neural Networks		
Project Description	Explain the inference logic of a black-box neural network, including the explanation of a DNN, the proof of the faithfulness of the explanation, and the analysis of the generalization power of a DNN.		
Pre-requisites	The student is supposed to have learned the machine learning class and be able to train a DNN.		
Field of Research	Artificial Intelligence		

18			
Name	Yuanfei Han	**Email**	hyuf1@sjtu.edu.cn
Department	School of Materials Science and Engineering		
Project Title	Tackling the strength-ductility trade off by nano-particle reinforced metal matrix composite via additive manufacturing		
Project Description	This project aims to study the basic science of high-strength metal matrix composites, especially the design of hybrid reinforcements, the non-equilibrium solidification behavior of additive manufacturing, revealing the various strengthening mechanisms of reinforcements. It is intended to solve the problems under non-equilibrium solidification conditions, such as the design strategy of multi-scale reinforcements, the matching of various interfaces, the precise control of multi-level microstructure. The theoretical basis and new technology system for composite design, and additive manufacturing of high strength metal matrix composites will be developed.		
Pre-requisites	Knowledge of Materials Science and Additive Manufacturing		
Field of Research	Metal Matrix Composites, Additive Manufacturing		

19			
Name	Xie Chen	**Email**	chenxie95@sjtu.edu.cn
Department	School of Electronic, Information and Electrical Engineering Department of Computer Science		
Project Title	Multi-lingual speech recognition system		
Project Description	The project aims to build a speech recognition system which can support multiple languages within a single model. The project will be carried out from two aspects, data and model. The first stage is collect and polish data from internet; and the second stage aims to improve the speech recognition performance based on the Whisper model.		
Pre-requisites	Deep learning; Pytorch;		
Field of Research	Speech Recognition; Deep Learning		

20			
Name	Weilong Zheng	**Email**	weilong@sjtu.edu.cn
Department	School of Electronic, Information and Electrical Engineering		
Project Title	Affective Brain-Computer Interfaces		
Project Description	The project would like to decode human emotions with EEG and physiological signals using machine learning techniques.		
Pre-requisites	Python, Pytorch, Machine Learning		
Field of Research	Artificial Intelligence, Biomedical Engineering, Computational Neuroscience.		

21			
Name	Ping Song	Email	songpingsjtu@sjtu.edu.cn
Department	School of Biomedical Engineering		
Project Title	DNA information storage using Nanopore sequencing		
Project Description	Design and implement a system that uses DNA as a medium for digital data storage. DNA has the potential to store vast amounts of information in a compact and durable form, making it an attractive option for long-term data archiving. This project can be divided into several phases: Data Encoding: Develop a method to encode digital data (such as text, images, or other files) into a DNA sequence. There are various encoding schemes to consider, such as binary-to-base-4 encoding or Huffman coding for efficient data representation. DNA Synthesis: Experiment with the chemical synthesis of DNA strands that represent the encoded data. This may involve using chemical reagents and automated DNA synthesizers. Data Decoding: Create algorithms and tools to decode the stored DNA sequences back into their original digital format, ensuring data integrity and accuracy. Storage and Retrieval: Develop a physical storage system for the DNA samples, including proper labeling, cataloging, and storage conditions (e.g., temperature and humidity control). Create a retrieval system that can quickly and accurately extract data from the stored DNA samples. Testing and Validation: Test the system by encoding, storing, and retrieving various types of data. Measure the efficiency, reliability, and durability of DNA-based storage compared to traditional digital storage methods. Cost Analysis: Evaluate the cost-effectiveness of DNA data storage in terms of synthesis, storage, and retrieval costs, and compare it with other archival storage solutions. Ethical Considerations: Explore the ethical implications of DNA data storage, including privacy, security, and potential ecological impacts. Develop policies and guidelines for responsible DNA data storage and disposal. Documentation and Outreach: Document your findings, methodologies, and		

	results in a comprehensive report. Create educational materials and outreach efforts to raise awareness about the potential of DNA data storage. Future Developments: Consider how this technology could evolve in the future, such as improvements in DNA synthesis techniques, cost reduction, and scalability. This project combines elements of biology, computer science, and data management, making it both interdisciplinary and forward-thinking. It can also contribute to the ongoing research in DNA data storage, which has the potential to revolutionize how we store and archive data for long periods.
Pre-requisites	PCR/qPCR, Matlab or R or python
Field of Research	biotechnology and information technology

22			
Name	Weiqiang Gao	Email	gao.weiqiang@sjtu.edu.cn
Department	School of Biomedical Engineering		
Project Title	Regulation of dormancy of tumor stem cells		
Project Description	The reciprocal regulation between cancer stem cell plasticity (including dormancy, re-activation and fate determination) and immune cells in the tumor microenvironment (especially the regulation from macrophages) might be a new mechanism for castration resistant prostate cancer (CRPC). We plan to unders the mechanism.tand		
Pre-requisites	Cell biology, Molecular biology		
Field of Research	Tumor biology, Immunoncology, Tumor neuroscience		

23			
Name	Sung-Liang Chen	Email	sungliang.chen@sjtu.edu.cn
Department	UM-SJTU Joint Institute		
Project Title	Optical neural network for the realization of U-Net		
Project Description	Deep learning has been utilized to execute advanced inference tasks using computers. However, as the needs have explosively increased in recent years, people face the challenges of excessive power consumption. All-optical neural networks are potential solutions to implement and realize deep learning with low power consumption as well as fast calculation speed, which is the speed of light. In this project, students will investigate the implementation of diffractive deep neural networks. We will focus more on design and simulation, and if situation allows, we will also conduct experiments. It is well known that there are many useful building blocks and tricks in conventional deep learning to help enhance the performance, e.g., ResNet, drop-out, batch normalization. As optical neural networks are not exactly the same as conventional neural networks, it is necessary and interesting to investigate whether the methods used in conventional neural networks are useful for optical neural networks. Especially, we will focus on the realization of U-Net using optical neural networks.		
Pre-requisites	optics; machine learning		
Field of Research	optics; machine learning		

24			
Name	Xueqing Gong	Email	xqgong@sjtu.edu.cn
Department	School of Chemistry and Chemical Engineering		
Project Title	Theoretical simulations of heterogeneous catalysis		
Project Description	In this project, theoretical simulation methods, such as density functional theory calculations, force-field molecular dynamics modeling, and artificial intelligent algorithms, will be used to study the heterogeneous catalysts and reactions. In particular, the structures of the catalysts and the reaction mechanisms will		

	be investigated, and the understanding of the structure-activity relationship will be built. Some important model catalysts, especiall the metal oxides and multi-component composite materials, and model reactions, such as CO oxidation, oxidative dehydrogenation, ammonia synthesis/oxidation, will be the main topics.
Pre-requisites	physical chemistry, organic/inorganic chemistry, general mathematics, materials science, scientific computation, basic artificial intelligent methods
Field of Research	heterogeneous catalysis

25			
Name	Yujun Xie	Email	yujun.xie@sjtu.edu.cn
Department	Global Institute of Future Technology		
Project Title	pyGLASS: an open source package for analyzing microstrucure in amorphous materials		
Project Description	We are seeking highly motivated undergraduate students to develop open source python-based package for processing and analysis of four-dimensional scanning transmission electron microscopy (4D-STEM) data. In particular, we focus on amorphous materials that lack of long range ordering and apparent crystal structure, such as metallic glass, glass and polymer. The students will need to apply cutting edge machine learing tools to extract the hidden information in these materials.		
Pre-requisites	Have expereience in computer science and python. Insterested in materials science.		
Field of Research	Materials Science, AI for science, image processing		

26			
Name	Xuyang Lu	Email	xuyang.lu@sjtu.edu.cn
Department	UM-SJTU Joint Institute		
Project Title	mmWave Integrated Circuit design for Radar Applications		
Project Description	The design of state-of-the-art integrated circuit for automotive radar using state-of-the-art SiGe technology		
Pre-requisites	Knowledge of analog, digital and microwave circuit		
Field of Research	Integrated circuit, mmWave, Electromagnetics, physics		

27			
Name	Liang Liu	Email	liul21@sjtu.edu.cn
Department	School of Physics and Astronomy		
Project Title	Topological materials for spin-based electronics study		
Project Description	Topological materials have emerged as a new frontier in the field of spintronics due to their unique electronic and magnetic properties. In this project, undergraduate students will investigate the spintronics phenomena in topological materials, such as topological insulators, Dirac semimetals, and Weyl semimetals. The project will involve the following tasks: Literature Review: The students will begin by studying the theoretical and experimental aspects of topological materials and their spintronics applications. They will familiarize themselves with the concepts of topological invariants, spin-momentum locking, and Berry curvature, which are crucial for understanding the spintronics phenomena in these materials. Material Synthesis and Characterization: The students will synthesize and characterize topological materials using various techniques, such as X-ray diffraction, energy-dispersive X-ray spectroscopy, and magnetometry. They will also study the surface morphology, crystal structure, and magnetic properties of these materials. Spintronics Measurements: The students		

	will perform spintronics measurements, such as spin-polarized current measurements and spin torque ferromagnetic resonance (ST-FMR), to investigate the spintronics properties of topological materials. They will study the spin transport phenomena, such as the spin Hall effect and spin-transfer torque, in these materials. Data Analysis and Interpretation: The students will analyze the experimental data to gain insights into the spintronics phenomena in topological materials. They will correlate the spintronics properties with the topological invariants and Berry curvature of the materials. They will also compare their experimental results with theoretical predictions and discuss possible mechanisms for the observed phenomena. Project Report and Presentation: The students will prepare a comprehensive project report that includes an introduction to topological materials and spintronics, material synthesis and characterization results, spintronics measurement results, data analysis and interpretation, and conclusions. They will also present their findings in a seminar talk or a poster presentation. By exploring topological spintronics in a broader range of topological materials, this project will provide undergraduate students with a deeper understanding of the relationship between topology and spintronics. It will also allow them to gain hands-on experience in synthesizing, characterizing, and measuring topological materials and their spintronics properties.
Pre-requisites	Experiment related
Field of Research	Spintronics, Magnetic materials, Nanofabrication, Thin film deposition

28			
Name	Shanying Zhu	Email	shyzhu@sjtu.edu.cn
Department	School of Electronic, Information and Electrical Engineering		
Project Title	On distributed online resource allocation considering dynamic load response		
Project Description	As an emerging and promising paradigm, the industrial internet achieves intelligent manufacturing by connecting and interacting with industrial production elements. Resource allocation is an important problem of the industrial internet, providing theoretical guidance for the flexible and computation-		

	friendly operation of industrial systems, and has widespread applications in software-defined networks and mobile edge computing systems. Specifically, byoptimizing the configuration of limited resources, resource allocation aims to improve the operational efficiency of the network system and reduce operating costs while satisfying the overall supply and demand balance and local constraints. However, the complex and changing industrial environment leads to time-varying production costs and constraints, posing challenges to traditional resource allocation algorithms. On the other hand, due to the limited computing and communication capabilities of field devices, designing low-complexity algorithms is a key measure for quickly responding to dynamic working conditions. Compared with centralized methods, distributed algorithms only require local information among neighboring nodes. They can effectively reduce the requirements for computing and communication capabilities of each node in solving resource allocation problems for large-scale industrial networks, thus having better scalability and robustness to single-point failures. This project aims to propose a distributed online optimization algorithm based on the Frank-Wolfe algorithm and mismatch-tracking method to solve the resource allocation problem considering dynamic working condition response.
Pre-requisites	Linear algebra, basic knowledge of convex optimiztion
Field of Research	Distributed optimization, online optimization

29			
Name	Shimin Wu	Email	wushimin@sjtu.edu.cn
Department	School of Agriculture and Biology		
Project Title	Oxilipins in Food and Food Ingredients		
Project Description	Oxilipins not only participate in aging and inflammation of living organisms, but also affect product quality and safety in food, medicine and cosmetics. The purpose of this project is to investigate the composition and toxicity of oxidized lipids in food and food ingredients. The results may provide scientific basis for the control and elimination of oxilipins in foods.		

Pre-requisites	1. Fluent in both Chinese and English, 2. Interested in aging, antioxidation and food safety, 3. Good team work and initiative
Field of Research	Lipid Science

30			
Name	Bei Ding	Email	bei.ding@sjtu.edu.cn
Department	School of Chemistry and Chemical Engineering		
Project Title	Simulations on protein structures and dynamics using Alphafold and MD simulation		
Project Description	We are interested in a type of proteins called photoreceptors, which are utilized by organisms in perceiving light such as in human vision, bird migration, and plant growth. This two-month project provides a small workshop for the students to learn how to simulate protein structures and dynamics using the machine-learning technique Alphafold and the molecular dynamics simulations. After the workshop, the student can pick one most interested photoreceptor to learn about its structure and dynamics.		
Pre-requisites	None		
Field of Research	Biochemistry and physical chemistry		

31			
Name	Fabo Feng	Email	ffeng@sjtu.edu.cn
Department	Tsung-Dao Lee Institute		
Project Title	Search for solar system analogs using multiple detection		

	methods
Project Description	Are we alone? Is our Solar System unique? The pursuit of answers to these questions became possible when the first exoplanet around a Sun-like star was discovered in 1995. Since then, we have identified more than 5,500 exoplanets using various methods. However, the detection of solar system analogs remains challenging due to the limitations of our detection methods. For instance, Jupiter-like planets may have orbital periods lasting decades, which far exceed the duration of single surveys. To extend the timescale of our observations and overcome the constraints of individual methods, the combination of different surveys and techniques has become increasingly popular in recent years. Notably, the astrometric satellite Gaia has provided exceptionally precise astrometry for over one billion stars. By analyzing data from Gaia and its predecessor, Hipparcos, in conjunction with high-precision radial velocity data, we have successfully located more than 100 giant planets in recent years. Some of these planets have already been or will be directly imaged by the James Webb Space Telescope (JWST). Currently, we are developing more advanced methods to detect colder and smaller planets, such as those resembling Saturn, thereby unveiling the mysteries of a scarcely explored exoplanetary population. In this project, you are expected to: learn how to integrate various methods for exoplanet detection; utilize the CDK14 telescope, situated atop the TDLI building, to observe the transits of hot Jupiters; identify the most intriguing exoplanets from a pool of hundreds of new planet candidates; draft proposals to secure JWST observation time for direct imaging of the exoplanets you have discovered; collaborate and engage with numerous like-minded exoplanet researchers; publish research papers detailing your discoveries.
Pre-requisites	Basic programming skill, Calculus, Linear algebra, Statistics
Field of Research	exoplanet, radial velocity, astrometry, astrostatistics

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Name	Jinjin Li	Email	lijinjin@sjtu.edu.cn
Department	School of Electronic, Information and Electrical Engineering		
Project Title	AI for Energy Conversion and Storage Materials		
Project Description	Efficient research and development of materials for energy storage and conversion is an inevitable requirement for the rapid development of economy and society. Traditional experimental research methods are limited resources, and it is difficult to achieve the speed of material research and development demanded. The excellent data processing capability and relatively low research cost of machine learning methods play an important role in realizing the efficient development of energy storage and conversion materials. In this project, we will use machine learning modeling to mine the constitutive relationships of energy conversion and storage materials, such as electrode materials, electrochemical reaction catalysts, etc., in order to realize the rational design of energy conversion and storage materials.		
Pre-requisites	Good programming skills and experience in AI-related projects.		
Field of Research	AI for Science		

33			
Name	Jingjing Wu	Email	wujingjingsjtu@sjtu.edu.cn
Department	Frontiers Science Center for Transformative Molecules		
Project Title	Photoinduced radical reactions and their application in the synthesis of steroid and triterpenoid natural products		
Project Description	Try to apply the mild photochemical reactions into steroid and triterpenoid natural products synthetic chemistry, to achieve a highly efficient synthesis.		
Pre-requisites	people who are interested in organic chemistry		
Field of Research	synthetic chemistry		

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Name	Qin Cao	Email	caoqin@sjtu.edu.cn
Department	Bio-X Institutes		
Project Title	Reproducing patient-derived amyloid fibrils in vitro: a platform for drug screening in neurodegenerative diseases		
Project Description	In this project, we will try to replicate patient derived amyloid fibrils in vitro to develop drug screening platforms for related neurodegenerative diseases. The formation of amyloid fibrils is a hallmark of many human diseases (particularly neurodegenerative diseases), such as Abeta and tau fibrils in Alzheimer's diseases and a-syn fibrils in Parkinson's diseases. Targeting these amyloid fibrils is a promising strategy for designing therapeutic and diagnostic drugs of related diseases. In vitro grown fibrils are ideal for initial drug screening due to their low cost and high reproductivity. However, recent cryo-electron microscopy (cryo-EM) studies have suggested that in vitro formed amyloid fibrils may not possess the same molecular structures as those found in patients' tissues. Therefore, there is an urgent need to reproduce patient derived amyloid fibrils in vitro to facilitate drug development. Here we will grow Abeta, TDP-43 and other amyloid fibrils in vitro and try to induce disease-related structures by introducing mutations or using fibrils extracted from patients or model animals as seeds. We will initially evaluate the morphologies of the fibrils by negative stain electron microscope and ultimately validate the fibril structures through cryo-EM structure determination.		
Pre-requisites	Basic biochemistry experiment skills		
Field of Research	Biochemistry, structural biology, neuron biology		

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Name	Tianquan Lin	Email	tqlin@sjtu.edu.cn
Department	School of Materials Science and Engineering		

Project Title	Photo-batteries
Project Description	Photo-rechargeable batteries represent an innovative approach to energy storage, aiming to directly harness light for recharging without relying on external solar cells. The conventional reliance on solar cells connected to rechargeable batteries or electrochemical capacitors introduces complexities and increased costs to off-grid power solutions. In response to this challenge, research efforts are directed toward developing various battery and capacitor materials designed for direct recharging by light. In the pursuit of enhancing reliability and reducing costs associated with photo-charging batteries, one notable advancement is the introduction of photo-rechargeable batteries, such as the Zin-Ion battery. A distinguishing feature of photo-rechargeable batteries is their ability to utilize an aqueous electrolyte, ensuring a cost-effective and safe energy storage solution. This research is working on the development of several different battery and capacitor materials that can be recharged directly by light without the need for external solar cells.
Pre-requisites	battery, photovoltaic conversion
Field of Research	Materials for Energy

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Name	Xiaohong Huo	Email	huoxiaohong@sjtu.edu.cn
Department	School of Chemistry and Chemical Engineering		
Project Title	Bimetallic catalysis in stereodivergent synthesis		
Project Description	As the extension of mono-metal catalysis, bimetallic catalytic systems are able to activate two inert substrates, and make it easy to construct two adjacent stereocenters. By using two chiral metal catalysis, it is possible to achieve stereodivergent 23ynthesis that any stereoisomer can be accessed by choosing appropriate catalyst combinations.		
Pre-requisites	Interested in organic chemistry		
Field of Research	organic synthesis; asymmetric catalysis		

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Name	Jinwei Zhu	Email	jinwei.zhu@sjtu.edu.cn
Department	Bio-X Institutes		
Project Title	Mechanistic basis of GIT1-mediated complexes in synaptic vesicle recycling		
Project Description	Precisely coupling of exocytosis and endocytosis of synaptic vesicle (SV) is crucial for synaptic signal transduction. Mutations in genes involved in this process can cause a broad spectrum of human psychiatric disorders. The components in the presynaptic active zone play critical roles in SV recycling. Although the molecular basis of active zone components in SV exocytosis has been extensively investigated, the mechanisms underlying the SV recycling (SV endocytosis process in particular) are largely elusive. Recent studies have demonstrated that GIT1-Piccolo-Arf6 complex in active zone plays an important role in SV recycling, however, little is known about how GIT1-mediated complex assembles. Here, we plan to systematically study the molecular details of GIT1-mediated protein complex, complex structure, regulation mechanism of the GAP activity of GIT1 toward Arf6, and in vivo function of the complex in SV recycling, using combination of biochemical, structural, enzymatic, and neurobiological approaches. We hope that our biochemical and structural discoveries will largely improve our understanding of action mechanisms of active zone components in SV recycling, and provide valuable information for the drug design for psychiatric disorders.		
Pre-requisites	Applications from candidates in the Biochemistry, Structural biology or Neuroscience are strongly encouraged.		
Field of Research	Molecular cellular neurobiology		

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Name	Jie Ma	Email	jma3@sjtu.edu.cn
Department	School of Physics and Astronomy		
Project Title	Studying the physical properties of quantum magnet		
Project Description	Exploring the ground state of frustrated quantum magnet has been one of the main subjects of condensed matter physics. Geometrically frustrated 25agome lattice is expected to give rise to highly degenerated ground states that prevent spins from ordering, thus allows for new states of matter such as quantum spin liquid and fractionalized magnetic excitations. Especially, if a spin liquid Mott insulator is found in, the method of doping might naturally lead to superconductivity. Therefore, a 25 agome antiferromagnet presents an ideal construct for studying the unusual physics from their strong magnetic frustration. In this project, we will synthesize a frustrated magnet and measure the physical properties including the lattice, magnetization, heat capacity, thermal conductivity and electronic conductivity by X-ray diffractometer and Physical Property Measurement System (my group owns both instruments.)		
Pre-requisites	pre-requisite courses: solid state physics or chemistry		
Field of Research	condensed matter physics, material, chemistry		

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Name	Xiaofeng Gao	Email	gaoxiaofeng@sjtu.edu.cn
Department	Department of Computer Science and Engineering		
Project Title	Machine Learning-based Microservice Workload Prediction		
Project Description	With the widespread adoption of microservice architectures in web applications, predicting the workload of microservices has become an important research topic. However, microservice workload prediction faces challenges such as microservice		

	similarity, dynamic temporal patterns, and the effect of system state. Existing methods have not adequately integrated the similarity of microservices with the temporal patterns of their workloads. To address these challenges, we use Spatio Temporal Graph Neural Networks (STGNN) for microservice workload prediction. By modeling microservices as nodes in a graph, we can capture their similarity through a dynamic fusion mechanism across multiple constructed graphs. This project is to use machine learning methods to effectively predict the workload of microservices in the real industrial scene.
Pre-requisites	self-motivated, have interests in time series prediction
Field of Research	Data Engineering, Timeseries Prediction, Spatio Temporal Prediction

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Name	Xiangwen Gao	Email	xiangwen.gao@sjtu.edu.cn
Department	Global Institute of Future Technology		
Project Title	Understanding the failure mechanism of solid-state lithium batteries		
Project Description	Li-ion battery technology has 26ecarbonize26ed consumer electronics and grid electricity storage, but even when fully developed today's Li-ion battery technology will not deliver the energy needed to meet the fast-expanding electric vehicle market's demands. New battery technologies are desired to 26ecarbonize transportation and achieve the net zero carbon emission target. Solid-state lithium batteries, in which the liquid electrolyte is replaced by a lithium-ion-conducting ceramic, offer improved safety and, if the graphite anode is replaced by lithium metal, higher energy density than liquid electrolyte cells. However, the substitution of liquid-solid interfaces with solid-solid interfaces presents complicated challenges on both the cathode and anode side, involving the chemical, electrochemical and mechanical failure mechanisms. In this research we will choose model systems to decouple various influencing factors and understand the true failure mechanism of solid-state		

	batteries to provide fundamental foundation to improve the performance of solid-state batteries, especially at practical conditions.
Pre-requisites	Students should have basic foundation of chemistry/materials science. Students should be outgoing, willing to collaborate with group members and eager to work on science.
Field of Research	Batteries, Electrochemistry, Energy Storage

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Name	Xizhong Chen	Email	chenxizh@sjtu.edu.cn
Department	Chemistry and Chemical Engineering		
Project Title	AI for science in chemical and pharmaceutical applications		
Project Description	Pharmaceutical sector is transitioning from traditional batch operations to continuous processing and predictive models will greatly facilitate this transition. As sensors and monitoring equipment are increasingly employed, valuable data on the critical material attributes, process parameters and quality attributes are now possible to be acquired in real-time through process analytical technology. It is expected that the next decade will see step changes in data-driven technology, impacting all aspects of the process industries. While the state-of-art machine learning models have great potential for process control and operations, machine learning alone ignores the fundamental laws of physics and makes predictions with little or no interpretability. Multiscale modelling can act as a complement to define the physical constraints of the design space, generate numerical data to enrich the data volume and elucidate mechanisms that explain the emergence of functions. Therefore, this project is focused on developing and implementing a Multiscale model Informed Machine Learning approach for modelling industrial processes.		
Pre-requisites	Some programming skills and interested in computer simulation		
Field of Research	Physics； Mathematics; Pharmaceutical; Engineering		

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Name	Xiaowei Yang	Email	yangxw@sjtu.edu.cn
Department	School of Chemistry and Chemical Engineering		
Project Title	Advanced rechargable magnesium battery (RMB)		
Project Description	magnesium batteries have become an important direction in the development of new electrochemical energy storage systems. However, achieving high–voltage, long–cycle secondary magnesium batteries still faces significant challenges: electrolytes with simple salts and wide electrochemical windows would react with the magnesium metal anode to form a "passivation layer" that doesn't conduct magnesium ions, resulting in suboptimal electrochemical performance. This project will investigate the formation mechanism of the components of the passivation layer on the magnesium metal anode and construct ideal interface phases, by revealing the role of ion solvation structures in the formation of the passivation layer, regulating solvation structures, constructing various functional interface phases, and promoting the reversible deposition/dissolution of the magnesium anode.		
Pre-requisites	NA		
Field of Research	interdiscipline, chemistry, material science, chemical engineering		

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Name	Gaojin Li	Email	gaojinli@sjtu.edu.cn
Department	School of Naval Architecture, Ocean & Civil Engineering		
Project Title	Experimental and Numerical Study of Multiphase Chemo-hydrodynamics of Artificial Cells		

Project Description	Artificial cells, including coacervate microdroplets and polymersome vesicles, have exhibited great potential in organelle mimicking, intelligent disease detection & therapy, and fabrication of biomimetic materials. The physiological functionalities of the artificial cells are closely related to their designed dynamic behavior, such as growth & division, oriented motility, endocytosis & exocytosis, etc. To understand the underlying physics, this project will develop chemo-hydrodynamical theory for active droplets, considering the coupling among phase field, chemical potentials, and fluid flow.
Pre-requisites	Fortran or C++, Fluid Mechanics
Field of Research	Fluid Mechanics

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Name	Chenglin Li	Email	lcl1985@sjtu.edu.cn
Department	School of Electronic, Information and Electrical Engineering		
Project Title	Graph network clustering-based federated learning		
Project Description	This project intends to construct a new federated learning algorithm by leveraging the graph network clustering methods. Specifically, the distribution heterogeneity of client data and the computing and storage capacity of these clients will be considered to construct a graph network, which will then be used for the federated optimization of a common objective via the local training of multiple clients. Based on the constructed graph network and though application of a proper graph clustering methods, a new federated learning algorithm will be designed to dynamically select the local participation clients at each communication/optimization round, such that the data heterogeneity issue can be alleviated.		
Pre-requisites	Be familiar with deep learning, federated learning and graph neural networks; master any deep learning framework such as Python and Tensorflow/Pytorch.		
Field of Research	Machine learning, communication systems		

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Name	Jianping He	Email	jphe@sjtu.edu.cn
Department	School of Electronics Information and Electrical Engineering		
Project Title	Research on Attack and Defense of the Platform of Multi-robot Cooperative Control		
Project Description	In recent years, more and more people focus on multi-robot cooperative control systems, for their excellent abilities of finishing complex tasks. However, the safety problem of the system is also fierce, due to its high distributed fashion and openness to outside world while operating in real environments. In this research, we aim at designing smart and efficient attack towards the multi-robot system via local information and learning-based methods, and then propose defense strategy through a systematic approach. In the end, we'll test our algorithm in simulation and real robot platforms to verify the effectiveness of the proposed theory.		
Pre-requisites	Prioritize students majoring in fields such as robotics, computer science, electrical engineering, or a related discipline. It is beneficial to have coursework or a strong interest in areas such as robotics, control systems, machine learning, or artificial intelligence.		
Field of Research	Robotics, Control System		

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Name	Genliang Chen	Email	leungchan@sjtu.edu.cn
Department	School of Mechanical Engineering		
Project Title	Interactive manipulation with a dexterous gripper embodied tactile sensor		
Project Description	This project studies the grasping performance of a flexible two-finger gripper that integrates tactile sensors into the structure. Theoretical analysis and experiments will be carried out to accomplish the interactive manipulation of grasped objects with the environment.		
Pre-requisites	Manufacturing of robotic system, including actuators, mechanisms, and control		
Field of Research	Robotics		

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Name	Wei Gu	Email	weiku@sjtu.edu.cn
Department	TSUNG-DAO LEE INSTITUTE		
Project Title	Dynamical manifestation of quantum information		
Project Description	This project aims to illustration the physical meaning of quantum information through its impacts on dynamical evolution of quantum systems.		
Pre-requisites	Quantum mechanics		
Field of Research	Quantum physics and information		

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Name	Yongping Huang	Email	insectgroup@sjtu.edu.cn
Department	School of Environmental Science and Engineering		
Project Title	Bioconversion of organic waste through Black Soldier Fly		
Project Description	Our daily life and production generate a large amount of organic waste, such as food waste, livestock manure, and industrial organic waste. The traditional methods of landfilling and incineration not only pollute the environment but also result in the waste of organic matter. Black soldier flies are a type of insects that can feed on organic wastes. Through their bilogical conversion, they can produce high-quality protein and organic fertilizers, turning waste into treasure. Our research focuses on improving conversion efficiency through molecular breeding to achieve the goals.		
Pre-requisites	Students who have strong interests in material circulation and motivation to promote the improvement of Environment.		
Field of Research	Environmental Science and Life Science		

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Name	Hongjian He	Email	hjhe@sjtu.edu.cn
Department	School of Physics and Astronomy		
Project Title	Scattering Amplitudes and Gauge-Gravity Duality		
Project Description	This is theoretical physics study, but suitable for undergraduate students, starting from learning basics of Quantum Field Theory.		
Pre-requisites	Quantum Mechanics, Electrodynamics		
Field of Research	Theoretical Physics		

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Name	Jun Zhao	Email	junzhao@sjtu.edu.cn
Department	School of Biomedical Engineering		
Project Title	Multi-Time Lung Nodule Image Generation in Follow-up CT Scans		
Project Description	Follow-up information plays an important role in lung nodule analysis. In clinical practice, the diverse follow-up intervals among patients pose a challenge for models to effectively capture temporal features. This project aims to harmonize the time intervals through the implementation of specialized image generation networks, which can enhance the performance of lung nodule malignancy classification.		
Pre-requisites	Image Processing		
Field of Research	Medical Image Analysis		

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Name	Jun Zhao	Email	junzhao@sjtu.edu.cn
Department	School of Biomedical Engineering		
Project Title	Implict neural representation based sparse 3d reconstruction for dental model.		
Project Description	Using implicit neural representation based methods to reconstruct the surface of dental model. We can supply the input data, which can be RGB or RGB-D. We need students to try these deep learning methods, using as few input angles as possible without compromising the quality of the final reconstruction.		
Pre-requisites	Computer Vision, Image Processing		
Field of Research	Medical Imaging		

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Name	Jun Zhao	Email	junzhao@sjtu.edu.cn
Department	School of Biomedical Engineering		
Project Title	Deep learning-based metal artifact reduction in oral CBCT		
Project Description	Oral Cone Beam Computed Tomography (CBCT) provides reliable imaging data for dentists with its advantages of lower radiation dose, higher spatial resolution and three-dimensional visualization images. However, with the widespread application of restorative and implant materials, the metal artifacts produced by some oral metal materials may affect the postoperative evaluation. There are many metal artifact reduction (MAR) techniques. Iteration-based methods have shown good performance in reducing metal artifacts, but their clinical application in CBCT is still limited due to excessive computational complexity. Interpolation-based methods correct metal data through interpolation in the sinogram, but secondary artifacts may be produced. In recent years, deep learning-based methods have been proposed to solve the		

	problem of MAR in CBCT. Although they have better MAR performance on simulation datasets than the traditional methods, further researches on clinical datasets are needed. In this research, we will focus on real-world MAR problem on oral CBCT images.
Pre-requisites	Image Processing
Field of Research	Medical Imaging

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Name	Zhe Liu	**Email**	liuzhesjtu@sjtu.edu.cn
Department	School of Electronic, Information and Electrical Engineering		
Project Title	Motion coordination for large-scale multi-robot systems		
Project Description	In this project, we will study the task allocation, path planning and motion coordination issues of multi-robot systems with thousands of mobile robots. Optimization approaches will be used for planning. Learning based approaches will also be utilized for traffic prediction and local motion coordination. The proposed approaches will be used for robotic warehousing application scenarios.		
Pre-requisites	We hope the candidate has some background knowledges of optimization and robot planning, but not necessary.		
Field of Research	Robotics		

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Name	Zhe Liu	**Email**	liuzhesjtu@sjtu.edu.cn
Department	School of Electronic, Information and Electrical Engineering		

Project Title	Robust end-to-end navigation of self-driving vehicles
Project Description	In this project, we will build an end-to-end navigation model for self-driving vehicles. In particular, we will investigate the robust drving issues in the presence of sensor noises, bad weathers, external disturbances, as these issues actually be as the main reason that the self-driving cars cannot be used in our daily life nowadays. We will use learning based approaches and specific simulator. We also will conduct real experiments on small-scale cars.
Pre-requisites	We hope the candidate has some background knowledges about learning models and navigation approaches, but not necessary.
Field of Research	Robotics; Self-driving