上海交通大學
SHANGHAI JIAO TONG UNIVERSITY

SJTU SUMMER RESEARCH INTERNSHIP PROGRAM

2025

Contact :
http://summerprogram.sjtu.edu.cn/
Email: isc.mobility@sjtu.edu.cn

S J T U

20 SUMMER RESEARCH INTERNSHIP PROGRAM 25

Shanghai Jiao Tong University (SJTU) is a higher education institute in China that enjoys a long history and a world-class reputation. Over 129 years, SJTU has become a top comprehensive and research-oriented international university in China. SJTU enjoys an ever-increasing level of excellence in scientific research and technological innovation.

The SJTU Summer Research Internship Program aims to promote international research collaboration and enhance the academic environment at Shanghai Jiao Tong University. It offers excellent undergraduate students from all around the world the opportunity to spend a summer working in a world-class research laboratory alongside prominent research professors. It will prepare undergraduate students for further studies through intensive research experience with faculty mentors and enrichment activities.

In addition, participants will develop their research skills by attending lectures with topics such as "How to Write a Research Essay" and "How to Collaborate on a Project". Participants will also learn about Chinese language and culture, which will enhance their intercultural awareness and communication.

What will participants receive?

> Knowledge of the top research projects in China
> The opportunity to work with top Chinese professors, fellows, and students
> A good foundation for a career in academic research
> The opportunity to co-author a scientific paper
> Exposure to Chinese language and culture
> A rewarding and unforgettable experience in China

Eligibility Requirements

> Students from overseas (Non-Chinese Citizens), Hong Kong, Taiwan, and Macao are eligible to apply.
> Students must have completed at least one year of an undergraduate program and be currently enrolled as an undergraduate.
> Hold at least a 3.0 GPA on a 4.0 scale or equivalent.
> Students from non-English speaking countries must provide an English language proficiency certificate: an IELTS with a score of no less than 6.0 or a TOEFL with a score of no less than 78 points. If you are studying in a fully English-taught program, you must provide the relevant certificates.
> Additional requirements vary according to the laboratory.

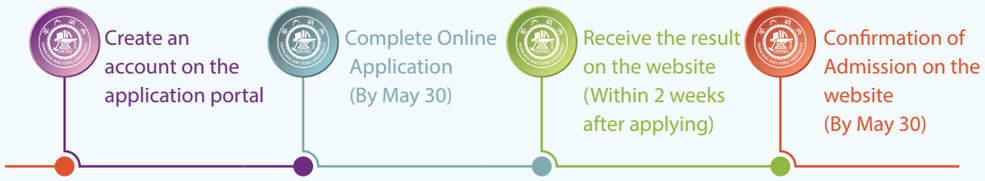
Duration

June 30, 2025 – August 10, 2025

Academic Information

Credit	3 SJTU Credits	
Program duration	In-Lab Hours: 20 hours/week	
Assessment	There are three grading sections in this program:	
	Attendance	=30%
	Midterm presentation	=30%
	Final written report	=40%

Application Procedures



Please apply through the website: ***http://apply.sjtu.edu.cn*** [1]

The following items shall be uploaded alongside the online application:

- A scan of the identification page of your passport. The passport must be valid for at least 6 more months for the visa application.
- ID photo (similar to a passport photo)
- Curriculum vitae (CV)
- Copy of your most recent academic transcript
- Motivation letter
- Recommendation letter
- Report of your past research experience (if available)
- Language proficiency certificate (if available)

Program Fee

Application fee (non-refundable)	400RMB

[1] It is very important that you fill in your name correctly on the online application. You should type in your legal name exactly as it appears on your passport.

Online Application Deadline

May 30, 2025

Announcement

You will be notified of the results through our website and receive an email confirming the receipt of your application within two weeks of submission.

Certificate and Transcript

After completing the program and submitting the final report, participants will receive an official certificate from the university.

Official transcripts will be sent in September 2025 by email. Students who wish to transfer credits need to obtain pre-approval from the relevant authorities at their home universities.

Timeline

Preparation for the Application	
Completion of the online application	January to May, 2025
Notification of the application result	February to May, 2025
Registration	June 30, 2025
Opening Ceremony	July 1, 2025
Internship	June 30 – August 10, 2025
Finishing the program survey of issuing of certificates	August 30, 2025
Transcript delivery	September 2025

Contact

Email: isc.mobility@sjtu.edu.cn
Website: http://summerprogram.sjtu.edu.cn/

PROJECT LIST

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MECHANICAL ENGINEERING

PROJECT 01

Digital Twin Technology in Workshops

Contact Information:
Prof. Hao Wang
Email: wanghao@sjtu.edu.cn

Project Description and Objectives:

Digital twin technology is developing very rapidly and has been widely used in all aspects of industrial production. This project will make full use of physical models, sensor updates, and other data to display the condition of equipment in workshops.

Eligibility Requirements:

Interested students should be very proficient in C++ programming and have basic knowledge of medical image computing.

Main Tasks:

> Finish a research report.
> Develop software.

Website:

Lab: http://fpcsm.sjtu.edu.cn
School: http://me.sjtu.edu.cn/English/Default.aspx

PROJECT 02

Intelligent Assembly Guidance System

Contact Information:
Prof. Hao Wang
Email: wanghao@sjtu.edu.cn

Project Description and Objectives:

Based on machine vision and machine learning, the main purpose of this system is to guide workers in assembling complex products. In addition, the system can correct an assembly if an error occurs.

Eligibility Requirements:

Interested students should be very proficient in C++ programming and have basic knowledge of medical image computing.

Main Tasks:

> Finish a research report.
> Develop software.

Website:

Lab: http://fpcsm.sjtu.edu.cn
School: http://me.sjtu.edu.cn/English/Default.aspx

PROJECT 03

The Development of Myoelectric Recording Device for Motionless Gesture Recognition

Contact Information:

Prof. Xinjun Sheng
Email: xjsheng@sjtu.edu.cn

Project Description and Objectives:

The objective of this project is to develop a myoelectric recording device for motionless gesture recognition. Surface electromyography (sEMG) contains abundant information related to hand motions that can be used to recognize different gestures. Motionless gesture recognition techniques aim to recognize gestures through electrophysiological activities of human muscles, even if there are only motor intentions but no real motions, which can be utilized to realize human-machine interactions under 00 b circumstances. To this end, we propose to develop a recording device for local high-density sEMG signals which could be used to decode the motor unit action potential trains (MUAPt). The relationship between motionless gestures and sEMG signals or the decoded MUAPt also will be investigated. Finally, a demonstration based on the motionless gesture recognition technique should be given, for example, by controlling a computer game.

Eligibility Requirements:

The interested student should have a basic knowledge of electronic engineering and signal processing.

Main Tasks:

> Finish a research report.
> Give two research presentations (a. references review; b. technical presentation).
> Submit one paper to a journal as a co-author.

Website:

Lab: http://bbl.sjtu.edu.cn
School: http://me.sjtu.edu.cn/English/Default.aspx

PROJECT 04

Chemistry in Clean Combustion

Contact Information:

Prof. Fei Qi
Email: fqi@sjtu.edu.cn

Project Description and Objectives:

Combustion provides over 85% of the global primary energy supply nowadays. Clean combustion is one of the most important approaches to achieve an environmentally friendly energy supply. To reduce the air pollutants in combustion, many novel combustion concepts have been proposed, where chemistry plays a crucial role. In this study, the chemistry in low-temperature combustion (LTC), which is a novel combustion concept to reduce both NOx and PM emissions in engine combustion, will be investigated with advanced experimental approaches. Key elementary LTC reactions will be investigated using a newly designed shock tube over a wide range of pressures and temperatures. A flow reactor and a jet-stirred reactor combined with mass spectrometry (MS), gas chromatography (GC), and GC×GC technique will be used to understand the secrets in LTC engine-relevant conditions. A kinetic model for the investigated fuel will be developed and validated based on the experimental findings. The outcome from this study will be used to explore strategies for the control of combustion pollutant emissions in a more intelligent way.

Eligibility Requirements:

> Understanding of lab safety.
> Physical chemistry knowledge.
> Students who have experience in labs are preferred.

Main Tasks:

> Measurements of key elementary LTC reactions in a shock tube.
> Measurements of key intermediates in a flow reactor and a jet-stirred reactor using various diagnostic tools.
> Development of a kinetic model for a specific engine fuel.

Website:

Lab: http://combustion.sjtu.edu.cn/home/
School: combustion.sjtu.edu.cn

PROJECT
05

Gas Turbine Model Reactor: Swirling Flame Dynamics Investigated by Laser Diagnostics

Contact Information:
Prof. Fei Qi
Email: fqi@sjtu.edu.cn

Project Description and Objectives:
Combustion diagnostics techniques based on laser spectroscopy are accurate and nonintrusive techniques that have emerged to become an indispensable tool of combustion science and the development of combustion technology. In this study, a swirl-stabilized burner is constructed to investigate flame dynamics and thermoacoustic instability. It consists of a driver unit, a settling chamber, a contraction ended by a constant diameter duct, a horizontal end piece and an enclosed chamber. The rotation of the flow is induced by an axial swirler equipped with eight twisted airfoil vanes. A small bluff body is used to stabilize the flame during the unsteady motion of the flow. A loud speaker installed at the bottom of the setup provides acoustic excitation to the flame. Air and fuel are premixed and then enter the bottom of the burner through two tubes.

To investigate the response of the swirling flame to the acoustic excitation, both the unsteady flow field and the evolution of the flame surface are measured simultaneously. The measurement techniques mainly depend on a high-speed burst mode Nd:YAG laser with a repetition rate of up to 100 kHz and two intensified high-speed CMOS cameras. High-speed PIV is used for the measurement of the unsteady flow field. PLIF for the distribution of CH2O/acetone is used to capture the evolution of the flame front. Tunable diode laser absorption spectroscopy is adopted for the measurement of flame temperature and concentrations of CO2/ H2O. A hot wire is equipped in the downstream of the swirler used to measure the flow velocity variation due to the acoustic excitation. Raman scattering techniques have also been used in this study.

Eligibility Requirements:
> Understanding of lab safety.
> Knowledge of combustion and flame dynamics is necessary.
> Interested students should have basic knowledge of laser and photonics.

Main Tasks:
> Measurement of swirling flame dynamics using laser diagnostics techniques based on burst mode pump laser, Raman spectroscopy, or absorption spectroscopy.
> Development of transverse sound measurement of the ring-shaped combustor.
> Developing a flame transfer function between the upstream forcing and flame response.

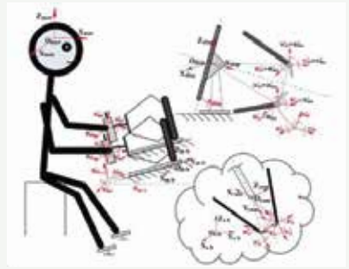
Website:
Lab: http://combustion.sjtu.edu.cn/home/
School: combustion.sjtu.edu

PROJECT
06

Hand-Eye Coordination Algorithm for a Minimally Invasive Surgical Robot

Contact Information:
Prof. Qixin Cao
Email: qxcao@sjtu.edu.cn

Project Description and Objectives:
Typical minimally invasive surgical robots are generally controlled by remote operation; that is, doctors use a main hand device to control the distal surgical robot to carry out operations according to the endoscopic image. This approach has a variety of advantages. On one hand, the robot can be more stable and accurate than the doctor's hand, on the other hand, it is very useful for surgeries that need to be operated in the X-ray environment, such as some orthopedic surgeries. More importantly, the isolation of doctors and patients by geographical location can make the future realize the sharing of genuine medical resources. Excellent doctors can be shared with people around the world.



The hand-eye coordination algorithm studied in this project aims to establish a mapping between hand movements and endoscopic images to enhance doctors' surgical precision. Hand-eye coordination involves the control of the robot, the coordinate system transformation, etc. This is one of the core technologies utilized by remote operation.

Eligibility Requirements:
The interested student should have a basic knowledge of robot controls and coordinate transformation.

Main Tasks:
> Finish a research report.
> Give two research presentations (a. references review; b. technical presentation).

Website:
Lab: http://robolab.sjtu.edu.cn/
School: http://me.sjtu.edu.cn/English/Default.aspx

PROJECT 07

Mechanism Design of Medical a Robotic System

Contact Information:

Asso. Prof. Yanping Lin
Email: yanping_lin@sjtu.edu.cn

Project Description and Objectives:

This medical robotic system would be used in surgical operations. Its main function is to accomplish puncturing or drilling operations accurately. In order to meet the requirements of surgical operations, the robotic system should have the following functions: 1) Locating different surgical tools conveniently such as puncture needle or drills in the right location and orientation. 2) Driving the surgical tools moving along its axis. This project mainly researches and designs a novel mechanical structure of the medical robotic system to meet the above functional requirements.

Eligibility Requirements:

The interested student should have a basic knowledge of Mechanical Engineering.

Main Tasks:

> Complete mechanical structure design of the surgical robot end-effector.
> Finish 3D modeling and 2D drawing of the end-effector.

Website:

Lab: http://sseme.sjtu.edu.cn/CN/Default.aspx
School: http://me.sjtu.edu.cn/English/Default.aspx

PROJECT 08

Key Technology in Surgical Robotics Based on Artificial Intelligence and Augmented Reality

Contact Information:

Prof. Xiaojun Chen
Email: xiaojunchen@sjtu.edu.cn

Project Description and Objectives:

For modern minimally-invasive surgery, microscopic/endoscopic techniques are widely used in the field of surgery, however, the current orthopedic robots are only applicable for traditional open surgery. Their working principles, operation modes, as well as the software and hardware systems simply do not apply to microscopic/endoscopic surgeries as they are currently designed. In this project, some leading-edge algorithms based on artificial intelligence regarding multi-modal image registration, automatic segmentation, high quality visualization, and precise planning are proposed for important anatomical structures in the musculoskeletal system. Then, a surgical navigation system based on Augmented Reality is established based on real time segmentation, non-rigid registration, and 3D reconstruction for an intra-operative ultrasound and endoscopic images, aiming at solving the problems of soft tissue deformation and tracking. Finally, the comprehensive, light, and smart mechanical structures and control systems for surgical robots in endoscopic orthopedics are designed and integrated with our previously self-developed surgical navigation and robotic system, achieving the ultimate prototype of "Microscopic/Endoscopic Surgical Robotics Based on Augmented Reality". The accuracy, effectiveness, and reliability of the whole system will be validated through phantom experiments and clinical trials, for the goal of the mass clinical application. The research outcome of this project will promote the personalization, safety, accuracy, and minimal invasion of microscopic/endoscopic orthopedics, leading the direction in the international field of orthopedic robotics.

Eligibility Requirements:

The interested student should be very proficient in C++ programming and have a basic knowledge of medical image processing.

Main Tasks:

> Develop a software.
> Finish a research report.
> Give two research presentations (a. references review; b. technical presentation).
> Submit one paper to a journal as a co-author.

Website:

Lab: http://sseme.sjtu.edu.cn/EN/Default.aspx
School: http://me.sjtu.edu.cn/English/Default.aspx

PROJECT 09

Research on Digital Design and Manufacturing of Customized Implants (Surgical Templates) Based on Artificial Intelligence and 3D-Printing

Contact Information:

Prof. Xiaojun Chen
Email: xiaojunchen@sjtu.edu.cn

Project Description and Objectives:

Oral disease is one of the most common diseases in humankind. As the treatment of oral diseases, oral and maxillofacial surgery aims to treat the entire craniomaxillofacial complex: the anatomical area of the mouth, jaws, face, skull, as well as associated structures. However, the limited intraoperative visibility, especially the anatomical intricacies, makes this kind of surgery a demanding procedure. Also, the accuracy and stability of the operations are very difficult to guarantee. In this project, with the integration of artificial intelligence, computer-assisted surgical planning, virtual reality, computer graphics, and 3D-Printing, the methodology of the design and manufacturing of a customized template is presented for oral and maxillofacial surgery, aiming to meet the unique demands of China's clinical application.

Based on relevant basic theory and innovative algorithms, a computer-assisted AI-based preoperative planning system and virtual simulation system will be realized to determine the optimal surgical path for oral and maxillofacial surgery. Then, the system for digital design and manufacturing of customized templates will be presented. Through phantom experiments and clinical trials, the influence of factors such as the geometrical contours, material properties, and processing parameters of the devices on the processing quality and clinical accuracy will be revealed. Therefore, those parameters can be optimized to demonstrate its accuracy, validity, and reliability. Ultimately, an integrated platform for digital design and manufacturing of customized templates will be formed, aiming to provide innovative technical methods for the personalization, digitalization, and minimal invasion of oral and maxillofacial surgery, and greatly improve the general life quality of the patients.

Eligibility Requirements:

The interested student should be very proficient in C++ programming and have a basic knowledge of medical image processing.

Main Tasks:

> Develop software.
> Finish a research report.
> Give two research presentations (a. references review; b. technical presentation).
> Submit one paper to a journal as a co-author.

Website:

Lab: http://sseme.sjtu.edu.cn/EN/Default.aspx
School: http://me.sjtu.edu.cn/English/Default.aspx

PROJECT 10

Efficient Usage of Low-Grade Heat

Contact Information:

Dr. Zisheng LU
Email: zslu@sjtu.edu.cn

Project Description and Objectives:

Commercial and residential buildings consume almost 40% of the primary energy in the United States or Europe and nearly 30% in China. To reduce the dependence of buildings on primary energy, several studies on energy-saving technologies have been conducted worldwide. In addition, renewable energy utilization is regarded as a reasonable solution to global warming, air pollution, and energy security. Through integrating the technologies of energy-efficient and renewable energy utilization in buildings, the net-zero energy building is an innovative concept for a high-performance building.

Eligibility Requirements:

> The interested student should have basic knowledge of renewable energy, air-conditioning, green building, sorption cooling technologies, etc.
> The interested student should be familiar with CAD or 3D software.
> Excellent writing and communication skills are mandatory.

Main Tasks:

> Be familiar with different building energy saving technologies, such as adsorption, absorption, dehumidification, etc.
> Can propose new designs, analyze and optimize them.
> Carry out simulations of different design concepts.
> Write a technical report on the results.

Website:

Lab: www.sjtuirc.sjtu.edu.cn
School: http://me.sjtu.edu.cn/English/Default.aspx

PROJECT 11

Modelling and Simulation of Debris Attachment on the CMM Stylus and the Impact on Measurement Accuracy

Contact Information:

Assoc. Prof. Xiaobing Feng
Email: xiaobing.feng@sjtu.edu.cn

Project Description and Objectives:

Coordinate measurement machines (CMMs) are widely used in industry to measure the geometrical dimensions of products as a part of the quality control process. During measurement, debris particles adhere to the surface of the CMM stylus tip. Such debris significantly impairs the dimensional accuracy of a CMM, which is critical for the measurement of precision-engineered products. This project will investigate the impact of the debris particles on the measurement accuracy of the CMM. The phenomenon of particle adhesion on the CMM stylus will be modeled. Simulation of particle adhesion and deformation will be conducted. The outcome of the project will help determine the significance of debris attachment during several CMM measurement tasks commonly used in industry and potential measurement errors.

Eligibility Requirements:

> 3rd year and above undergraduate students majoring in Mechanical/Electrical/Sensory engineering.
> Students with research experience are highly desired.
> Knowledge of metrology and/or the CMNC machine tool is highly desired.

Main Tasks:

The participant will carry out particle mechanics analysis of debris involved in CMM measurement, investigate the debris attachment/detachment mechanism, and conduct a simulation of debris attachment on the CMM stylus tip during measurement.

Website:

Lab: N/A
School: http://me.sjtu.edu.cn/English/Default.aspx

PROJECT 12

Experimental Investigation of Debris Attachment on the CMM Stylus Particles on the Measurement Accuracy of the CMM

Contact Information:

Assoc. Prof. Xiaobing Feng
Email: xiaobing.feng@sjtu.edu.cn

Project Description and Objectives:

Coordinate measurement machines (CMMs) are widely used in industry to measure the geometrical dimensions of products as a part of the quality control process. During measurement, debris particles adhere to the surface of the CMM stylus tip. Such debris significantly impairs the dimensional accuracy of a CMM, which is critical for the measurement of precision-engineered products. This project will experimentally investigate the adhesion of debris particles on the CMM stylus. Debris of various materials and shapes from multiple manufacturing processes will be studied and categorized. CMM measurements will be conducted and data analysis will be performed to determine the impact of debris on measurement error. The outcome of the project will help determine the significance of debris attachment and assess measurement errors.

Eligibility Requirements:

> 3rd year and above undergraduate students majoring in Mechanical/Electrical/Sensory engineering.
> Students with research experience are highly desired.
> Knowledge of metrology and/or the CMNC machine tool is highly desired.

Main Tasks:

Students will carry out experimental investigations on debris attachment on CMM stylus tips, including the collection and characterization of manufacturing debris, applying different methods for applying collected debris particles onto the workpiece surface with desired distribution, conduct CMM measurement experiments using contaminated workpieces, and determining the extent of contamination on the stylus tips.

Website:

Lab: N/A
School: http://me.sjtu.edu.cn/English/Default.aspx

PROJECT 13

On-Machine Measurement of the Workpiece on a CNC Machine Tool towards Industry 4.0 and Intelligent Manufacturing

Contact Information:

Assoc. Prof. Xiaobing Feng
Email: xiaobing.feng@sjtu.edu.cn

Project Description and Objectives:

On-machine workpiece measurement is becoming a key part of the next industrial revolution in precision manufacturing. On-machine metrology can not only assist in automated precision workpiece positioning, but also enable the in-situ detection and compensation of machining errors. This project will implement on-machine metrology by integrating a surface measurement sensor on the machine tool. The software will be developed to simultaneously control sensor readings and the motion of the machine tool. The accuracy of on-machine measurement will be evaluated according to ISO 10360 specification standards. The outcome of the project will demonstrate the capabilities of on-machine metrology utilizing the machine tool as part of the metrology system.

Eligibility Requirements:

> 3rd year and above undergraduate students majoring in Mechanical/Electrical/Sensory engineering.
> Students with research experience are highly desired.
> Knowledge of metrology and/or the CMNC machine tool is highly desired.

Main Tasks:

The student will carry out an experimental investigation on on-machine metrology, including analysis of common measurement sensors, the design, installation and operation of an on-machine sensor on the machine tool, establish communication between the sensor and machine tool, and evaluation of the performance of the developed on-machine measurement sensor according to methods specified in ISO 10360 specification standards.

Website:

Lab: N/A
School: http://me.sjtu.edu.cn/English/Default.aspx

PROJECT 14

Preliminary Study on Fuel Cell and DIY for its Catalysts

Contact Information:

Prof. Junliang Zhang
Email: junliang.zhang@sjtu.edu.cn

Project Description and Objectives:

This program aims to cultivate the interest and research ability of overseas students in the field of electrochemical energy, especially in the domain of fuel cells. It also hopes to improve the hardware infrastructure for student learning, experimentation, and discussion. In addition, we would like to build a team of instructors with an international perspective to guide engineers, and to consider the characteristics of overseas students to ensure effective teaching management and communication for these students.

Eligibility Requirements:

> Be interested in new energy.
> Have basic knowledge of electrochemistry.
> Have experience with chemical experiments in a lab.
> Ability to write a standard experimental report.

Main Tasks:

> Develop students' interest in electrochemistry.
> Let students enjoy the process of basic scientific research at SJTU.

Website:

Lab: http://fuelcell.sjtu.edu.cn
School: http://me.sjtu.edu.cn/English/Default.aspx

PROJECT 15

Computer Vision for Intelligent Vehicles

Contact Information:

Assoc. Prof. Xuesong Li
Email: xuesonl@sjtu.edu.cn

Project Description and Objectives:

Automotive engineering and related technologies have gained substantial attention and investment in the information era. With the technology of hybrid vehicles, electric vehicles, vehicle-to-everything (V2X), assisted driving and autonomous driving, etc., new insights and rapid growth are seen in this industry, which embraces both traditional technologies and new methodologies. This summer research program will focus on some of the popular topics in this field, such as computer vision for the application of assisted-driving and autonomous driving. This program will aim at both theoretical studies including a literature review and report drafting, as well as gaining hands-on experience from programming and image processing to recognize vehicles/pedestrian/signal lights from real images captured. The objective of the project is to help the students develop ideas about how research projects and engineering projects are performed, and also help the students to understand the fundamentals for the chosen topics so that they would be better equipped in continuing or starting education/employment in the field of automotive engineering.

Eligibility Requirements:

Basic understanding of programming (Python preferred) and image processing.

Main Tasks:

> Traditional computer technology study such as camera calibration, color space conversion, edge detection, etc. for lane line detection.
> Image classification using machine technology like SVM and deep neural network such as LeNet, VGGNet, etc. These architectures are used in the up-to-date object detection algorithms like region-proposed CNN.
> Semantic segmentation of the image for drivable area detection using a fully connected neural network.

Website:

Lab: http://www.auto.sjtu.edu.cn
School: http://me.sjtu.edu.cn/

PROJECT 16

Optical Diagnostics for Optical IC Engines

Contact Information:

Assoc. Prof. Xuesong Li
Email: xuesonl@sjtu.edu.cn

Project Description and Objectives:

Although renewable energy vehicles are attracting increasing attention, traditional energy conversion schemes, such as a gasoline internal combustion engine, are still significant in the years to come. This course will offer a modern touch on how to optimize the new generation of gasoline power using laser diagnostics means. Various laser diagnostics methods, including laser-induced fluorescence, particle imaging velocimetry, high-speed imaging, Schlieren Interferometry, etc., will be introduced and implemented on a transparent optical engine. The liner and the piston of this single-cylinder engine are made from sapphire glass so that the situations inside can be well observed. Then data processing methods will be used to infer information such as combustion species, in-cylinder velocity distribution, soot formation, etc. This course aims to offer a preliminary experience in advanced optical methods for future studies in thermal and fluid sciences.

Eligibility Requirements:

Basic understanding of thermodynamics, fluid mechanics, and/or combustion physics.

Main Tasks:

> Perform optical/laser-based experiments for fuel spray diagnostics.
> Work on an actual optical engine and adjust operation parameters to vary the performance of the optical engine.
> Utilize laser-induced fluorescence, particle imaging velocimetry, Mie scattering, etc. and understand the flow field and combustion characteristics in the engine.

Website:

Lab: http://www.auto.sjtu.edu.cn
School: http://me.sjtu.edu.cn/

PROJECT 17

Design & Develop Highly Efficient Heat Exchangers/Heat Sinks by Additive Manufacturing

Contact Information:

Dr. Xu Yamin/ Prof. Yao Yu
Email: yaminxu@sjtu.edu.cn; yurao@sjtu.edu.cn

Project Description and Objectives:

To improve heat dissipation efficiency and save energy, we will design a new type of heat sink or heat exchanger, which will be made with 3D technology. Afterwards, a numerical simulation and a test will be performed to study its performance.
Through the scientific research project, the students will master basic experimental skills and enhance their scientific research skills in experimentation, innovation, and cooperation.

Eligibility Requirements:

Students should have some knowledge of physics and mathematics. Students with knowledge of thermodynamics and hydromechanics are preferred.

Main Tasks:

First, we will have students conduct three basic experiments to enhance their understanding of basic concepts, such as the three forms of heat transfer: heat conduction, convection and radiation. At the same time, students can master commonly used experimental techniques and methods. All these skills and knowledge are fundamental for further scientific research.
Second, students will be trained to solve practical problems. They will design a new type of heat sink or heat exchanger, and then a numerical simulation is performed using the model. Finally, the simulation results are verified by tests.

Website:

Lab: https://lcme.sjtu.edu.cn/openlab/
School: http://me.sjtu.edu.cn/

PROJECT 18

Optical Measurement Technologies for Complex Tube Geometries

Contact Information:

Assoc. Prof. Xiaobo Chen
Email: xiaoboc@sjtu.edu.cn

Project Description and Objectives:

As industries such as shipbuilding, aerospace, and aviation increasingly demand precision manufacturing, the design and production of complex tube systems have become critical areas for technological advancement. Traditional tube measurement techniques can no longer meet the growing need for high precision, efficiency, and adaptability. This project aims to develop advanced optical measurement methods for complex tube geometries based on the technologies of multi-stereo vision, system calibration, 3D reconstruction, image processing, and data evaluation. An optical measurement system for complex tubes will be developed and validated through practical applications. The ultimate goal of this project is to improve the accuracy of dimensional evaluations during the manufacturing process, leading to enhanced precision, higher quality, and greater efficiency in the production of tube components.

Eligibility Requirements:

1. Academic Background: Students from Mechanical Engineering or related fields with a solid foundation in engineering applications.
2. Technical Skills: Proficiency in MATLAB, capable of using the software for data processing, image processing, and algorithm development.

Main Tasks:

Participants in this program will learn and gain hands-on experience in the following areas:
1. Multi-Stereo Vision Measurement Principles: Understand the fundamentals of multi-stereo vision systems, and explore how they are applied for 3D measurement.
2. System Calibration: Learn how to calibrate multi-stereo vision systems to improve the measurement accuracy.
3. Digital Image Processing: Learn the image processing methods for extracting and reconstructing complex tube geometries.
4. Measurement Data Evaluation: Learn how to analyze the measurement data to evaluate the accuracy and reliability of results.
5. System Development and Validation: Design and construct an optical measurement system for complex tubes, and conduct experimental validation to evaluate its performance in practical applications.

Website:

Lab: https://lcme.sjtu.edu.cn/openlab/
School: http://me.sjtu.edu.cn/

ELECTRONIC INFORMATION AND ELECTRICAL ENGINEERING

PROJECT 19

Knowledge Graph Construction and its Application in Individual Relationship Analysis

Contact Information:
Assoc. Prof. Lihong Jiang
Email: Jianglh@sjtu.edu.cn

Project Description and Objectives:
A knowledge graph is a promising method of representing the semantics of information formally, which is mainly used in Web search engine development. For Web searching, knowledge graphs act as knowledge bases providing relationships between searched objects to enhance the search results. However, it is not easy to construct a knowledge graph automatically. NLP (Natural Language Processing) could be used to handle the problem of a knowledge graph. Based on the Knowledge Graph, entity relationships could be established so that the search results could be refined.
There exist several NLP toolkits to process sentences of natural language, but they need to be tailored for knowledge graph construction. Also, for the recognition of relationships of concepts in the knowledge graph, open-linked data need to be involved in building a bridge between isolated entities. Based on the setup of knowledge graphs, individual information on the Web can be searched, recognized and analyzed semantically.

Eligibility Requirements:
Interested students should be proficient in JAVA and Web application development.

Main Tasks:
> Software development.
> Finish a research report.
> Two research presentations.
> Submit one paper to a journal or conference as a co-author.

Website:
Lab: http://istsjtu.edu.cn
School: http://english.seiee.sjtu.edu.cn/

PROJECT 20

Cloud-Based Model-Driven Service Development

Contact Information:
Prof. Hongming Cai
Email: hmcai@sjtu.edu.cn

Project Description and Objectives:
Cloud-based software is a service or platform that interacts through the cloud or the Internet. One of its most streamlined delivery models is through the Software-as-a-Service (SaaS) model. These services are hosted and maintained by the vendor, meaning that the vendor hosts the service in a remote data center. Today's enterprise software application development is faced with complex and changing requirements, new needs and growing systems, software systems are becoming more and more complex, and it is difficult for ordinary software development methods to meet user needs quickly. Through model driven development, code generation can be archived. And a configuration engine can be implemented to generate information service so as to respond to requirement changes. The basic idea is to shift the development center from programming to high-level abstraction, and to drive some or all of the automated development by converting models into code or other artifacts.
First, we derive the basic model-driven principles of enterprise information systems by learning cloud-based service development methods. Second, by learning data mining related techniques, we generate corresponding process models from data and analyze the results to build corresponding business models. Then, through service application development, we master the driven service configuration and front-end development methods. Finally, the interface prototype of the system is implemented by using the existing cloud-based data modeling platform.

Eligibility Requirements:
Interested students should be proficient in java and web application development. Understanding microservices architecture and docker.

Main Tasks:
> Software development.
> Finish a research report.
> Two research presentations.
> Submit one paper to a journal or a conference as a co-author.

Website:
Lab: http://istsjtu.edu.cn
School: http://english.seiee.sjtu.edu.cn/

PROJECT 21

Energy Router for Future Energy Internet

Contact Information:

Prof. Miao Zhu
Email: miaozhu@sjtu.edu.cn

Project Description and Objectives:

With the development of energy and internet technologies, energy routers are becoming a key device for future energy internet. Energy internet is a brand-new concept that integrates the Internet with energy generation, transmission and consumption. Energy routers are the center of energy conversion and information interaction in energy internet, which is still developing and deepening with the on-going new scientific and technological revolution. This project will focus on energy routers for future networks. First, the basic concept and functions of an energy router will be investigated. Typical energy internet scenarios for energy routers will be summarized and presented afterward. Then key technologies, restraints and development trends of energy routers will be studied respectively. A general report will be presented as the final achievement.

Eligibility Requirements:

Basic knowledge of EE.

Main Tasks:

> Investigation of the concept of energy routers and energy internet.
> Summarizing typical scenarios of an energy router in energy internet.
> Investigation of key technologies of energy routers in typical scenarios.
> Discussion on the restraints and the development trends of energy routers.
> Finish a research report about this project.

Website:

Lab: http://www.ssgc.sjtu.edu.cn/
School: http://english.seiee.sjtu.edu.cn/

PROJECT 22

Wind Power Generation and Grid-Integration Control

Contact Information:

Assoc. Prof. Jing Lyu
Email: lvjing@sjtu.edu.cn

Project Description and Objectives:

This project focuses on the wind power conversion system and its control. With the rapid development of wind power, the scale of the wind farm is becoming larger and larger, which has a great influence on the stability of the power system. To address these issues, more advanced control strategies are needed for the grid-friendly integration of wind turbine generators. This project will study the advanced control of wind turbine generators to meet the strict grid codes, i.e., frequency support, inertial response, high-voltage fault ride-through, etc.

Eligibility Requirements:

> Basic knowledge of electric circuit theory is mandatory.
> Basic knowledge of electrical engineering is needed.
> Basic knowledge of power electronics is preferred.

Main Tasks:

> Implement the simulation modeling of wind turbine generators.
> Do some experiments on the laboratory setup of the wind turbine generator.
> Finish a research report about this project.

Website:

Lab: http://www.ssgc.sjtu.edu.cn/
School: http://english.seiee.sjtu.edu.cn/

PROJECT 23

Design and Control of Haptic Systems for Robot Surgery

Contact Information:

Assoc. Prof. Hongbing Li
Email: lihongbing@sjtu.edu.cn

Project Description and Objectives:

Haptics is the study of human touch sensing, specifically via kinesthetic (force/position) and cutaneous (tactile) receptors, associated with perception and manipulation. In robotics, haptics is broadly defined as real and simulated touch interactions among robots, humans, and real, remote, or simulated environments, in various combinations. In this project, you will study the design and control of haptic systems, which provide force feedback to human operators interacting with virtual environments or teleoperated surgical robots. You will develop specialized robotic devices and their corresponding control, known as haptic interfaces, which allow human operators to experience the sense of touch in remote (teleoperated) or simulated (virtual) environments. You will explore the use of handheld devices in virtual environments, try to understand the interactions between vision and touch, and enable portable devices to generate compelling touch interactions. Also, you can incorporate machine learning techniques to understand how humans and haptic devices can adapt to each other during use.

Eligibility Requirements:

This project requires a background in robot dynamic systems and C++ programming. Experience with feedback control and mechanical prototyping is also useful.

Main Tasks:

This project covers device modeling (kinematics and dynamics), synthesis and analysis of control systems, design and implementation of mechatronic devices, and human-machine interaction.

Website:

Lab: http://shiirc.sjtu.edu.cn/
School: http://english.seiee.sjtu.edu.cn/

PROJECT 24

Learning-based Collaborative Operations of Underwater Robots

Contact Information:

Prof. Jianping He
Email: jphe@sjtu.edu.cn

Project Description and Objectives:

This project aims to develop a collaborative system for underwater robots that leverages machine learning to enhance their performance in coordinated tasks. The goal is to create a fleet of autonomous underwater vehicles (AUVs) capable of working together to achieve complex missions such as underwater exploration, environmental monitoring, and maintenance of submerged infrastructure. By employing advanced learning algorithms, these robots will be able to adapt to dynamic ocean conditions, communicate effectively, and make intelligent decisions to optimize their collective efforts. The project's success will pave the way for more efficient and safer underwater operations, reducing human risk and expanding our capabilities in marine research and industry.

Eligibility Requirements:

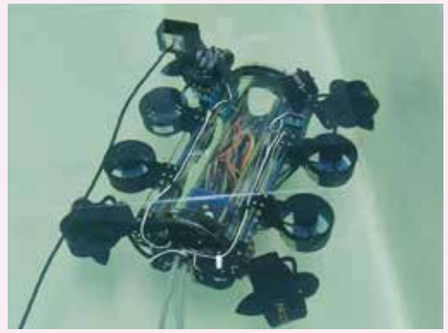
Interested students should be proficient in Python/C++ programming, basic knowledge of artificial intelligence and have basic knowledge of robot control. In addition, proficiency in English writing and speaking is mandatory.

Main Tasks:

> Collaborative Scenarios: Develop algorithms for multi-robot coordination in various underwater mission scenarios.
> Task Operations: Program and optimize the robots' task execution to ensure efficiency and accuracy in mission-critical operations.
> Simulation and Physical Experiments: Conduct both simulated and real-world experiments to validate the robots' performance and robustness.

Website:

Lab: http://iwin-fins.com
School: http://www.seiee.sjtu.edu.cn/



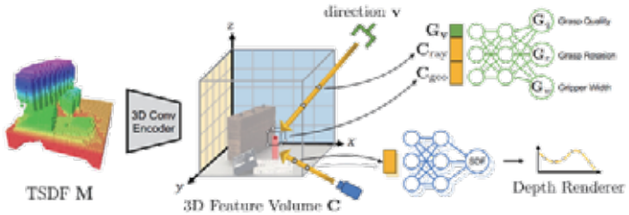
PROJECT
25

Learning-based Control for Robot Grasping Operations

Contact Information:

Prof. Jianping He
Email: jphe@sjtu.edu.cn

Project Description and Objectives:



This summer research project focuses on integrating advanced technologies to enhance robotic grasping operations. Here's a concise overview:

1. Incorporating Control Barrier Functions: Develop control strategies using control barrier functions to ensure the safety and stability of robotic grasping in complex environments.
2. Deep Learning Integration: Implement deep learning models to improve the perception and decision-making capabilities of robots during grasping operations, allowing them to adapt to various objects and conditions.
3. Reinforcement Learning for Autonomous Grasping: Utilize reinforcement learning to enable robots to learn optimal grasping strategies through trial and error, enhancing their autonomy and efficiency in real-world applications.

Eligibility Requirements:

Interested students should be proficient in Python/C++ programming, basic knowledge of artificial intelligence and have basic knowledge of robot control. In addition, proficiency in English writing and speaking is mandatory.

Main Tasks:

> Develop control strategies using control barrier functions to ensure robotic grasping safety and stability.
> Integrate deep learning models to enhance robotic perception and decision-making in grasping operations.
> Apply reinforcement learning to enable robots to autonomously learn and optimize grasping techniques.

Website:

Lab: http://iwin-fins.com
School: http://www.seiee.sjtu.edu.cn/

PROJECT
26

Decision-making Games and Control in Uncertain Environments

Contact Information:

Prof. Jianping He
Email: jphe@sjtu.edu.cn

Project Description and Objectives:

This summer research program for undergraduates delves into decision-making under uncertainty using Markov Decision Processes (MDPs) and Reinforcement Learning (RL). Students will explore the theoretical foundations of MDPs and apply them to real-world scenarios where outcomes are probabilistic. They will also engage with RL algorithms to train agents to make optimal decisions in dynamic environments with unknown parameters. The project aims to bridge the gap between theoretical knowledge and practical applications, equipping students with skills to tackle complex decision-making problems in AI.

Eligibility Requirements:

The project requires students to have programming skills in languages such as Python, as well as a mathematical foundation in reinforcement learning, stochastic processes, and game theory. Additionally, a basic understanding of control theory is also required.

Main Tasks:

> Analyze and understand the theoretical underpinnings of Markov Decision Processes to model probabilistic outcomes in decision-making scenarios.
> Implement and experiment with Reinforcement Learning algorithms to train agents for optimal decision-making in uncertain environments.
> Apply theoretical knowledge to practical problems, developing solutions that demonstrate the intersection of AI and complex decision-making.

Website:

Lab: http://iwin-fins.com
School: http://www.seiee.sjtu.edu.cn/

PROJECT 27

High-Speed Integrated Optical Interconnects

Contact Information:

Prof. Wenjia Zhang
Email: wenjia.zhang@sjtu.edu.cn

Project Description and Objectives:

The rapid development of data centers and high-performance computers demands massive connectivity to orchestrate geographically distributed heterogeneous computation capabilities. Optical interconnects have been inevitable solutions to provide Tbps class transmission capacity to accommodate the increasing demand for high-speed interconnects. Advanced equalizations have been proposed to provide powerful linear and nonlinear compensation for bandwidth and noise-limited optical interconnects. In this project, equalization algorithms will be designed and evaluated regarding the computation complexity and transmission performance for the integrated optical interconnects through an in-depth understanding of the connection of the algorithm and physical implication.

Eligibility Requirements:

Basic understanding of photonics and communication principles.

Main Tasks:

> Learn the basics of integrated optical interconnects.
> Simulation and experiment evaluation of the integrated optical interconnects.
> Off-line signal processing and performance evaluation of equalization through the data collected through simulation and experiments.

Website:

Lab: http://cip.sjtu.edu.cn
School: http://www.seiee.sjtu.edu.cn/

PROJECT 28

All-fiber Acousto-optic Modulator

Contact Information:

Assoc. Prof. Qingwen Liu
Email: liuqingwen@sjtu.edu.cn

Project Description and Objectives:

An Acousto-optic Modulator (AOM) uses acousto-optic effect to realize the modulation of frequency, amplitude and phase of light. It has a wide range of applications in lasers, optical radar and other fields. AOM based on crystalline and free-space coupling inevitably suffer from the shortcomings of large insertion loss and high cost, while the AOM with all-fiber structure solves the above problems well. However, it is difficult for the acoustic wave to induce a large refractive index modulation in the optical fiber, results in low efficiency of the all-fiber AOM. In this project, new structures of the fiber will be designed, with which the refractive index modulation depth of fiber can be significantly enhanced, so as to realize an all-fiber acousto-optic modulator with high efficiency and compact structure.

Eligibility Requirements:

Basic understanding of photonics and fiber optics.

Main Tasks:

> Study the basics of few-mode fibers and figure out the intensity and phase distribution of each mode.
> Learn the principle of holography technology, and recover the wave front of one single mode using the holography figure captured by the digital camera.
> Set-up the system and realize the coherent detection through the digital camera with a reference beam.
> Learn how to recover all the modes from the few-mode fibers, and compare the shape of the recovered mode with the theoretical modes in few-mode fibers.

Website:

Lab: http://cip.sjtu.edu.cn
School: http://www.cs.sjtu.edu.cn/PeopleDetail.aspx?id=87

PROJECT
29

Improving Gravitational Wave Detection with Neural Networks

Contact Information:

Prof. Yuan Luo
Email: yuanluo@sjtu.edu.cn

Project Description and Objectives:

Sensitive gravitational wave (GW) detectors such as that of the Laser Interferometer Gravitational-wave Observatory (LIGO) realize the direct observation of GW signals that confirm Einstein's general theory of relativity. However, it remains challenging to quickly detect faint GW signals from a large number of time series with background noise under unknown probability distributions. Traditional methods such as matched-filtering in general assume Additive White Gaussian Noise (AWGN) are far from being real-time due to its high computational complexity. To avoid these weaknesses, one-dimensional (1D) Convolutional Neural Networks (CNNs) are introduced to achieve fast online detection in milliseconds. However, they do not allow enough consideration on the trade-off between the frequency and time features, which will be revisited in this project through data pre-processing and subsequent two-dimensional (2D) CNNs during offline training to improve the online detection sensitivity.

Eligibility Requirements:

> Good English communication skills.
> Theoretical analysis ability, logical thinking ability, teamwork ability.
> Software: Machine Learning Software.
> Interest in Computer Science, Astronomy, Physics or Mathematics.

Main Tasks:

> Feature extraction analysis.
> Sensitivity performance analysis under real noise.
> Interpretability analysis.

Website:

Lab: N/A
School: http://www.cs.sjtu.edu.cn/PeopleDetail.aspx?id=87

PROJECT
30

Distributed Storage Coding Scheme in HDFS-RAID

Contact Information:

Prof. Yuan Luo
Email: yuanluo@sjtu.edu.cn

Project Description and Objectives:

Distributed Storage is widely used in industry. The optimal tradeoff between node storage and repair bandwidth is an important issue for distributed storage systems (DSSs). For realistic DSSs with clusters, while repairing a failed node, downloading more data from intra-cluster nodes than from cross-cluster nodes is effective. Therefore, differentiating the repair bandwidth from intra-cluster and cross-cluster is useful. For cluster DSSs, the tradeoff is considered with special repair assumptions where all alive nodes are used for repairing a failed node. In this project, we investigate the optimal tradeoff for the cluster DSSs under more general storage/repair parameters.

Eligibility Requirements:

> Good English communication skills.
> Theoretical (Algebra) analysis ability, logical thinking ability, teamwork ability.
> Software: Hadoop HDFS.
> Interest in Computer Science, Mathematics.

Main Tasks:

> MDS code performance analysis.
> IO and bandwidth analysis of Hadoop HDFS and RAID.
> Program Development.

Website:

Lab: N/A
School: http://www.cs.sjtu.edu.cn/PeopleDetail.aspx?id=87

PROJECT 31

Screening and Auxiliary Diagnosis System of Diabetic Retinopathy Based on Artificial Intelligence

Contact Information:

Prof. Bin Sheng
Email: shengbin@cs.sjtu.edu.cn

Project Description and Objectives:

The harm of diabetes to health is mainly caused by a variety of chronic complications (retinal, kidney, peripheral nerve and cardiovascular diseases) caused by long-term and chronic hyperglycemia, which seriously affects the quality of life of the population. Complications screening is the main measure to prevent and cure related complications. The question of how to effectively improve the efficiency of diabetes complications screening and reduce the cost of screening is a common problem faced by many developing countries. This project develops artificial intelligence algorithms for screening diabetic retinopathy and other diabetic complications. The system has been used to screen populations in developing countries for diabetes complications under the leadership of the International Diabetes Federation (IDF).

Eligibility Requirements:

Applicants must have some computer programming skills, basic understanding of neural networks and artificial intelligence, and a passion for medical care.

Main Tasks:

Understand digital medical image processing.
Perform and analyze experiments, and write a research report.
Give a research presentation (technical presentation).

Website:

Lab: https://www.deepdrdoc.com/
School: http://www.cs.sjtu.edu.cn/en/PeopleDetail.aspx?id=149

PROJECT 32

A Diabetes Monitoring and Health Management System Based on Machine Learning

Contact Information:

Prof. Bin Sheng
Email: shengbin@cs.sjtu.edu.cn

Project Description and Objectives:

The incidence of long-term complications of type 2 diabetes is high. One of the main reasons for this phenomenon is the contradiction between the large population of diabetes patients and limited medical resources. This study aims to build a set of multi-scene integrated diabetes intelligent decision-making system based on neural network and reinforcement learning for the linkage between hospitals and communities, to realize intelligent and to accurate treatment guidance for patients with diabetes in different scenarios such as hospital hospitalization and daily life.

Eligibility Requirements:

Applicants must have some computer programming skills, an understanding of neural networks and artificial intelligence, and a passion for medical care.

Main Tasks:

Understand digital medical image processing.
Perform experiments, analyze experimental, and write a research report.
Give a research presentation (technical presentation).

Website:

Lab: https://www.deepdrdoc.com/
School: http://www.cs.sjtu.edu.cn/en/PeopleDetail.aspx?id=149

PROJECT 33

Intelligent Analysis and Auxiliary Diagnosis System Based on Renal Tissue Pathological Image

Contact Information:

Prof. Bin Sheng
Email: shengbin@cs.sjtu.edu.cn

Project Description and Objectives:

The incidence rate of kidney diseases is up to 10.8%, and glomerular diseases are an important part of kidney diseases. This project aims to develop an imaging system that can objectively analyze typical glomerular diseases through the analysis of digital pathological images. The project results can not only assist doctors in the image analysis of glomerular diseases, but also provide objective and quantitative analysis results, improve the diagnostic efficiency, and make the pathological diagnosis of glomerular diseases, a highly difficult diagnostic technology, more commonly applied in primary medical care.

Eligibility Requirements:

Applicants must have some computer programming skills, an understanding of neural networks and artificial intelligence, and a passion for medical care.

Main Tasks:

Understand digital medical image processing.
Perform experiments, analyze experimental, and write a research report.
Give a research presentation (technical presentation).

Website:

Lab: https://www.deepdrdoc.com/
School: http://www.cs.sjtu.edu.cn/en/PeopleDetail.aspx?id=149

PROJECT 34

Digital Artist: Creating ART with Deep Learning

Contact Information:

Prof. Lizhuang Ma
Email: ma-lz@cs.sjtu.edu.cn

Project Description and Objectives:

Neural style transfer is one of the main techniques in the machine learning area for combining the artistic style of one image with the content of another image. The basic idea is to take the feature representations learned by a pre-trained deep convolutional neural network to obtain separate representations for the style and content of an image. Once these representations are found, we can then try to optimize a generated image to recombine the content and style of different targets. Since 2015, much progress has been made on style transfer to make training and inference faster and also to extend the style transfer technique from still images to videos and even to game scenes.

Besides, one of the most attractive research areas in Computer Vision is colorizing the grey-scale images or sketches. Focusing on clear and plausible colorization of images or sketches to obtain a final realistic result is the main goal of research in this area. Picture colorization has been shown as an inverse problem, and there are final multimodal solutions for these kinds of problems. Numerous studies have been done in image colorization, among them, some teams have been working on presenting the robust colorization of cartoon black-white pictures. However, there are some bugs in the final results of the previously proposed method, such as the inability of their methods in showing a smooth background for some images and some special kinds of reference colors.

In this project, our purpose is to present an efficient and robust solution to the problem of generating a plausible cartoon-style picture and colorization of cartoon sketches, thereby giving more inspiration to the original painting that could be accepted by human vision and perception.

Eligibility Requirements:

An ideal candidate is expected to

> have experience in deep learning, as well as excellent programming skills especially in Python or C/C++.
> be self-motivated and active.
> respect the rules of the laboratory as well as the department.

Main Tasks:

> Preparing a final report of the internship.
> Providing a presentation.
> Proposing a new idea for converting a given a scene photo into the desired 2D style scene through an algorithm.
> Proposing a new idea to enhance the reliability of output-colored pictures for automatic coloring a line art image.

Website:

Lab: http://dmcv.sjtu.edu.cn/
School: http://seiee.sjtu.edu.cn/

PROJECT
35

Quantum Computation for Wireless Communications

Contact Information:

Assoc. Prof. Zhiyong Chen
Email: zhiyongchen@sjtu.edu.cn

Project Description and Objectives:

Recently, quantum computation technology is making great breakthroughs and is playing a part in triggering the next technological revolution. Specifically, quantum computation is now widely used in machine learning design for speeding up processes, the quantum hardware-based machine learning algorithms, and the convex optimization algorithm. This project mainly focuses on how quantum computation can solve the convex optimization problem in wireless communications, including wireless resource allocation, machine learning, and quantum convex optimization algorithm design.

Eligibility Requirements:

Interested students should have basic knowledge of wireless communications and the convex optimization.

Main Tasks:

> Finish a research report.
> Submit a paper to a conference or a journal as a co-author.

Website:

Lab: http://iwct.sjtu.edu.cn/
School: www.seiee.sjtu.edu.cn/

PROJECT
36

Active Device Detection in MIMO Massive Access Communication

Contact Information:

Assoc. Prof. Yongpeng Wu
Email: yongpeng.wu@sjtu.edu.cn

Project Description and Objectives:

Massive access is an emerging technology that accommodates the number of users per transmission medium by possible orders of magnitude at a higher rate compared to the current state-of-the-art technologies. A typical application for massive access is a distributed sensor network that intelligently monitors and manages a large number of devices. Normally, the activation of these devices is intermittent, i.e., each device is periodically active based on a random pattern and constitutes a massive random-access scenario.

For massive random access, the receiver needs to decode the messages transmitted by these random active devices on each transmission. This project mainly focuses on how to design active device detection algorithms for MIMO massive access communication based on tools of compress sensing, estimation and detection theory, and matrix theory.

Eligibility Requirements:

Interested students should have basic knowledge of wireless communications and the matrix theory.

Main Tasks:

> Finish a research report.
> Submit a paper to a conference or a journal as a co-author.

Website:

Lab: http://iwct.sjtu.edu.cn/
School: www.seiee.sjtu.edu.cn/

PROJECT 37

Internet-Distributed Hardware-in-the-Loop Simulation for Renewable Energy Generation

Contact Information:

Dr. Jin Xu
Email: xujin20506@sjtu.edu.cn

Project Description and Objectives:

In power system research, the hardware experiment is an accurate testing method at the cost of high expenditure and poor flexibility. Software simulation is flexible and efficient, but the accuracy is limited by mathematic models. The hardware-in-the-loop (HIL) simulation is a hybrid testing method, in which part of the system is simulated in software while the rest is the actual hardware.

The modern power system is integrated in more and more renewable energy generators, which has a great impact on the dynamic characteristics of the power system. The internet-distributed hardware-in-the-loop simulation for renewable energy generation is to simulate the main grid of the simulation platform and interact with the actual renewable energy system in real-time via a cloud server.

Eligibility Requirements:

Interested students should have a basic knowledge of electrical engineering and have mastered one or more programming languages.

Main Tasks:

> Midterm technical presentation.
> Final project report.

Website:

Lab: http://www.ssgc.sjtu.edu.cn/
School: www.seiee.sjtu.edu.cn/

PROJECT 38

Real Time Simulations of Renewable Energy System with High Penetration of Power Electronic Apparatus

Contact Information:

Assoc. Prof. Dewu Shu
Email: shudewu@sjtu.edu.cn

Project Description and Objectives:

This project focuses on the real-time simulations of a renewable energy system with high penetration of power electronic apparatus. Real-time simulations of large-scale AC/DC grids, integrating a large number of converters, are becoming the recent research hotspots. This is due to the dynamics of the power system which is dramatically reshaped by the dynamics of large-scale AC grids and multi-converters. In this project, the following issues are targeted to be resolved:

(1) Efficient electromagnetic transient (EMT) and transient stability models of the large-scale AC/DC systems containing the line commutated converters (LCCs), voltage sourced converters (VSCs) and the modular multi-level converters (MMCs).

(2) The coordination control strategies between the HVDC and renewable energy, such as wind farms in China or Denmark.

(3) Study on the oscillation mechanism aroused by interactions of converters and the AC grids. To dampen or eliminate these oscillations, the active damping control strategies should be carefully designed.

Eligibility Requirements:

> Basic ability in C++ programming.
> Basic knowledge of PSCAD/EMTDC, BPA.

Main Tasks:

> Design the multi-rate interface model for the hybrid simulation method.
> Software and hardware design for the hybrid simulation method.

Website:

Lab: http://eei.sjtu.edu.cn/
School: http://eei.sjtu.edu.cn/

PROJECT
39

Learning-Driven Power Maps

Contact Information:
Assoc. Prof. Ce Shang
Email: shangce@sjtu.edu.cn

Project Description and Objectives:
In this project, machine learning tools will be used to depict a nation-wide map of power and energy supply and demand. The power system that connects the power supply and demand, with the uncountable devices it is made of, has become the biggest and most complex artificial system of data of all time. The well-functioning of the power system, with a balanced power supply and demand, determines the well-being of all aspects in modern society. Mapping the power supply and demand benefits the system operation in the short term and planning in the long run. Extracting useful information drives the application of machine learning tools to power systems, especially when the power system is being developed towards the ubiquitous Internet of Things and the data capacity consequently explodes. This program studies the application of machine learning tools for drawing power maps, which is aimed to assist power system operation and planning.

Eligibility Requirements:
> Power System Analysis; Linear Algebra, Probability and Statistics; Computer Programming (with C or Python language).
> This program involves the interdisciplinary study of machine learning and power engineering. Background knowledge and interest in both fields is required as well as the willingness to do hands-on programming work. An in-term oral presentation and a final written report are required for a mark to be given.

Main Tasks:
> Learning the background knowledge of the power system: its history, the cutting-edge research topics with a focus on power system operation and planning.
> Reviewing machine learning tools: different algorithms, the basic math they require, and typical problems they can solve.
> Implementing a machine learning tool, which can either be during supervised or unsupervised learning; targeting a specific group data of the power system, which can either be operational or planning data.
> Tuning the learning tool with acquired power system data; mapping power system supply demand either in the short term of operation or in the long term of planning.

Website:
Lab: http://www.ssgc.sjtu.edu.cn/
School: www.seiee.sjtu.edu.cn/

PROJECT
40

Research in the Next Generation of DFM Physical Design Modeling, Verification, and Optimization Algorithm Based on Deep Learning Techniques

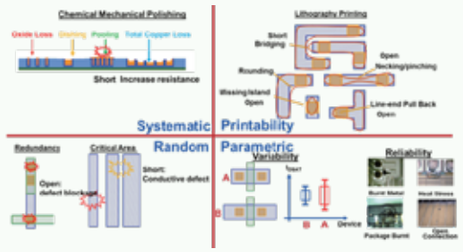
Contact Information:
Assoc. Prof. Yongfu Li
Email: yongfu.li@sjtu.edu.cn

Project Description and Objectives:
With the increasing demand for more integrated circuit chips, ranging from automotive vehicles, computers/servers, and mobile devices, it has been reported that the cost of producing new cutting-edge chips with the latest technology is now more than $500 million. To lower the financial barriers of designing chips, reducing the design cycle and increasing design robustness, it is important to have a comprehensive circuit verification and optimization tools. In this research internship program, we aim to cultivate the next generation of EDA software engineers through the development of machine/deep learning-based EDA software. The researcher will be involved in one of the existing research projects and assist the post-graduate researchers in their work. One example of our current research is based on using deep learning technology to develop new pattern-matching software to detect all the outlier polygon shapes in a layout that prevents any catastrophic failures in the chip. The intern will need to have a basic understanding of the CMOS process, deep learning techniques, and Python programming language. The intern will explore different deep learning models and hyper-parameters optimization to identify the best model for physical verification.

Eligibility Requirements:
> Proficiency in English writing and speaking is mandatory.
> Basic knowledge of machine learning, semiconductor, and circuit design.
> Programming skills on Unix operating system and Python programming.

Main Tasks:
> Develop a prototype software.
> Finish a report of the internship.
> Give two research presentations (a. references review; b. technical presentation).
> Submit one paper to a journal.

Website:
Lab: https://www.bicasl.com
School: http://english.seiee.sjtu.edu.cn/



PROJECT 41

Research on DNN-based Deepfake Face Detection Technology

Contact Information:

Prof. Yue Wu
Email: wuyue@sjtu.edu.cn
Prof. Shilin Wang
Email: wsl@sjtu.edu.cn

Project Description and Objectives:

Deepfake detection research involves the detection and defense of manipulated faces. It usually exploits the specific tampered dynamic and static artifacts presented in the facial texture, which is important in digital media forensics and authentication protection. Although there have been efforts devoted to designing face forgery detection methods, they always experience a severe performance drop in the cross-database scenario due to the diversified data distributions generated by different manipulation techniques, thus limiting broader applications. This project aims to devise a more generalizable deepfake detector based on DNN to apply it to practical complex scenarios.

Eligibility Requirements:

> Elementary knowledge of machine learning and deep learning.

Main Tasks:

> Review literature on deepfake technology and deepfake detection algorithms.
> Design a deepfake detection model with high generalization performance in a cross-database scenario.

Website:

Lab: http://nelcat.sjtu.edu.cn/
School: http://infosec.sjtu.edu.cn

PROJECT 42

Design and Implementation Scheme of Privacy Protection in AI-Enabled Internet of Things

Contact Information:

Prof. Yue Wu
Email: wuyue@sjtu.edu.cn

Project Description and Objectives:

Considering the image transmission in an AIoT scenario, the private and useful information are always entangled and hard to split by simple processes in data space, such as cropping a certain region of pixels. Traditional privacy protection methods often use differential privacy to add noise to the entire data, which not only causes a huge waste of resources and computing power of edge devices, but also adversely affects the performance of downstream tasks. By proposing and utilizing a feature decoupling algorithm, the private features and features corresponding to downstream tasks are extracted separately. Also, selective noise addition can be achieved. This project intends to realize targeted privacy protection by identifying the private features and applying differential privacy to protect users' private data in AIoT conditions.

Eligibility Requirements:

> Basic knowledge of machine learning, matrix analysis, and optimization theory.
> Mastery of Python and at least one deep learning framework, Pytorch preferred.

Main Tasks:

> Review literature on differential privacy.
> Achieve a prototype of a feature decoupling algorithm to extract privacy-related features.

Website:

Lab: http://nelcat.sjtu.edu.cn/
School: http://infosec.sjtu.edu.cn

PROJECT 43

Method of Detecting and Defending Network Attacks in the Internet of Vehicles

Contact Information:
Prof. Yue Wu
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Prof. Xiuzhen CHEN
Email: chenxz@sjtu.edu.cn

Project Description and Objectives:
With the increasing types and numbers of onboard terminals in intelligent and connected vehicle networks, security threats which the Internet of Vehicles (IoV) faces are also increasing. The information security of intelligent and connected vehicle networks has increasingly attracted attention all over the world. This project focuses on the detection and defense of common network attacks in the Internet of Vehicles, especially Sybil attacks. As a major type of attack in the Internet of Vehicles environment, Sybil attacks cause confusion and obstruction of road information by simulating the operating characteristics of normal vehicles, which brings huge challenges to the safe driving of vehicles. The main goal is to propose a detection method based on trust management system. In addition, a series of validity tests of the proposed approach will be done through simulation experiments under Veins and in the road test scenario.

Eligibility Requirements:
> Have professional knowledge of Computer, Communication, and Information Security;
> Good working attitude and self-learning ability;
> Good team spirit.

Main Tasks:
> Review literature on Sybil detection algorithms in the IoV environment.
> Design a trust-based detection model for detecting Sybil attacks.
> Perform the work model test both in the simulation environment and in the real road test scenario.

Website:
Lab: http://nelcat.sjtu.edu.cn/
School: http://infosec.sjtu.edu.cn

PROJECT 44

Optimization for the Multi-layer Convolutional Sparse Coding

Contact Information:
Assoc. Prof. Wenrui Dai
Email: daiwenrui@sjtu.edu.cn

Project Description and Objectives:
Convolutional sparse coding (CSC) has been demonstrated to facilitate the representation of high-dimensional visual signals in the tasks of image classification, visual recognition, image reconstruction, and feature extraction. This unsupervised method improves the efficiency of sparse representation by posing a global model with localized dictionaries. Recently, online learning and consensus optimization have been studied to enable scalability in high-dimensional feature learning, but still suffer from a degraded reconstruction performance for multi-layer cases. This project aims to develop a multi-layer dictionary learning method for multi-layer CSC. This optimization method is supposed to guarantee convergence with a bounded approximation error under the varying sparsity requirement for multiple layers. Furthermore, this project also plans to study the connection between multi-layer dictionary learning and deep convolutional neural networks.

Eligibility Requirements:
> Basic knowledge of signals and systems, digital signal processing, digital image processing, matrix analysis, and optimization theory.
> Mastery of more than one programming language, C/C++ and MATLAB preferred.

Main Tasks:
> Develop a multi-layer dictionary learning method for multi-layer convolutional sparse coding.
> Analyze the convergence condition and approximation error of the proposed method.
> Establish its connection with deep convolutional neural networks for interpretability.

Website:
Lab: http://min.sjtu.edu.cn/
School: http://english.seiee.sjtu.edu.cn/

PROJECT 45

AI-Driven Time Series Prediction in Healthcare

Contact Information:

Prof. Chenglin Li
Email: LCL1985@sjtu.edu.cn

Project Description and Objectives:

Electronic Health Records (EHRs) have amassed vast Irregularly Sampled Medical Time Series (ISMTS) data, comprising multiple medical variables with distinct attributes and varied sampling patterns. Techniques like Ordinary Differential Equations (ODEs) address irregular sampling but often neglect variable-specific temporal patterns and dynamic inter-variable correlations, which are crucial for accurate predictions. Additionally, current models rely heavily on data-driven approaches, potentially overlooking valuable expert knowledge and limiting their effectiveness. Enhancing prediction performance also requires addressing multiple related clinical tasks simultaneously. Multi-Task Learning (MTL) facilitates knowledge sharing across tasks, boosting efficiency and accuracy in prediction. However, existing MTL frameworks depend on manual task grouping and model design, leading to inefficiencies and task interference.

This project aims to develop an intelligent medical time series prediction system by integrating advanced time series processing, knowledge-driven modeling, and automated multi-task learning to enhance clinical prediction accuracy and efficiency. Specific objectives include developing methods to handle varying temporal patterns and sampling intervals, incorporating medical expertise to understand relationships between variables for better prediction outcomes, and implementing an automated MTL framework to optimize training and reduce task interference. Achieving these objectives will improve the analysis and prediction of medical time series data, supporting precise clinical decision-making.

Eligibility Requirements:

> Basic knowledge of machine learning and deep learning, such as Transformer and Graph Neural Networks.
> Proficiency in at least one programming language, such as Python, and familiarity with relevant machine learning frameworks (e.g., TensorFlow, PyTorch).

Main Tasks:

> Develop techniques to handle irregular and heterogeneous time series data, capturing unique characteristics of medical variables in ISMTS.
> Incorporate medical expertise by extracting insights from medical literature and clinical texts to improve model interpretability.
> Implement a multi-task learning framework to automate task grouping and optimize the model training process.

Website:

Lab: http://min.sjtu.edu.cn/
School: http://english.seiee.sjtu.edu.cn/

PROJECT 46

Performance Evaluation of Visual Tracking on Encoded Videos

Contact Information:

Prof. Hongkai Xiong
Email: xionghongkai@sjtu.edu.cn

Project Description and Objectives:

In computer vision, visual tracking deals with non-stationary image streams that change over time, intending to detect and locate moving objects. It can be used in various multimedia applications, such as visual surveillance, human-computer interaction, augmented reality, and visual servoing control (a control task based on computer vision data). In some applications, the video has to be encoded and transmitted to another end for implementing the tracking task, the performance of which might be affected by the distortion introduced by video encoding. Therefore, it would be interesting to see the visual tracking algorithms' performance under differently encoded video versions, which will further affect the control accuracy of the visual servoing control tasks.

Eligibility Requirements:

> Basic knowledge of video codec (e.g., H.264 and HEVC), control theory and computer vision.
> Mastering more than one programming language, C/C++ and MATLAB preferred.

Main Tasks:

> Create a library of distorted video versions by choosing different combinations of critical encoding parameters.
> Use the created library to test the performance of some of the selected tracking algorithms under differently encoded video versions.
> Try to understand and explain the performance curves that are obtained from the previous step based on the implementation detail of each tracking algorithm.

Website:

Lab: http://min.sjtu.edu.cn/
School: http://english.seiee.sjtu.edu.cn/

PROJECT
47

Blockchain and its Application in Energy Internet

Contact Information:

Assoc. Prof. Sijie Chen
Email: sijie.chen@sjtu.edu.cn

Project Description and Objectives:

Blockchain is a decentralized ledger that can enable trustworthy systems at large scales. A copy of the ledger is stored by each participating party and synchronized using a consensus algorithm, making the ledger transparent and robust against cyberattacks. While these technologies have already significantly impacted the financial industry (e.g., Bitcoin), they also have many applications to the power and energy sector.

Applications of blockchain in the energy sector include automatic energy transactions, power system asset ownership tracking, etc. Several demonstrations have been deployed around the world, such as the peer-to-peer energy transaction project deployed in Brooklyn, NY, by LO3Energy, the PowerLedger project backed by the Australian government, and Enerchain, which is joined by a large number of European utilities. Hopefully, these applications will revolutionize the way that energy transactions and power system asset tracking are performed, bringing opportunities for numerous small-scale players.

This project aims to help students learn the basic knowledge of blockchain, explore some typical applications of blockchain technology in the energy sector, build blockchain-enabled energy trading simulation platforms, visit some related pilot projects in Shanghai, and lay the foundation for students to explore further applications.

Eligibility Requirements:

> Interested students should be proficient in Python/Go programming language and have basic knowledge of energy/power systems.

Main Tasks:

> Acquire basic knowledge of blockchain.
> Understand typical applications of blockchain technology in the energy sector.
> Explore new applications of blockchain in energy Internet.
> Finish a report.

Website:

Lab: http://eei.sjtu.edu.cn/en/default.aspx
School: http://www.seiee.sjtu.edu.cn/

PROJECT
48

Optimal Design and Operation of Multi-Energy Communities

Contact Information:

Dr. Xuezhi Liu
Email: liuxz@sjtu.edu.cn

Project Description and Objectives:

This project proposes a whole-system approach to planning the deployment and operation of energy storage and conversion devices in integrated energy systems to reach the overall optimum energy system (in terms of flexibility, economy, reliability and emissions reduction targets). Conversion devices include gas-fired power generators, combined heat, power (CHP) plants, heat pumps, gas boilers, electric boilers, and absorption chillers located at different levels of the networks. Renewables and energy storage include solar photovoltaics (PV), concentrated solar power, wind power, solar thermal energy, battery energy storage, ice storage, electric vehicles, hydrogen vehicles, etc. The optimization of multi-vector energy system design and operation includes the identification of the optimal combination of energy supply, conversion, and storage technologies as well as the network infrastructure required to meet the estimated energy demand and its future evolution.

Eligibility Requirements:

> Major in energy systems engineering or a relevant subject.
> Mathematical programming skills (MATLAB, CPLEX, etc.).

Main Tasks:

> Identify the optimal combination of energy supply, conversion and storage technologies.

Website:

Lab: http://eei.sjtu.edu.cn/en/default.aspx
School: http://www.seiee.sjtu.edu.cn/

PROJECT 49

Optimization Scenario Design and Practice for Electric Vehicles and Smart Grid Interaction

Contact Information:

Dr. Yun Zhou
Email: yun.zhou@sjtu.edu.cn

Project Description and Objectives:

Governmental policies and incentives have been beneficial for the adoption of electric vehicles (EVs) all around the world. The higher prevalence of EVs brings down greenhouse gas emissions but also noticeably increases the power demand on the power system. The increased load must be dealt with economically, either by adding power generation or implementing effective demand-side management techniques for the sound operation of the power system. Typical interaction modes for EVs and the power grid include coordinated EV charging, ancillary services provided by the EVs, etc. With the development of Energy Internet, changing factors exist in the interactions of EVs and the power grid or other energy grids. It has important practical significance to further design and practice newer optimization scenarios for EVs and smart grid interaction.

Eligibility Requirements:

> Major in Engineering.
> Strong analysis and design capability.
> At least one programming skill (MATLAB, C++, Java etc.).
> Fluent in English.

Main Tasks:

> Designing and modeling optimization scenarios for electric vehicles and smart grid interaction.
> Programming practice to realize the proposed models.

Website:

Lab: http://eei.sjtu.edu.cn/en/default.aspx
School: http://www.seiee.sjtu.edu.cn/

PROJECT 50

Secure Intelligent Wireless or Optical Networks

Contact Information:

Prof. Xuelin Yang
Email: x.yang@sjtu.edu.cn

Project Description and Objectives:

Based on long-term experiences in networks, we will integrate artificial intelligence technologies to investigate the following two targets in the related research platforms
1. Intelligent hardware fingerprint;
2. Intelligent security during data transmission.

Eligibility Requirements:

Applicants are expected to have a strong hands-on ability and certain knowledge of artificial intelligence methods. It will be better if he/she has solid knowledge of data networks, or data communications.

Main Tasks:

> Investigate the intelligent hardware fingerprints from radio-frequency or optical transmitters) by introducing artificial intelligence technologies to support the decision in the network control and management, in order to meet the requirements of distinguishing the possible illegal attacks for future networks.
> Combined with artificial intelligence technologies, we will investigate a secure transmission in data transmission wireless or optical network platforms. The related performances of data security, confidentiality, and transmission will be comprehensively evaluated.

Website:

Lab: http://loct.sjtu.edu.cn
School: http://www.seiee.sjtu.edu.cn/

PROJECT 51

Multimodal Event Detection Under Unparalleled Situations

Contact Information:

Assoc. Prof. Mengyue Wu
Email: mengyuewu@sjtu.edu.cn

Project Description and Objectives:

Audio-based event detection is challenging due to data imbalance and various durations of audio events. This project investigates how to introduce video information for multi-modal event detection and improve the robustness of event detection. However, with unparalleled data, it is critical to explore the fusion method according to the scenario and select corresponding information according to the modal confidence at different times.

Eligibility Requirements:

> Interested students should have basic knowledge of machine learning.

Main Tasks:

> Development of a paradigm to fuse audio and video for robust event detection.
> Completion of a research report.

Website:

Lab: https://speechlab.sjtu.edu.cn/
School: http://english.seiee.sjtu.edu.cn/

PROJECT 52

Spoken Language Understanding with Graph Neural Network

Contact Information:

Prof. Kai Yu
Email: kai.yu@sjtu.edu.cn

Project Description and Objectives:

In the task-based human-machine dialogue system, it is important to convert the sentences of user input or speech recognition automatically into the semantic understanding of structured information. This topic aims at the structural and hierarchical definition of semantic objects (domain knowledge). It aims to use graph neural network to combine relevant domain knowledge with a general semantic understanding model to construct a robust and extensible semantic understanding system.

Eligibility Requirements:

> Interested students should have basic knowledge of machine learning.

Main Tasks:

> Development of a paradigm to employ knowledge graph in spoken language understanding.
> Completion of a research report.

Website:

Lab: https://speechlab.sjtu.edu.cn/
School: http://english.seiee.sjtu.edu.cn/

PROJECT 53

Automatic Speech Recognition of Accented Speech and Medical Terminology

Contact Information:

Prof. Kai Yu
Email: kai.yu@sjtu.edu.cn

Project Description and Objectives:

Automatic speech recognition is one of the fields that has seen great advances over the last few decades thanks to deep learning, however under non-cooperative conditions, the performance is still not ideal. Data imbalance and sparsity are difficulties in accented speech recognition with medical terminology. This leads to the key scientific problems of structured modeling of sparse data with uneven distribution. This project aims to investigate the implementation of transfer by learning to effectively improve the speech recognition effect of medical terms under different accents.

Eligibility Requirements:

> Interested students should have basic knowledge of machine learning.

Main Tasks:

> Development of a paradigm for accented speech recognition;
> Completion of a research report.

Website:

Lab: https://speechlab.sjtu.edu.cn/
School: http://english.seiee.sjtu.edu.cn/

PROJECT 54

Theory and Practice of Federated Learning

Contact Information:

Prof. Fan Wu
Email: fwu@cs.sjtu.edu.cn

Project Description and Objectives:

The concept of federated learning was first proposed by Google research scientists in 2015, which is a general collaborative machine learning framework for billions of mobile devices with the coordination of the Cloud. Under this framework, (1) a mobile device first downloads a global model from the Cloud, then trains a local personalized model using its user data, and finally uploads the model update to the Cloud, (2) the model updates from multiple mobile clients that are securely aggregated to form a consensus update to the global model in the Cloud, (3) the above process is repeated for the timeliness of the global model and the local models.

In this project, we intend to investigate several theoretical aspects of federated learning, including learning theory, security and privacy, and game theory. We also plan to develop an on-device training framework, and further to deploy our design in practice, benefitting millions of worldwide users.

Eligibility Requirements:

> Basic knowledge of machine/deep learning is mandatory.
> Basic knowledge of mobile computing, cryptography, and game theory is preferred.
> Experience of Android/iOS development is preferred.
> Proficiency in writing and speaking in English.
> Interest in theoretical analysis or coding.

Main Tasks:

> Propose an intriguing idea in the scope of the project.
> Present a novel solution and validate its practical feasibility.
> Finish a research report in this project.

Website:

Lab: http://www.cs.sjtu.edu.cn/~fwu/
http://anl.sjtu.edu.cn/en

PROJECT 55

Pricing and Protection Mechanisms for Big Data

Contact Information:

Prof. Fan Wu
Email: fwu@cs.sjtu.edu.cn

Project Description and Objectives:

The intrinsic value of the big data, which has been described as a new kind of oil, has been paid a great amount of attention to from people across the globe. However, due to the lack of effective data trading platforms, the existing datasets are mostly analyzed and used by the data owners in the enterprise, resulting in a large number of data islands. Therefore, it is highly necessary to implement open data trading platforms to promote the circulation of big data over the Internet. Thus, we can further exploit the economic value of big data and discover potential applications based on various kinds of data. In this project, we will investigate closely connected issues of data exchange including data collection, data pricing, and data protection. First, we will study market demand-oriented data collection schemes to provide high-quality and massive data resources to the market. Second, we will design pricing strategies for data in the market with asymmetric information that will determine the selling form and market price of data goods to maximize the revenue of data sellers. Third, we will study privacy-preserving and verifiable data trading mechanisms to guarantee individual users' protections and high availability of data goods at the same time.

Eligibility Requirements:

> Basic knowledge of algorithm design is mandatory.
> Basic knowledge of game theory or cryptography is preferred.
> Proficiency in writing and speaking in English.
> Interest in theoretical analysis and experiments.

Main Tasks:

> Propose a novel idea in the scope of the project.
> Present the design result either through a simulation or an experiment.
> Finish a research report in this project.

Website:

Lab: http://www.cs.sjtu.edu.cn/~fwu/
http://anl.sjtu.edu.cn/en
School: http://english.seiee.sjtu.edu.cn/

PROJECT 56

Remote Sensing Image Classification with Deep Learning Methods

Contact Information:

Assoc. Prof. Zenghui Zhang
Email: zenghui.zhang@sjtu.edu.cn

Project Description and Objectives:

Remote sensing image classification aims to identify regions of unique or dominant land cover from their attributes of spectral signature, texture, and context. Examples include classifying images into water, buildings, forest, grass, road, and other classes. In general, remote sensing image classification techniques include unsupervised/supervised methods, pixel-based or object-based methods, and deep learning-based methods. Recent researches show that the deep neural networks, such as a fully convolutional network (FCN) and SegNet, can far outperform traditional segmentation methods providing with a large training dataset. This internship aims to realize the deep learning-based image classification methods and do some improvements with the dataset provided by the lab.

Eligibility Requirements:

> Fundamentals of digital image processing.
> Programming skills of MATLAB and Python.

Main Tasks:

> Study the remote sensing concepts, principles, and traditional methods for image segmentation.
> Realize the fully convolutional network (FCN) and test the performance on remote sensing image dataset.
> Improve the FCN method with dense connection, pyramid pooling or multi-task training and do further experiments.

Website:

Lab: http://ast.sjtu.edu.cn
School: http://english.seiee.sjtu.edu.cn/

PROJECT 57

Radar Based Human Gesture and Movement Detection and Classification

Contact Information:

Assoc. Prof. Dongying Li
Email: dongying.li@sjtu.edu.cn

Project Description and Objectives:

The project aims at a series of theoretical and practical explorations with the main target being extracting key features of human body movements and recognizing/classifying different types of these movements using radar sensors. Techniques including Deep Convoluted Networks are suggested to be used in the recognition and classification process to ensure accurate results.

Eligibility Requirements:

Applicants shall have basic knowledge and have attended courses regarding electromagnetism, signal processing, and communication theory. Experience in C++/MATLAB programming and deep learning is preferable.

Main Tasks:

> Collect, extract, and tag human body movement data from the radar sensor.
> Study the methodology of using deep learning technologies regarding the classification of the tagged radar echo wave data.

Website:

Lab: http://ast.sjtu.edu.cn
School: http://english.seiee.sjtu.edu.cn/

PROJECT 58

Design, Optimization, and Deployment of In-Hand Object Rotation Control

Contact Information:

Prof. Wang Hesheng
Email: wanghesheng@sjtu.edu.cn

Project Description and Objectives:

The task of in-hand object rotation enhances robotic manipulation capabilities, enabling the execution of more sophisticated operations by integrating tactile and visual sensory information. However, controlling multi-degree-of-freedom systems, processing complex sensory data, and manipulating objects with uncertain motion dynamics present substantial challenges. The rapid advancements in reinforcement learning provide a promising avenue for addressing these challenges, offering robust adaptability across diverse tasks.

This study aims to leverage reinforcement learning to model robotic states within a simulated environment, design task-specific reward functions to optimize training processes, and enable biomimetic robotic hands to perform complex in-hand manipulation tasks. To accomplish these objectives, participants are expected to acquire a comprehensive understanding of reinforcement learning principles, develop training environments tailored to controller design, and validate the proposed approach through experimental deployment on real-world robotic systems.

Eligibility Requirements:

> Python, ROS

Main Tasks:

> Design an In-Hand Object Rotation Controller, Relying on Tactile and Visual Information for Training Dexterous Hand Manipulation Tasks
> Conduct real-world experiments to achieve sim-to-real transfer, enabling a dexterous robotic hand to perform object rotation tasks in practical settings.

Website:

Lab: https://irmv.sjtu.edu.cn/
School: http://english.seiee.sjtu.edu.cn/

PROJECT 59

VLM-Based Robot Task and Motion Planning

Contact Information:

Prof. Wang Hesheng
Email: wanghesheng@sjtu.edu.cn

Project Description and Objectives:

Conventional Task and Motion Planning (TAMP) approaches rely on manually designed interfaces connecting symbolic task planning with continuous motion generation in robot applications. These domain-specific and labor-intensive modules are limited in addressing emerging tasks in real-world robot settings. The rapid development of large vision language models (VLMs) offers new possibilities for addressing TAMP problems in a zero-shot manner, without the need for manual scheme adaptation by providing additional human demonstrations. The program aims to leverage the powerful visual grounding and generalization reasoning capabilities of VLMs to achieve zero-shot TAMP tasks in real-world environments. To achieve this goal, students are required to study the fundamental knowledge related to VLMs, as well as conduct experimental validations with real-world robot settings.

Eligibility Requirements:

> Python, C++, ROS

Main Tasks:

> Designing a novel paradigm for task composition and motion trajectoriy generation with VLMs in real-world robot manipulation.
> Conducting extensive experiments to demonstrate that the proposed VLM-based TAMP approach can achieve high success rates for multiple robot settings.

Website:

Lab: https://irmv.sjtu.edu.cn/
School: http://english.seiee.sjtu.edu.cn/

PROJECT 60

Computer Aided Diagnosis Based on Artificial Intelligence and Medical Image Analysis

Contact Information:

Prof. Jie Yang
Email: jieyang@sjtu.edu.cn

Project Description and Objectives:

With the significant development of artificial intelligence in recent years which has been motivated by great demand from clinical practice, computer-aided diagnoses have become increasingly important. Advances in artificial intelligence and medical imaging technology will greatly contribute to the diagnoses of many diseases. In particular, computer-aided diagnoses that can reduce the disequilibrium of medical resources in China, where there is a significant difference between the main top hospitals that are located in big cities, such as Shanghai and Beijing, and smaller more localized hospitals.

In this project, some important and typical problems will be investigated and close collaborations with hospitals and institutes abroad will be pursued, including osteosarcoma (with Renji Hospital), diabetic retinopathy (with Shanghai First People's Hospital), Alzheimer's disease (with Chalmers University of Technology), and chromosome mutation (with Ruijin Hospital). The objectives of this project consist of:
1) Study medical imaging process methods and artificial intelligence techniques for one particular disease.
2) Experiments on clinical data with the developed techniques.
3) Interpretation analysis of the neural networks that are trained for computer-aided diagnosis.

Eligibility Requirements:

> Basic knowledge of artificial intelligence and image processing.
> Programming skills of Python, C; experience with TensorFlow, PyTorch is preferred.

Main Tasks:

> Processing of clinical images and AI methods implementation.
> Experiments based on clinical data for one particular disease.
> Interpretation analysis of the neural networks for clinical applications.

Website:

Lab: http://www.pami.sjtu.edu.cn/En/Home
School: http://english.seiee.sjtu.edu.cn/

PROJECT 61

Advanced Kernel Methods for Machine Learning

Contact Information:

Prof. Xiaolin Huang
Email: xiaolinhuang@sjtu.edu.cn

Project Description and Objectives:

Kernel methods, which implicitly maps data into feature spaces, are very important in machine learning and have been widely applied in many fields. In recent years, the success of deep learning implies that enhancing the flexibility with the support of big data is promising to improve machine learning performance. The route is also applicable to advancing kernel methods, which are traditionally restricted to shallow structures.

In this project, we will investigate several key issues of advanced kernel methods. First, it is necessary to design a deeper structure, with several nonlinear layers, and develop the corresponding training methods. Second, making kernels flexible usually violates positive definiteness condition that is usually required by classical kernels, and an investigation of indefinite kernel methods is desirable. Third, flexible kernels need to admit value-defined matrices, for which the out-of-sample extension technique is necessary.

The objectives of this project consist of:

1) Novel kernel methods in one of the three topics: deep kernel/indefinite kernel/out-of-sample extension;

2) A toolbox for the developed techniques.

Eligibility Requirements:

> Basic knowledge on machine learning.
> Programming skills in MATLAB, Python, C.

Main Tasks:

> Develop novel machine learning methods based on flexible kernels.
> Establish and release a toolbox for the developed methods.

Website:

Lab: http://www.pami.sjtu.edu.cn/En/Home
School: http://english.seiee.sjtu.edu.cn/

PROJECT 62

Machine Learning for Optical Communications

Contact Information:

Prof. Lilin Yi
Email: lilinyi@sjtu.edu.cn

Project Description and Objectives:

Machine learning and neural networks have become very popular these years and have shown their strength especially in the domain of computer vision and machine translation. The neural network also comes into view of optical communities with more layers and a more intrinsic inter-layer relationship. A much more powerful tool, convolutional neural network (CNN), is now widely used in the domain of computer vision and also is the key for AlphaGo to defeat various professional Go players. CNN has also shown its powerful capability in optical performance monitoring and modulation formats identification.

This project mainly focuses on how machine learning can solve the signal performance distortion in optical fiber transmission, including dispersion, nonlinearities, and bandwidth limitation-induced inter-symbol interference. The performance of different machine learning structures such as supported-vector machine (SVM), fully-connected neuron network, CNN, and recurrent neuron network (RNN) will be compared and evaluated.

Eligibility Requirements:

> Interested students should have basic knowledge of optical communications and programming.

Main Tasks:

> Finish a research report.
> Give two research presentations (1. Background review, 2. Technical progress).
> Submit a paper to a conference or a journal as a co-author.

Website:

Lab: http://front.sjtu.edu.cn/~llyi/index_en.html
School: www.seiee.sjtu.edu.cn/

PROJECT 63

Cross-Culture Emotion Recognition from EEG and Eye Tracking

Contact Information:

Prof. Bao-Liang Lu
Email: bllu@sjtu.edu.cn

Project Description and Objectives:

Emotion plays a significant role in our daily lives and has been described as the 'driving force' behind motivation, endowing meaning to all human interactions. As we all know, various environments and cultures influence a human's physical characteristics, thought processes, and many other aspects. Humans all over the world may have different emotional patterns or possess similar emotional characteristics. Recently, multicultural research concerning emotion recognition has provided explanations for cross-cultural differences as well as similarities.

This project mainly investigates the emotional neural patterns among different cultures using EEG and eye movement signals. As we all know, facial expressions for different emotions are similar all over the world, regardless of culture. This study aims to find out whether people sharing the same emotions have similar neural patterns and to discover more facts about human emotions.

Eligibility Requirements:

> Interested students should have basic knowledge of machine learning and programming skills in Python.
> Experience with TensorFlow or PyTorch is preferred.

Main Tasks:

> Finish a research report.
> Carry out at least 10 EEG experiments to collect emotional EEG and eye-tracking data. Analyze EEG and eye-tracking data using machine learning methods.

Website:

Lab: http://bcmi.sjtu.edu.cn
School: http://english.seiee.sjtu.edu.cn/

PROJECT 64

Decoding Visual Perception from EEG Signals

Contact Information:

Asso.Prof. Wei-Long Zheng
Email: weilong@sjtu.edu.cn

Project Description and Objectives:

Our visual experience in daily life is dominated by dynamic change. Decoding such dynamic information from brain activity can enhance the understanding of the brain's visual processing system. As a signal which directly reflects brain activity, electroencephalography (EEG) has been demonstrated to be a reliable and promising indicator of human mental state.

In this project, we will investigate decoding visual perception using EEG and eye movement signals with diffusion models. Based on the existing research and datasets, the study aims to reconstruct vivid images or videos stimuli from brain activity.

Eligibility Requirements:

> Interested students should have basic knowledge of machine learning and programming skills in Python.
> Experience on Diffusion Model is preferred.

Main Tasks:

> Explore brain decoding method.
> Collect EEG and eye tracking experimental data if needed.
> Finish a research report.

Website:

Lab: http://bcmi.sjtu.edu.cn
School: http://english.seiee.sjtu.edu.cn/

PROJECT 65

Multimodal Emotion Recognition in Response to Oil Paintings

Contact Information:

Prof. Bao-Liang Lu
Email: bllu@sjtu.edu.cn

Project Description and Objectives:

Most artworks are created to raise strong emotional responses and emotions in aesthetics are contained within the narrative. Artworks could be another potential approach to study how our brain perceives and processes affective information. Could we develop computational models to recognize human emotions in response to oil paintings? Based on our previous work in the lab, we have collected multimodal data including EEG and eye tracking while watching the oil paintings. We use oil paintings as stimuli to evoke three types of emotions, namely, negative, neutral, and positive, in affective brain-computer interfaces. This project mainly analyzes the multimodal data to classify different emotions using multimodal deep neural networks and explores critical EEG and eye movement features of different emotions.

Eligibility Requirements:

> Interested students should have basic knowledge of machine learning and programming skills in Python.
> Experience with TensorFlow or PyTorch is preferred.

Main Tasks:

> Finish a research report.
> Develop multimodal deep learning methods to analyze multimodal data.

Website:

Lab: http://bcmi.sjtu.edu.cn
School: http://english.seiee.sjtu.edu.cn/

PROJECT 66

Environment-adaptive 3-D Locomotion of Magnetic Flapping Milliswimmer

Contact Information:

Assoc. Prof. Anzhu Gao
Email: anzhu_gao@sjtu.edu.cn

Project Description and Objectives:

Magnetic miniature soft robot has potential for non-invasive surgery and in vivo treatment. However, the complex environment and tortuous lumens inside human body imposes requirements on the agile motility of robots. Inspired by the flexibility of underwater and aerial animals with flapping moving mechanism, a magnetic field controlled underwater milliswimmer has been designed and the basic motion control is realized. To further enhance the adaptability of the robots, the mobility in diverse and complex environment should be developed. The soft robot could deform in various mode under different external magnetic field, which leads to adaptive moving pattern under complicated environments like tortuous lumens, smaller holes than the body size, undulating surfaces and so on. The multi-mode mobility of the magnetic miniature soft robot is expected to improve the adaptability in complex working scenarios, especially in clinical treatments.

Eligibility Requirements:

Familiar with basic programming language (mainly python).
Basic knowledge of control theory.

Main Tasks:

> Review relevant literature to learn the basic knowledge of micro soft robots.
> Experiment and design on magnetic field controlled multi-mode mobility of robots.
> Control algorithms and experiments on validation models.

Website:

Lab: https://robotics.sjtu.edu.cn/
School: http://english.seiee.sjtu.edu.cn/

PROJECT 67

Motion Control of Micro-Soft Robots based on Reinforcement Learning

Contact Information:

Assoc. Prof. Zhuo-Chen Ma
Email: zcma@sjtu.edu.cn

Project Description and Objectives:

As a rapidly developing field that intersects with manufacturing, intelligent control and robotics, micro-soft robots are showing good application prospects in many areas of concern and challenge. However, due to the complicated dynamic characteristics of the soft structure, it is hard to establish accurate dynamic models for motion control. As a result, model-based control methods cannot work effectively in motion control tasks of micro-soft robots. As an alternative, reinforcement learning can be leveraged as an adaptive model to fit complex and nonlinear dynamic characteristics of soft deforming action. The objective of this project is to establish the input-output model of micro-soft robots' motion with reinforcement learning. After establishing the dynamic model, a model-based control algorithm will be integrated to achieve accurate and robust control.

Eligibility Requirements:

Familiarity with basic programming language (mainly Python and C++).
Basic knowledge of machine learning and reinforcement learning.
Basic knowledge of control theory.

Main Tasks:

> Review relevant literature to acquire the basic knowledge of micro-soft robots
> Construct a network and algorithm structure to deploy reinforcement learning in the control of micro-soft robots

Website:

Lab: https://robotics.sjtu.edu.cn/
School: http://english.seiee.sjtu.edu.cn/

PROJECT 68

Continuum Robot Design for Endoluminal Intervention or Diagnosis

Contact Information:

Prof. Weidong Chen
Email: wdchen@sjtu.edu.cn

Project Description and Objectives:

This project aims to develop a small-diameter continuum robot to work in a confined space for endoluminal intervention and diagnosis. The objectives include some of the following tasks: 1) Design an actuation method for the robot motion; 2) Create a robot body as a prototype; 3) Conduct the phantom study or animal test to validate the developed robot or the proposed method.

Eligibility Requirements:

Familiarity with Solidworks etc. for robot modelling.
Good theoretical knowledge of robot kinematics and control.
Be good at hand-on capabilities to create or assemble the robot.

Main Tasks:

> Design an actuation method for robot motion and create a robot body as a prototype.
> Develop or use the sensors to achieve motion tracking and then design the control strategy to achieve the trajectory control.
> Finish the experimental validation and the project report.

Website:

Lab: https://imr.sjtu.edu.cn/en/re_xyyjzx/390.html
School: https://imr.sjtu.edu.cn/en/

PROJECT 69

Design of System Structures to Achieve Collective Cooperation Based on Machine Learning

Contact Information:

Asso.Prof. Qi Su
Email: qisu@sjtu.edu.cn

Project Description and Objectives:

Collective intelligence demonstrates that a group of individuals, each with basic abilities, can collaborate to accomplish a complex task beyond the capability of any single person. Unraveling the process by which this collective cooperation arises from the independent decision-making of individuals stands as one of the paramount challenges for scientists, ranking among the top 125. The configuration of a system, governing the scope of interactions and communication among individuals, profoundly influences their decision-making, specifically regarding cooperation.

This study endeavors to present a streamlined algorithm designed to uncover system structures that facilitate collective cooperation. Through a thorough examination of the identified structures, we distill key attributes and underlying mechanisms, contributing to the discovery of additional structures. Ultimately, our objective extends to applying analogous analyses to both static and dynamic networks.

Eligibility Requirements:

Interested in Mathematics.
Have basic knowledge of machine learning and neural networks.
Proficient in Python or any other language programming.

Main Tasks:

> Study the basics of game theory and network science.
> Apply machine learning techniques to search system structures promoting collective cooperation.
> Analyze the obtained structures and extract the key features.

Website:

Lab: https://iwin.sjtu.edu.cn/En
School: http://www.seiee.sjtu.edu.cn/

PROJECT 70

Deep learning-based Motion Planning in High Dimensional Spaces

Contact Information:

Assi. Prof. Xiaoming Duan
Email: xduan@sjtu.edu.cn

Project Description and Objectives:

Highly efficient motion planning is key enabler for robots to be deployed in real-world scenarios. Traditional sampling-based motion planning algorithms often suffer from high time complexity and are not applicable in high dimensional planning spaces with strict real-time performance requirement. Recent advances in deep learning techniques are promising in helping address the complexity of sampling-based motion planning algorithms. The objective of this project is to develop deep learning-based motion planning algorithms that are efficient in high dimensional planning spaces. The developed algorithm will be tested against state-of-the-art learning-based motion planning algorithms on established simulation environments.

Eligibility Requirements:

Interested students should be proficient in python and C++ programming and have basic knowledge about deep learning algorithms. Proficiency in English writing and speaking is also mandatory.

Main Tasks:

> Build motion planning simulation platform for simulating the robots and typical planning environments and implementing motion planning algorithms.
> Investigate existing learning-based motion planning algorithms and implement them.
> Develop new learning-based motion planning algorithms and compare them with SOTA.

Website:

Lab: https://iwin.sjtu.edu.cn/En
School: http://www.seiee.sjtu.edu.cn/

PROJECT 71

Large-model-driven Perception and Planning for Humanoid Robots

Contact Information:

Asso. Prof. Yue Gao
Email: yuegao@sjtu.edu.cn

Project Description and Objectives:

This project focuses on leveraging large-scale pre-trained models to enhance humanoid robot perception and planning capabilities. The objective is to design an advanced robot perception system that integrates pre-trained models, such as vision-based transformers or language models, to process and interpret complex sensory data. By utilizing this system, the project aims to explore intelligent planning and decision-making strategies for humanoid robots operating in dynamic and complex tasks.

Participants will engage in a hands-on approach, constructing perception and planning modules, implementing task-based simulations, and testing on real-world humanoid and legged robotic platforms. The key objectives include optimizing the integration of pre-trained models for sensory understanding, improving task coordination under dynamic conditions, and achieving robust performance in experimental environments. The project provides an end-to-end research opportunity, encompassing theoretical model development, system integration, and practical robot testing.

Eligibility Requirements:

Basic understanding of reinforcement learning, computer vision, or motion planning.
Knowledge of large-scale pre-trained models and their applications.

Main Tasks:

> Development of a Robot Perception System.
> Exploration of Intelligent Planning and Decision-Making.
> Experimental Integration and Validation.

Website:

Lab: https://gaoyue.sjtu.edu.cn
School: http://www.seiee.sjtu.edu.cn/

PROJECT 72

Motion Control of Hexapod Robot based on Reinforcement Learning

Contact Information:

Asso. Prof. Yue Gao
Email: yuegao@sjtu.edu.cn

Project Description and Objectives:

Hexapod robots are highly stable and flexible and are widely used in exploration and rescue missions in complex terrains. However, due to their high-dimensional nonlinear dynamics and complex motion patterns, traditional control methods have certain limitations when dealing with dynamic environments. Reinforcement learning (RL), as a highly adaptive decision-making method, can continuously optimize motion strategies by interacting with the environment and improve the robot's motion performance on complex terrains. This project aims to study and implement hexapod robot motion control based on reinforcement learning. By learning reinforcement learning theory and conducting hexapod robot experiments, students' theoretical knowledge and engineering practice abilities can be comprehensively improved, laying a solid foundation for further in-depth research on robots and reinforcement learning.

Eligibility Requirements:

Basic understanding of programming (Python preferred) and deep learning

Main Tasks:

> Develop a simulation environment tailored for hexapod robots.
> Design a reinforcement learning training framework for locomotion tasks.
> Transfer the learned locomotion policy to a physical robot to achieve robust walking capability across diverse terrains.
> Investigate disturbance perception and adaptive mechanisms to enhance the robot's stability and efficiency under external force disturbances through trained models.

Website:

Lab: https://gaoyue.sjtu.edu.cn
School: http://www.seiee.sjtu.edu.cn/

PROJECT 73

Vortex-induced Vibration of Catenary Riser

Contact Information:
Prof. Zhou Dai
Email: zhoudai@sjtu.edu.cn

Project Description and Objectives:
Highly flexible risers, such as steel catenary risers, are widely deployed in the deep-water drilling industry to convey oil from the seabed to the sea surface since it can offer a low-cost alternative to conventionally used rigid risers on floating platforms and can also provide economic riser design solutions for fixed platforms. As placed within ocean currents, Vortex-induced vibrations (VIV) would be excited for such a long flexible structure with bluff cross-sections and possible fatigue damage resulting from VIV on these structures requires a careful calculation and prediction of the responses. In this project, three-dimensional spectral/hp computations will be performed to study the fundamental mechanisms of vortex-induced vibration of a flexible catenary riser in the laminar flow regime. This will be a first step to understand the complex responses of a long flexible riser in the turbulent flow regime in real engineering situation.

Eligibility Requirements:
> The interested student should have a basic knowledge of hydrodynamics and numerical simulation.

Main Tasks:
> Finish a research report.
> Give two research presentations (a. references review; b. technical presentation).
> Submit one paper to a journal as a co-author.

Website:
Lab: N/A
School: http://naoce.sjtu.edu.cn/en/

PROJECT 74

Dynamic Damage of Geotechnical Structures

Contact Information:
Assoc. Prof. Jianliang Deng
Email: dengjianliang@sjtu.edu.cn

Project Description and Objectives:
In Shanghai as well as numerous other coastal cities in China, the foundations of many old buildings contain liquefiable soil layers. The destructive effects of these liquefiable soil layers on buildings have been observed in many countries.
The goal of this internship will be to study the liquefaction of soils and evaluate the destructive effects on the buildings by using a shaking table, and to study the destructive effects of traffic loading and sea wave loading.

Eligibility Requirements:
> Have a good knowledge of soil properties.
> Have good dexterity and be familiar with manual work in a laboratory.

Main Tasks:
> Understand basic theory.
> Learn basic skills in experimentation.

Website:
Lab: http://celab.sjtu.edu.cn/
School: http://naoce.sjtu.edu.cn/en/

PROJECT 75

Study of Transportation and Environment in an Urban Area

Contact Information:

Prof. Hongdi He
Email: hongdihe@sjtu.edu.cn

Project Description and Objectives:

Transportation and environmental engineering is an interdisciplinary project which aims to teach students how to solve transportation and environmental problems independently. In this project, students will learn to do data analysis on the traditional vehicle emission as well as the electric vehicle battery efficiency based on the measured data. This kind of hands-on experience with real data will also give students a deeper understanding of the practical challenges and benefits of each vehicle type.

Eligibility Requirements:

The students should have an interest in data analysis in the sustainable transportation problem.

Main Tasks:

The students are required to cooperate with other graduate students under the supervision of their mentor(s) to work on the above projects. The students need to attend regular lab meetings and give weekly reports to their mentor(s). They need to learn statistical analysis method as well as machine learning methods to do data analysis and provide the project report by the end of the internship period.

Website:

Lab: http://uav.sjtu.edu.cn/
School: http://naoce.sjtu.edu.cn/en/

PROJECT 76

Green Building Materials

Contact Information:

Prof. Jian Yang
Email: j.yang.1@sjtu.edu.cn

Project Description and Objectives:

This project primarily focuses on the use of recycled materials in modern construction. In particular, the demolition and construction waste will be recycled and utilized to replace new materials (mainly in the form of recycled aggregates) in the new construction. To compensate for the loss of strength, the recycled aggregates will be strengthened in advance. Meanwhile, scrap tire rubber will also be used as a fine aggregate to replace sand. The methods of enhancing the interfacial transition zone will be examined. The percentage of replacement, particle size distribution, and size of recycled aggregates will be studied to investigate their effects on the properties of the resulting concrete. The performances to be studied include workability, strength, and durability. MIP, SEM, XRD tests and inspection will be carried out to investigate the micro-structure and composition of the material. The objectives of this project are to get students to be familiar with the production of recycled concrete that is used in modern construction such as precast concrete for modular construction and the top layer for smart motorway. The possibility of using this kind of materials for 3D printing will also be researched.

Eligibility Requirements:

> Interested students should have a basic knowledge of building materials.

Main Tasks:

> Becoming familiar with the production of recycled materials in modern construction.
> Completing a research report.
> Delivering two research presentations: a reference review and a technical presentation.
> Submitting one paper to a journal as a co-author.

Website:

Lab: N/A
School: http://naoce.sjtu.edu.cn/

PROJECT 77

Modular Construction

Contact Information:

Prof. Jian Yang
Email: j.yang.1@sjtu.edu.cn

Project Description and Objectives:

The technology and application of modular construction are developing rapidly. Modular construction is based on three-dimensional units that are usually fabricated and fitted out in a factory and are delivered/assembled to the site as the main load-bearing elements for buildings. In the past, the main use of modular structures was for mobile or temporary buildings. However, due to the modern pre-fabricated construction technology using volumetric units, it is now used in a wide range of building types, such as schools, hospitals, offices, and even high-rise residential buildings. This demand has been driven by the off-site nature of the construction process, which leads to quantifiable economic and sustainable benefits. This project mainly investigates the design and assessment of modular construction using novel construction materials. It aims to introduce the key features of the modular construction and to offer training for students about how to design buildings using this new technology.

Eligibility Requirements:

> Interested students should have a basic knowledge of building engineering.

Main Tasks:

> To complete the design and drawing of buildings using modular construction.
> To check and validate the design adequacy as well as optimize the design.
> To deliver a presentation about the design philosophy and demonstrate the novelty of its design.

Website:

Lab: N/A
School: http://naoce.sjtu.edu.cn/

PROJECT 78

Automated Construction Systems of High-Rise Buildings

Contact Information:

Prof. Jian Yang
Email: j.yang.1@sjtu.edu.cn

Project Description and Objectives:

The total output value of the construction industry accounts for 5.7% of the global GDP. However, the productivity of the construction industry has been declining in the past 30 years. Automated construction systems provide a modern and efficient way to build high-rise buildings in urban areas. The major benefits of this type of system include significant waste reduction, improved construction site safety, and a more controllable quality of construction projects. This research project aims to develop a virtual control system for automated construction equipment by utilizing digital innovations (including BIM, 3D laser scanning, and multi-sensor technology). The system should be capable of updating the building information model on a real-time basis by using 3D laser scanning and robotic survey technology. It should also provide a synchronized monitoring system for equipment during operation by using multi-sensor technology.

Eligibility Requirements:

> Basic knowledge of building construction.
> Preference in students studying civil engineering or architecture.

Main Tasks:

> Become familiar with BIM software.
> Complete a research report.
> Submit one paper to a journal as a co-author.

Website:

Lab: N/A
School: http://naoce.sjtu.edu.cn/

PROJECT 79

Study on the Microstructure and Mechanical Properties of the Laser Additive Manufactured CrCoNi Medium Entropy Alloy

Contact Information:

Assoc. Prof. Kai Feng
Email: fengkai@sjtu.edu.cn

Project Description and Objectives:

Equiatomic CrCoNi medium entropy alloy (MEA) has excellent cryogenic mechanical properties, including high strength and toughness. It approaches the best combinations of strength, ductility and toughness on record. These advantages endow its great potential in cryogenic extremes, such as in the aerospace and petrochemical industry. In this project, we will use selective laser melting and one of the laser additive manufacturing technologies to fabricate the CrCoNi MEA build. Its microstructure and mechanical properties with different fabrication parameters will also be investigated.

Eligibility Requirements:

> Should have solid background knowledge in materials science, solidification, mechanics of metallic materials, etc.
> Should have knowledge about selective laser melting.
> Candidates who have related experience are preferred.
> Should be familiar with various materials characterization and test methods.

Main Tasks:

> Explore the optimal parameters to fabricate the CrCoNi MEA build by selective laser melting.
> Observe the microstructure and test the mechanical properties (including cryogenics) of selective laser melted CrCoNi MEA samples.
> Correlate the parameters, microstructure, and mechanical properties.
> Reveal the deformation mechanism of selective laser melted CrCoNi MEA (especially in the cryogenic temperature).

Website:

Lab: http://lpl.sjtu.edu.cn
School: http://smse.sjtu.edu.cn

PROJECT 80

The Joining Between Polymer and Metal for Biomedical Application

Contact Information:

Prof. Ke Chen
Email: chenke83@sjtu.edu.cn

Project Description and Objectives:

The joining between polymer and metal has attracted significant attention recently due to its advantage of excellent integrated physical and chemical properties. There is an increasing demand for high quality metal-polymer hybrid structures in biomedical industries. Friction stir welding (FSW) has advantages in the joining between metal and polymer materials and has been proven to be a suitable technology to produce dissimilar metal-polymer overlapping joints. In this project, we will complete the realization and optimization of the joining process between metal and polymer. The welding temperature (TW) and axial load (FZ) evolution will be measured during welding to study the temperature-force coupling process. A lot of focus will be put into the bonding mechanisms (including macroscopic interlocking mechanism and microscopic bonding mechanism) and their effects on the mechanical properties of the joints which are studied through the Transmission Electron Microscope (TEM), X-ray Photoelectron Spectroscopy (XPS), Fourier Transform Infrared Spectroscopy (FTIR) and Electron Energy Loss Spectroscopy (EELS). The obtained results will fulfill the urgent needs of polymer/metal joints in biomedical applications and also contribute to the understanding and further development of FSW and other welding methods for joining metals and polymers together.

Eligibility Requirements:

> Interested students should have a basic knowledge of polymeric and metallic materials.
> Interested students should be familiar with SEM and EBSD and have hands-on capabilities.

Main Tasks:

> Finish a research report.
> Give two research presentations: a literature review and a technical presentation.

Website:

Lab: http://lpl.sjtu.edu.cn
School: http://smse.sjtu.edu.cn

PROJECT 81

Remanufacturing Technology of 3D printed Ti64 Alloy via Laser Welding

Contact Information:

Asso. Prof. Chen Shen
Email: cshen486@sjtu.edu.cn

Project Description and Objectives:

Due to limited chamber size of 3D printing machine, selected laser melting (SLM) is always considered inappropriate for manufacturing large sized part. While in aircraft manufacturing, the need of high accuracy part production by SLM technique is quite large, especially for certain large sized parts in the aircraft envelope. To breakthrough this bottleneck problem, laser welding is considered a promising method that is capable of connecting SLM produced parts together with high accuracy and low distortion. In the present project, laser welding technique is used to connect SLM produced 2.5 mm thick Ti64 alloy plates. Research objectives include: (1) achieving defect-free (especially pore-free) laser welding joint in the SLM made Ti64 plates; (2) Characterizing the microstructure of laser welded SLM produced Ti64 alloy, and its microstructural deforming feature; (3) Testing the tensile property of the laser welded joint and investigating the tensile property evolution via adjusting the laser welding parameters.

Eligibility Requirements:

Microstructure Engineering background, better with experience or at least interest in additive manufacturing and welding technology.

Main Tasks:

Laser welding experiments; Microstructure characterization including optimal microscopy and scanning electron microscopy; Tensile testing.

Website:

Lab: http://lpl.sjtu.edu.cn
School: http://smse.sjtu.edu.cn

PROJECT 82

Design and Application Research of Bio-inspired Hierarchical Hygroscopic Material

Contact Information:

Assoc. Prof. Yao Li
Email: liyaosjtu@sjtu.edu.cn

Project Description and Objectives:

The moisture in the air has drawn great concerns in various industries, including food preservation and processing, the chemical and petrochemical industry, microelectronics, architecture materials, pharmaceuticals, cosmetics, and paper making. Due to the limited amount of fresh water (being approximately 3% of the world's water) in the world, atmospheric moisture is potentially an alternative renewable water resource as the earth is surrounded by over 12.9*1012 m3 of atmospheric moisture. This could potentially be collected by adsorptive dehumidification from the moist air. Therefore, air dehumidification has become a prime research topic worldwide. In this study, bio-inspired hierarchical porous materials possessing effective adsorption-desorption characteristics will be designed and researched for the application of water harvesting.

Eligibility Requirements:

> Experience in porous material design and fabrication.
> Basic measurement skills.

Main Tasks:

> Through a variety of set parameters, the student will master three different synthesis techniques and the principle of hierarchical Hygroscopic Material.
> Use similar chemometric methods for water adsorption ability identification (LDA, PCA, least squares, etc.).

Website:

Lab: http://sklcm.sjtu.edu.cn/
School: http://smse.sjtu.edu.cn

PROJECT 83

Design and Fabrication of Wood-inspired Monolithic Porous Carbon Material

Contact Information:

Assoc. Prof. Yao Li
Email: liyaosjtu@sjtu.edu.cn

Project Description and Objectives:

With the depletion of fossil fuels and increasing environmental pollution, there is an urgent need for efficient, clean, and sustainable materials. Wood with its mesoporous, low-tortuosity, and hierarchical structure has attracted much research interest recently. Most importantly, it is renewable, environmentally friendly, naturally abundant, and biodegradable. In recent years, wood has found a range of applications, including transparent and haze paper for optoelectronics, biodegradable electronics, and solar cells. These advanced applications using wood-based materials are promising for a sustainable future. In this project, we utilize the unique structure of wood to fabricate wood-derived monolithic porous carbon materials by changing the conditions of the experiment to cater to different practical applications.

Eligibility Requirements:

> Experience in materials preparation.
> Familiarity with the structure of natural wood.

Main Tasks:

> Attempt a variety of fabrication methods and raw materials to explore the influence of these conditions on the structure of wood-derived monolithic porous carbon materials so that they can better cater to different uses.

Website:

Lab: http://sklcm.sjtu.edu.cn/
School: http://smse.sjtu.edu.cn

PROJECT 84

Design and Application Research of Bio-inspired Stimulus-Response Material

Contact Information:

Assoc. Prof. Yao Li
Email: liyaosjtu@sjtu.edu.cn

Project Description and Objectives:

The stimuli-responsive photonic crystals have many potential applications in physical, chemical and biological detections. The colors of the stimuli-responsive photonic crystals, which are a kind of smart color shifting material, can be tuned by external stimuli, such as temperature, pH, ions, or electric fields. When external conditions change, the physical or chemical properties of the materials will change correspondingly, leading to a change of the periodic lengths or the refractive indexes of the photonic crystals, which will eventually cause change to the structural colors of these materials. Thus, the external stimuli signals will transfer into the color change of the photonic crystals, which can be detected by the spectra or directly observed by the naked eye, providing an effective and intuitionistic detection for the stimuli signals.
In nature, many living creatures have shining colors which are related to their photonic structures. This study focuses on the synthesis of the stimuli-responsive photonic crystals by using biomaterials as the templates and investigation of the properties.

Eligibility Requirements:

> Experience in material chemical synthetic, material structure characterization and analysis or simulation are preferred.

Main Tasks:

> Preparation of stimuli-responsive photonic polymers with hierarchical structures.
> Preparation of organic-inorganic muti-stimuli responsive systems with hierarchical structures.
> Characterization of stimuli-responsive photonic structures and properties.
> Simulation of the photonic structures and responsive mechanism study.

Website:

Lab: http://sklcm.sjtu.edu.cn/
School: http://smse.sjtu.edu.cn

PROJECT
85

Numerical Simulation Aided Manufacturing System Optimization for Single-Crystal Blades

Contact Information:

Prof. Mingxu Xia
Email: mingxu.xia@sjtu.edu.cn

Project Description and Objectives:

Single-crystal blades with perfect high-temperature mechanical properties are one of the most important parts in gas turbines. Due to the complex geometry of the blade, defects are prone to be formed in the castings. In order to avoid these defects, we should develop a deeper understanding of the directional solidification of the single-crystal blade. In this project, we will utilize the numerical model to simulate the directional solidification of a single crystal blade in the Bridgman furnace. The characteristics of the heat transfer and solidification sequence will be discussed based on the simulation results. Optimization of the process design (including but not limited to furnace and shell mold) and the selection of operating parameters will be proposed according to the analysis, and then estimated using further simulations. The obtained results will extend the understanding of the radiative heat transfer patterns in the furnace, and improve the furnace design and the parameter control in the fabrication of single-crystal blades.

Eligibility Requirements:

> Interested students should have a basic knowledge of directional solidification.
> Interested students should be familiar with the software of ANSYS FLUENT.

Main Tasks:

> Finish a research report.
> Give two research presentations (1. References review; 2. Technical presentation).

Website:

Lab: http://iams.sjtu.edu.cn
School: http://smse.sjtu.edu.cn

ENVIRONMENTAL SCIENCE AND ENGINEERING

PROJECT
86

Coupled Solar Driven Electro-Catalytic Purification of Natural Gas via Simultaneous CO2 and H2S Conversion

Contact Information:

Assoc. Prof. Bai Jing
Email: Bai_jing@sjtu.edu.cn

Project Description and Objectives:

Natural gas is an important clean energy source. However, the large amount of natural gas produced from gas fields contains about 15% hydrogen sulfide and 10% carbon dioxide, which must be removed before use. Traditional separation methods make it difficult to remove CO2 and H2S simultaneously. This is because apart from consuming lots of chemical reagents, the separated CO2 and H2S require subsequent processing that is complicated and expensive. Hence, if CO2 and H2S can be separated and respectively converted into CO and S, the treatment process will be simplified and bring huge economic benefits. Thus, this project will focus on developing a new catalytic system and equipment that combine solar energy conversion technology and CO2 and H2S catalytic technology.

Eligibility Requirements:

> Chemistry or Material Science background.

Main Tasks:

> Fabrication of electrode materials and testing of a catalytic system.

Website:

Lab: http://sese.sjtu.edu.cn/research/1970.html
School: http://sese.sjtu.edu.cn/

PROJECT 87

Photocatalytic Production of H2O2 on Modified C3N4 under Simultaneous Sunlight

Contact Information:

Prof. Mingce Long
Email: long_mc@sjtu.edu.cn

Project Description and Objectives:

H2O2 is one of the fastest growing industrial chemicals in the world. In the recent ten years, it has been widely used as a multi-purpose environmentally friendly oxidant in the biological process, water purification and chemical industry since it only emits water as a final byproduct. Industrial production of H2O2 is through anthraquinone oxidation which is limited by the high energy input and tedious steps for multiple hydrogenation and oxidation reactions. It is still challenging but highly demanding to produce H2O2 in a facile, clean, and safe way. Photocatalytic production of hydrogen peroxide (H2O2) using water and molecular oxygen as the sole material source is a promising and sustainable solar fuel approach. However, the efficiency is limited by the low efficiency of oxygen reduction reaction (ORR) in H2O2 formation and the simultaneous decomposition of H2O2. C3N4 is a promising visible light-driven photocatalyst for H2O2 production. In this study, we plan to synthesize highly active C3N4 by improving crystallinity and doping single atoms. The prepared catalysts will be fully characterized. The performance for H2O2 production and enhanced mechanism will be explored.

Eligibility Requirements:

> Basic knowledge of Math/Chemistry/Physics.
> High motivation for scientific studies and experiments.
> Majors in chemistry, material science, or environmental science and engineering are preferred.

Main Tasks:

Students are required to work with the graduate students under the supervision of the mentor(s) on the above projects. The students need to attend the regular lab meetings and give a weekly report to the mentor(s). By the end of the internship, a project report should be submitted.

Website:

Lab: http://sese.sjtu.edu.cn/people/2784.html
School: http://sese.sjtu.edu.cn/

PROJECT 88

Human iPSC-Based Mutation Characteristics Evaluation Induced by Carbon Nanomaterials

Contact Information:

Assoc. Prof. Yanbin Zhao
Assoc. Prof. Kun Zhang
Email: zhaoyanbin@sjtu.edu.cn ; kunzhang@sjtu.edu.cn

Project Description and Objectives:

Carbon nanomaterials (CNMs) have been widely applied in drug delivery and biosensing. However, the understanding of their potential health risks remains highly limited. In particular, whether CNMs can increase the risk of cellular carcinogenesis remains a subject of significant controversy. To address this issue, we aim to develop novel bioinformatics methods capable of rapidly identifying genome-wide mutation characteristics. By conducting human-induced pluripotent stem cell (iPSC) exposure experiments coupled with whole-genome sequencing (WGS), this study seeks to clarify whether CNMs can increase mutation frequencies in human cells, identify their specific mutational signatures, and assess potential health risks to populations. Furthermore, we aim to establish a comprehensive database of CNM-induced mutational characteristics in iPSCs. This research is expected to fill a critical knowledge gap regarding the carcinogenic effects of short multi-walled carbon nanotubes on human cells, thereby enriching the scientific foundation of nanomaterial toxicology. Additionally, the proposed research strategy has the potential to drive innovation in detection technologies, overcoming the limitations of traditional toxicological evaluation methods. The findings are anticipated to have a profound impact on both biomedical research and environmental health studies.

Eligibility Requirements:

> Basic knowledge of biology/bioinformatics.
> Self-motivation and the enjoyment of lab work.
> Majors in biology, bioinformatics or environmental science are preferred.

Main Tasks:

> Systematically assess the cell mutation characteristics caused by carbon nanomaterials.
> Explore the possible mechanism of action behind the observed toxicity with molecular biological and chemical techniques.

Website:

Lab: http://sese.sjtu.edu.cn/people/2808.html; http://sese.sjtu.edu.cn/people/2848.html
School: http://sese.sjtu.edu.cn/

PROJECT 89

Selectively Capture of Ionic Resource from Micro-electronic Wastewaters Using an Electrochemical Membrane Reactor

Contact Information:
Prof. Jiahui Shao
Email: jhshao@sjtu.edu.cn

Project Description and Objectives:
Resource capture is an effective technique for the removal of recalcitrant pollutants in micro-electronic wastewaters. However, the selective capture of ion resource from multi-pollutant wastewater remains a significant challenge. In the lab, we proposed an electrochemical membrane reactor (EMR) for the in-situ capture of fluoride and silica as hexafluorosilicate salts. The EMR combines a bipolar membrane to produce protons forSiF_6^{2-} in-situ generation from the reaction between fluoride and silica. An internal integrated ultrafiltration (UF) membrane was used to reject nanoparticles/organics while providing ion channels for protons and SiF_6^{2-} migration. The key operation parameters need to be optimized to evaluate the recovery performance of the EMR in terms of Na_2SiF_6 yield, purity, current efficiency and energy consumption. Na_2SiF_6 recovery mechanisms also will be elucidated.

Eligibility Requirements:
> Major in environmental engineering, chemical engineering, polymer or other related areas
> Motivation to work
> Willing to conduct lab experiments

Main Tasks:
> Optimize key operation parameters to evaluate the recovery performance of the EMR in terms of Na_2SiF_6 yield, purity, current efficiency and energy consumption.
> Elucidate Na_2SiF_6 recovery mechanisms.

Website:
Lab: http://sjtu.cf.labscout.cn/lims/
School: http://sese.sjtu.edu.cn/

PROJECT 90

Neuro-biomechanical Mechanism and Physical Therapy of Cognitive Behavior in Patients with Cognitive Impairment

Contact Information:
Prof. Dongyun Gu
Email: dongyungu@sjtu.edu.cn

Project Description and Objectives:
With the aging of the global population, the prevalence of cognitive impairment disorders is increasing and is seriously affecting the lives and health of the elderly. However, the neuro-biomechanical mechanisms in patients with cognitive impairment have not been clearly understood. The nervous system and musculoskeletal system are the two main systems responsible for the coordinated control of human behavior. The study of neurobiomechanics will be beneficial to our understanding of the mechanism of central nervous control of cognitive behaviour in patients with cognitive impairment. Meanwhile, the study of its mechanism will enable us to better target physical rehabilitation therapy to cognitively impaired patients. Therefore, this project aims to study the neuro-biomechanical mechanisms of cognitive disorders and develop targeted physical rehabilitation therapies to provide an important reference for clinical rehabilitation.

Eligibility Requirements:
The students should have an interest in sports biomechanics and portable devices to solve biomedical problems. The prerequisites being engineering training, e.g. motion analysis, and/or electronic engineering are desirable.

Main Tasks:
Students are required to cooperate with graduate students, engineers, and clinicians under the supervision of their mentor(s) to work on the above projects. The students need to attend regular lab meetings and make weekly reports to their mentor(s). By the end of the internship, a project report should be submitted.

Website:
Lab: http://dm.sjtu.edu.cn/En_Default.aspx
School: http://bme.sjtu.edu.cn/en/

PROJECT
91

Smart Imaging-Based Functional Evaluation for Contemporary Arthroplasty

Contact Information:
Prof. Tsung Yuan Tsai
Email: tytsai@sjtu.edu.cn

Project Description and Objectives:
More than a million people in the US received primary total joint replacements in 2018. The demand for joint arthroplasty is rapidly growing each year. Although significant pain relief and improvement of the functional capacity have been observed in post-operative patients, the negative effects being a reduced range of motion, asymmetric gait pattern, and an inability to restore their normal joint kinematics are still prevalent. Advances in arthroplasty have largely focused on the development of improving implant tribology and implant fixation methods. However, the performance of contemporary arthroplasty is related to the adverse in-vivo dynamic phenomenon. This includes edge loading, wearing, impingement, and dislocation. Accurate knowledge of in-vivo joint dynamics is crucial for further improvement of arthroplasty. This project will include investigations on the bone geometry of Asian people. Statistical shape modeling will be used to extract ethnic characteristics. Non-invasive imaging tracking methods, including skin-marker-based motion analysis and dual fluoroscopic imaging tracking technique, will be employed to quantify accurate joint kinematics during daily functional activities. Subject-specific bone modeling and inverse dynamics will enable estimations of joint forces and moments. This study aims to compare the performance of contemporary total joint replacements and hopefully lead to innovations in arthroplasty.

Eligibility Requirements:
> Interested students should have basic knowledge of human anatomy, computer vision, biomechanics, and MATLAB programming.

Main Tasks:
> Collect a minimum of 10 subject's CT, MRI, fluoroscopic or motion capture data.
> Develop custom-made scripts and analyze the collected data.
> Review relevant literature.
> Finish a research report.

Website:
Lab: http://obl.sjtu.edu.cn/
School: http://bme.sjtu.edu.cn/en/

PROJECT
92

Effects of Carpal Tunnel Pressure-induced Changes in Transverse Carpal Ligament Structure on the Shear Wave Velocity: A Multiphysics Study

Contact Information:
Assoc. Prof. Yifei Yao
Email: yifeiyao@sjtu.edu.cn

Project Description and Objectives:
Carpal Tunnel Syndrome (CTS) is one of the most common hand disorders. Carpal tunnel pressure measurement can facilitate the prevention, diagnosis and assessment of treatment for CTS. So far, there is not an economical and efficient way to measure the carpal tunnel pressure non-invasively. Acoustic Radiation Force Impulse (ARFI) imaging on Transverse Carpal Ligament (TCL) may be an ideal tool to measure carpal tunnel pressure non-invasively. The relationship between the carpal tunnel pressure and the shear wave velocity is critical for the estimation of tunnel pressure in vivo. This project aims to establish the theoretical relationship between TCL shear wave velocity and carpal tunnel pressure in silico using a multi-physics finite element analysis with mechanical and acoustic simulation to explore the theoretical function of relationship between SWV on TCL and carpal tunnel pressure. The investigation will have a clinical influence on CTS prevention, diagnosis and treatment.

Eligibility Requirements:
The students should have the desire of using engineering and technologies to solve biomedical problems. A prerequisite of engineering training, e.g., data analysis (using Matlab toolbox), finite element software (COMSOL, ANSYS or ABAQUS), and/or biomechanics are desirable.

Main Tasks:
Students are required to work with the graduate students under the supervision of their mentor(s) to work on the above projects. The students need to attend the regular lab meetings and give weekly reports to their mentor(s). By the end of the internship, a project report should be submitted.

Website:
Lab: http://dm.sjtu.edu.cn/En_Default.aspx
School: http://bme.sjtu.edu.cn/en/

PROJECT 93

Development of Myelinated and Vascularized Human Brain Organoid

Contact Information:

Prof. Yaohui Tang
Email: yaohuitang@sjtu.edu.cn

Project Description and Objectives:

Animal models are inherently difficult to translate to human physiology and pathophysiology of the central nervous system. The brain of a living organism is too complex and tightly integrated for detailed studies of metabolic interactions. Contributions of specific structures such as vasculature or perivasculature cannot be disentangled, let alone contributions by distinct cell types. Thus, it is quite challenging to develop treatments for brain diseases including stroke due to the lack of established methods for generating human relevant data. This proposal aims to develop a vascularized brain organoid with myelin sheath structure, and explore the interaction between myelin and blood vessels based on this brain organoid. The students will join a team of graduate students and research faculty members. Techniques used in this project will include but are not limited to stem cell culture, brain organoid culture, staining and data analysis.

Eligibility Requirements:

> Must be at least in their sophomore year.

Main Tasks:

> Attend weekly lab meetings and carry out experiments.
> Give two research presentations. (one on literature review, one on research progress)
> Finish a research report.

Website:

Lab: http://bme.sjtu.edu.cn/
School: http://bme.sjtu.edu.cn/

PROJECT 94

In Vitro Brain Modeling with 3D Bioprinting

Contact Information:

Assoc. Prof. Wanlu Li
Email: liwanlu-0424@sjtu.edu.cn

Project Description and Objectives:

The establishment of the in vitro brain model to simulate the physiological and pathological state of the brain is crucial for translational medicine. However, the applications of in vitro brain models are limited because of the difficulty in accurately reproducing the specific structure of the brain. 3D bioprinting, as an advanced technique, favors the biofabrication of tissues with improved structural complexity. In this project, we aim to develop a 3D bioprinting method to construct physiological-relevant brain tissue models. The students will join a team of graduate students and research faculty members. Techniques used in this project will include but are not limited to cell culture, biomaterial synthesizing, 3D bioprinting, and data analysis.

Eligibility Requirements:

> Must be at least in their sophomore year.
> Basic knowledge in biology, enthusiasm for cutting-edge 3D bioprinting techniques and their applications.

Main Tasks:

> Attend weekly lab meetings and carry out experiments.
> Give two research presentations (one on literature review, one on research progress).
> Finish a research report.

Website:

Lab: http://bme.sjtu.edu.cn/
School: http://bme.sjtu.edu.cn/

PROJECT 95

Developing Biomaterials to Recreate Physiological-Relevant Brain Signaling Cues

Contact Information:
Assoc. Prof. Wanlu Li
Email: liwanlu-0424@sjtu.edu.cn

Project Description and Objectives:
The neural extracellular matrix (ECM) influences cellular proliferation, dif-ferentiation, migration and maturation throughout brain development. Although the neural ECM shapes key developmental processes, 2D and 3D culture approaches rely mostly on heterogenous, insufficiently manipulatable ECM-inspired materials (such as Matrigel) or are cultured as free-floating cell aggregates devoid of exogenous. Therefore, the introduction of biomaterials that better emulate the composition or downstream signaling effects of the endogenous neural ECM may yield cell culture models with more biomimetic neural proliferation, differen-tiation, migration and maturation. In this project, we aim to develop biomaterials that imitate the physiological-relevant brain signaling cues. The students will join a team of graduate students and research faculty members. Techniques used in this project will include but are not limited to cell culture, biomaterial synthesizing, and data analysis.

Eligibility Requirements:
> Must be at least in their sophomore year.
> Basic knowledge in biology and biomaterials.

Main Tasks:
> Attend weekly lab meetings and carry out experiments.
> Give two research presentations (one on literature review, one on research progress).
> Finish a research report.

Website:
Lab: http://bme.sjtu.edu.cn/
School: http://bme.sjtu.edu.cn/

PROJECT 96

Medical Image Synthesis and Multi-Modal Fusion

Contact Information:
Assoc. Prof. Lichi Zhang
Email: lichizhang@sjtu.edu.cn

Project Description and Objectives:
Using multi-modal medical imaging technology is essential to assist diagnosis and treatment in healthcare. However, from the technical perspective, multi-modal fusion has been daunting for decades, due to the giant incoherence of visual cues in images of different modalities. Recently, deep learning-based image synthesis has provided a revolutionary chance to mitigate this issue, by performing image-domain or feature-domain data conversion. In this project, we expect students to develop tools for multi-modal fusion, by utilizing the fast-evolving technique of image synthesis. The outcome of this project, which consists of both novel algorithm development and user case demonstration, is expected to benefit clinicians and patients significantly.

Eligibility Requirements:
Solid background in mathematics and programming, enthusiasm for cutting-edge artificial intelligence techniques and their application to healthcare.

Main Tasks:
> Develop core algorithms to complete image synthesis.
> Develop methods to complete the pipeline of multi-modal fusion.
> Develop and deploy tools for user-case demonstration of the algorithms and methods.

Website:
Lab: http://mic.sjtu.edu.cn/
School: https://bme.sjtu.edu.cn/

PROJECT
97

Liquid Sampling Protein Western Blotting to Replace Traditional Labor Intensive Western Blotting

Contact Information:
Prof. Xianting Ding
Email: dingxianting@sjtu.edu.cn

Project Description and Objectives:
Single Cell Western Blotting (scWB) is powerful method for high resolution single cell protein analysis, as the technique reports both target molecular mass (via protein electrophoresis) and probe binding (via subsequent antibody probing), not simply probe binding. In recent years, various techniques have been developed based on scWB, including but not limited to: 3D projection electrophoresis for single cell immunoblotting, multi-detection of protein isoforms and nucleic acid by scWB, DropBlot: single-cell western blotting of chemically fixed cancer cells... However, the core principle of the technique involves single-cell loading, followed by in-well cell lysis and electrophoresis, which makes it poorly suited for liquid protein samples analysis. In this project, we aim to develop a novel Western blotting-based technology, called 'Liquid Protein Sample Western Blotting,' for analyzing liquid samples. This approach can potentially serve as a faster, simpler, and more sensitive alternative to traditional Western blotting.

Eligibility Requirements:
The students should have an interest in microfluidics and single cell proteomics analysis and should have a background in biotechnology, microfluidics, and analytical chemistry.

Main Tasks:
The students are required to cooperate with other graduate students under the supervision of their mentor(s) to work on the above projects. The students need to attend regular lab meetings and make weekly reports to their mentor(s). By the end of the internship a project report should be submitted.

Website:
Lab: www.dinglab.com.cn
School: http://ipmsjtu.sjtu.edu.cn/

PROJECT
98

Surface-enhanced Raman spectroscopy for Metabolomics and Disease Early Diagnosis

Contact Information:
Prof. Jian Ye
Email: yejian78@sjtu.edu.cn

Project Description and Objectives:
Disease early diagnosis is of great concern in clinics and will highly benefit the patients. Metabolites are a kind of important disease biomarkers to indicate the disease-related physiological status in addition to the nucleic acids and the proteins, and have been recently attracted a lot of attentions from scientists. However, metabolites are typically detected via the mass spectrometer but shows few clinical potentials due to the high cost of the equipment and time-consuming pre-treatment process.
This project will focus on surface-enhanced Raman scattering (SERS)-based digital colloid-enhanced Raman spectroscopy (dCERS) (Nature, 2024) and SERSome (Cell Reports Medicine, 2024) technique for rapid and sensitive metabolomics analysis of the biofluids. This technique is based on the molecule-fingerprinting spectral nature with the advantage of ultra-high throughput and single-molecule sensitivity. With the targeting the biomarkers, SERS technique, as the non-targeting, non-invasive and efficient technique, will pave a new way of the accurate disease diagnosis and basic pathological studies with high practical and popularizing value.

Eligibility Requirements:
> Background in biomedical nanomaterials and clinical diagnosis
> Prerequisite of biomedical statistics and basic algorithms for data analysis
> Enthusiasm to advancing the in vitro diagnostics (IVD) techniques

Main Tasks:
> Synthesis and optimization of SERS nanomaterials for metabolite detection
> Practicing SERS measurements of the biofluids
> Developing and optimization of the algorithms for spectral analysis and bioinformatics
> Writing final reports.

Website:
Lab: http://www.yelab.sjtu.edu.cn/
School: https://bme.sjtu.edu.cn/

PROJECT
99 Development of AI Models for SERSome Metabolomics Analysis

Contact Information:
Prof. Jian Ye/ Dr. Zhou Chen
Email: yejian78@sjtu.edu.cn

Project Description and Objectives:
Metabolomics hold significant promise for the early diagnosis of diseases, which can identify specific biomarkers associated with disease onset. For more rapid and sensitive metabolomics analysis of the biofluids, SERSome (Cell Reports Medicine, 2024) technique has been recently proposed with advantages of low-cost, ultra-high throughput and single-molecule sensitivity. However, the complexity and volume of SERSome data pose significant analytical challenges. This project will focus on developing reliable AI models specialized for comprehensive SERSome metabolomics analysis. Deep learning architectures (e.g., convolutional neural networks, U-net) can extract latent feature information from massive data. By integrating cutting-edge AI methods with metabolomics, this project will pave the way for transformative advancements in early disease diagnosis and precision medicine.

Eligibility Requirements:
> Background in artificial intelligence and clinical diagnosis
> Prerequisite of programming skills using Python and AI modelling using PyTorch
> Enthusiasm to advancing the in vitro diagnostics (IVD) techniques

Main Tasks:
> Preprocessing Raman spectra: baseline reduction and denoising
> Developing deep learning architectures based on the order-invariant SERSome for metabolomics analysis
> Training and fine-tuning AI models
> Writing final reports.

Website:
Lab: http://www.yelab.sjtu.edu.cn/
School: https://bme.sjtu.edu.cn/

AERONAUTICS AND ASTRONAUTICS

PROJECT
100 Smartphone Decimeter Challenge

Contact Information:
Assoc. Prof. Xin Zhang
Email: xin.zhang@sjtu.edu.cn

Project Description and Objectives:
The challenge is initiated by the Institute of Navigation, sponsored and technically supported by Google. The motivation is to encourage students interested in GNSS to develop high precision GNSS positioning on smartphones and exploiting every qualified state-of-the-art technique to fuse data from an inertial measurement unit (IMU) and GNSS. The developed algorithms will be such a universal package that with slight modification of the incoming sensor data stream, it can even perform the navigation tasks required for Mars rovers such as "Perseverance", launched in 2020. Participants will go through systematic training in GNSS positioning programming, Android app development and deployment, after which they will be encouraged to compete in a challenge using a pool of GNSS datasets collected from smartphones and high accuracy ground truth. They will also interact with our brilliant faculty, graduates, and undergraduate students in the team.

Eligibility Requirements:
> Basic knowledge of linear algebra is required. Ability to program in C++ will be a plus.

Main Tasks:
> Learn how to do sensor fusion for navigation as it was done for the Mars rover "Perseverance" using raw data from a phone that you use in your daily life.
> Students will be encouraged to participate in the second Google-ION (Institute of Navigation) Smartphone Decimeter Challenge by using the developed algorithms.

Website:
Lab: https://gnc.sjtu.edu.cn
School: https://www.aero.sjtu.edu.cn

PROJECT 101

High-Fidelity Peridynamic Modeling Strategy for Advanced Composites

Contact Information:

Assoc. Prof. Yile Hu
Email: yilehu@sjtu.edu.cn

Project Description and Objectives:

Various numerical methods have been developed and used to analyze the progressive damage and failure of advanced composite materials. However, the spatial derivatives needed to solve differential equations are not defined at the crack surface or tip. This introduces an inherent limitation to the classical theory. An alternative approach for simulation failures and damages in advanced composite materials is highly needed to improve the shortcomings in classical mechanics. In this project, a new continuum mechanics theory, the PeriDynamic (PD) theory, will be applied to analyze progressive failures in advanced composite structures. Students can gain fundamental and practical knowledge of the numerical implementation of peridynamics. Moreover, students will be able to perform some experimental investigations of composite materials to verify their observation in a numerical simulation.

Eligibility Requirements:

> Knowledge in Solid Mechanics and Finite Element class;
> Programming with C/C++, Fortran, Python or other language;
> Students with working experience in a lab are preferred.

Main Tasks:

> Develop a peridynamic model for simulating matrix cracking and delamination in aerospace composite material;
> Perform experimental study with the standard testing method to measure material properties of composites.

Website:

Lab: N/A
School: https://www.aero.sjtu.edu.cn

PHYSICS

PROJECT 102

Imaging Topological Materials via a Scanning Tunneling Microscopy

Contact Information:

Prof. Jinfeng Jia
Email: jfjia@sjtu.edu.cn

Project Description and Objectives:

Scanning Tunneling Microscopy is capable of visualizing atoms on a crystal surface and thus has become a top priority for scientists who work in atomic-scale physics, chemistry or material science. Topology, a special kind of advanced mathematics, was introduced into solid-state physics and breeds the emergence of topological materials. This project aims to utilize a low-temperature Scanning Tunneling Microscopy to directly image the atoms on several typical topological materials, including Bi2Te3, stanine, etc.

Eligibility Requirements:

> Understanding of lab safety.
> Interested students should have basic knowledge of quantum mechanics and solid-state physics.
> Proficiency in writing and speaking in English is mandatory.

Main Tasks:

> Finish a research report.
> Give two research presentations (a. references review; b. technical presentation).

Website: Lab:

Lab: http://lodiphie.physics.sjtu.edu.cn/
School: http://www.physics.sjtu.edu.cn/

PROJECT 103

Molecular Beam Epitaxy Growth of Topological Insulator Thin Films

Contact Information:

Prof. Jinfeng Jia
Email: jfjia@sjtu.edu.cn

Project Description and Objectives:

Molecular beam epitaxy (MBE) is a delicate technology that was designed to synthesize high-quality single crystalline ultra-thin films and atomic layers. Topological insulators are a popular topic and also a frontier of condensed matter physics research in recent years. This project aims to show the interested student how to use the MBE method to successfully grow high quality thin films of topological insulator material, Bi_2Te_3.

Eligibility Requirements:

> Understanding of lab safety.
> Interested students should have basic knowledge of quantum mechanics and solid-state physics.
> Proficiency in writing and speaking is mandatory.

Main Tasks:

> Finish a research report.
> Give two research presentations (1. References review; 2. Technical presentation).

Website:

Lab: http://lodiphie.physics.sjtu.edu.cn/
School: http://www.physics.sjtu.edu.cn/

PROJECT 104

Ultrafast Optical Investigation of Solid State Materials

Contact Information:

Asso. Prof. Hao Chu
Email: haochusjtu@sjtu.edu.cn

Project Description and Objectives:

The electric properties of solids are intimately related to their optical properties (for example metals are usually reflective while insulators are transparent). When we shine a laser beam onto a semiconductor, charge carriers will be excited from the valence band to the conduction band, resulting in a modification of the optical reflectivity of the sample. The subsequent relaxation of the photo-excited charge carriers can be monitored via the reflectivity change of the sample. By shining a femtosecond laser pulse onto a semiconductor and monitoring its reflectivity change as a function of time, we can visualize the ultrafast photo-carrier relaxation dynamics in a semiconductor.

Eligibility Requirements:

Expected candidates are in their 3rd year or 4th year of undergraduate studies, and should have some knowledge about solid state physics as well as equipped with good hands-on skills in the laboratory. Daily communication will be conducted in English.

Main Tasks:

Learn to use a femtosecond ultrafast reflectivity set-up and use it to investigate the ultrafast photo-carrier relaxation dynamics as well as the coherent phonon dynamics of solid state materials.

Website:

Lab: https://ultrafastandnonlinearopticslab.wordpress.com/
School: http://www.physics.sjtu.edu.cn/

PROJECT 105

Nonlinear Optical Investigation of the Symmetries of Solids

Contact Information:
Asso. Prof. Hao Chu
Email: haochusjtu@sjtu.edu.cn

Project Description and Objectives:
One technologically important aspect of condensed matter physics research is that one can engineer different phases of the same material that exhibit dramatically different physical properties (for example ferromagnet vs. antiferromagnet, paraelectric vs. ferroelectric). According to Landau theory, phase transitions are usually characterized by symmetry-breaking. In order to fully understand the mechanism of a phase transition (i.e. so that one can better control such a phase transition), often we need to understand what kind of symmetry is broken. In optics, second harmonic generation (where the outgoing light frequency is doubled with respect to the incoming light frequency) is found to exhibit an extraordinary sensitivity to symmetry breaking . In this project, the student will explore how such a technique can be used for studying the symmetries of solids.

Eligibility Requirements:
Expected candidates are in their 3rd year or 4th year of undergraduate studies, and should have some knowledge about solid state physics as well as equipped with good hands-on skills in the laboratory. Daily communication will be conducted in English.

Main Tasks:
Learn to use a second harmonic generation (SHG) setup based on a femtosecond laser system to study the rotation-, mirror-, inversion-symmetries of solids.

Website:
Lab: https://ultrafastandnonlinearopticslab.wordpress.com/
School: http://www.physics.sjtu.edu.cn/

PROJECT 106

Ultrafast Dynamics of Magnons

Contact Information:
Asso. Prof. Hao Chu
Email: haochusjtu@sjtu.edu.cn

Project Description and Objectives:
When the electron spins align parallel or anti-parallel to each other in a periodic fashion in a solid, they form macroscopically the so-called ferromagnet or antiferromagnet. However, this doesn't mean the orientation of the individual spins will remain fixed under thermal environment or under optical excitation. In reality, the spins will collectively manifest a spatially varying and periodic precession, known as magnons or spin waves. Experimentally, the characterization of magnon dynamics usually requires large and sophisticated facilities like neutron diffraction station, x-ray diffraction station. It turns out that optics can also be sensitive to the magnetic order inside a solid via the optical Kerr effect. If one employs a femtosecond laser pulse first to excite the individual spins out of their equilibrium alignment and then measures their subsequent re-equilibration using another time-delayed pulse via the optical Kerr effect, one can similarly obtain information about the magnons dynamics.

Eligibility Requirements:
Expected candidates are in their 3rd year or 4th year of undergraduate studies, and should have some knowledge about solid state physics as well as equipped with good hands-on skills in the laboratory. Daily communication will be conducted in English.

Main Tasks:
Build a femtosecond ultrafast Kerr-rotation set-up and use it to investigate the magnon dynamics of magnetic materials.

Website:
Lab: https://ultrafastandnonlinearopticslab.wordpress.com/
School: http://www.physics.sjtu.edu.cn/

CHEMISTRY AND CHEMICAL ENGINEERING

PROJECT 107

Enantioselective Addition of Inactivated Alkenes

Contact Information:
Prof. Yongqiang Tu
Email: tuyq@sjtu.edu.cn

Project Description and Objectives:
Selective functionalization of the carbon?carbon double bond in olefins provides a tremendous number of fundamental transformations that hold widespread applications in organic synthesis and exert a great impact on the development of organic chemistry. Transition metal catalysis is one of the most important tools to accurately forge chemical bonds in modern organic synthesis. Organocatalysis, a biomimetic catalyst that usually catalyzes with metal-free small organic molecules, is a relatively young research area that started to flourish at the beginning of this century. In this project, we will investigate the enantioselective addition reaction of inactivated alkenes enabled by transition metal/organocatalysis cooperative catalysis, resulting in successive multiple bond-forming events, further forming useful building blocks that exist extensively in bioactive molecules and pharmaceuticals.

Eligibility Requirements:
> Basic knowledge of organic chemistry.
> Motivation to work and an interest in organic synthesis chemistry.
> Majors in organic chemistry preferred.

Main Tasks:
> Finish a research report.
> Submit a paper to a conference or a journal as a co-author.

Website:
Lab: N/A
School: http://scce.sjtu.edu.cn/en/

PROJECT 108

Synthesis and Self-Assembly of Asymmetric Organic Cages

Contact Information:
Assoc. Prof. Shaodong Zhang
Email: sdzhang@sjtu.edu.cn

Project Description and Objectives:
Unlike the Cross-linked Metal Organic Framework (MOF) and Covalent Organic Framework (COF) that cannot be processed once they are synthesized, discrete organic cages not only have a well-defined intrinsic cavity, but also can be easily processed as they are solvent-soluble and can be melted. Moreover, depending on their interaction with guest molecules, organic cages can be used as a building block to construct guest-responsive supramolecular structures, providing a versatile platform for novel materials discovery. The aim of the project is to design organic cages with asymmetric geometry, which can self-assemble into various hierarchical superstructures with different superlattices. This can be realized by introducing different guest molecules into the cavity of those cages via specific host-guest chemistry.

Eligibility Requirements:
The successful candidates should be fluent in English and will need basic knowledge of organic chemistry, characterization techniques (NMR, Mass Spectroscopy, MALDI-TOF, etc.), or crystallography.

Main Tasks:
Design, synthesis and characterization of precursors, and organic cages under the guidance of the postdocs or Ph.D. students in the group.

Website:
Lab: https://thezhanggroup.sjtu.edu.cn
School: http://scce.sjtu.edu.cn/en/

PROJECT 109

Protein Structure and Dynamics Using Artificial Intelligence and Ultrafast Spectroscopy

Contact Information:

Assoc. Prof. Bei Ding
Email: bei.ding@sjtu.edu.cn

Project Description and Objectives:

The objective of this 6-week internship is to gain exposure to interdisciplinary research involving physical chemistry, biology and optics, gain knowledge about protein structural and dynamics by following up with today's cutting-edge scientific advances from the literature, and developing skills in using PYMOL software, Alphafold2 and molecular dynamic simulations. In the last week, an academic presentation is required about things learnt. The internship will provide valuable hands-on experience, enhanced technical abilities, and contribution to academic and professional growth.

The students are encouraged to select from three interesting topics.

1) Artificial photoenzymes that can achieve new organic reactions that are beyond natural design. (J. Am. Chem. Soc. 2024, 146, 2748-2756)

2) Nature's smallest photoreceptor BLUF domain with photocycles involving intricate proton transfer reactions. (Proc. Natl. Acad. Sci. 2022, 119, e2203996119)

3) Blue-light photoceptor cryptochromes that modulate bird navigation and plant circadian clock.

Eligibility Requirements:

> Interest in physical chemistry or biological chemistry.

Main Tasks:

> Sequence Alignment and Bioinformatics Analysis.
> PYMOL Software and Molecular Visualization.
> Challenge: Molecular Dynamics Simulation.
> Molecular biology or Ultrafast Experiments (Optional).

Website:

Lab: https://www.x-mol.com/groups/bei_ding/jiaruwomen
School: http://scce.sjtu.edu.cn/en/

PROJECT 110

Biomimetic Total Synthesis of Ergot Alkaloids

Contact Information:

Assoc. Prof. Gang CHEN
Email: gchen2018@sjtu.edu.cn

Project Description and Objectives:

Ergot alkaloids are typical indole alkaloids with 3,4-fused rings, and natural or semi-synthetic ones were approved for treatment or relief of neurodegenerative diseases. Due to their unique structure and good biological activities, both the biosynthetic and total syntheses of these natural products were widely studied. In particular, the development of transitional metal-catalyzed reaction provided new synthetic strategies for the total syntheses, for example, Heck reaction, allylic reaction and C-H activation. In this project, we proposed the biomimetic strategy using the C-H activation and decarboxylative reaction. The key steps of the synthesis of lysergic acid include indole C4-H olefination and intramolecular decarboxylative Giese reaction, a chiral route by asymmetric decarboxylative allylic reaction will also be investigated; similarly, indole C4-H alkynylation followed by intramolecular decarboxylative coupling with alkyne provided the key precursor of agroclavine. The aim of this project is not only to provide another efficient route of ergot alkaloids in a biomimetic way, but also to prepare lots of ergot alkaloids for further medical chemistry studies.

Eligibility Requirements:

> Major in chemistry, including chemistry& biochemistry, chemistry & chemical biology.

Main Tasks:

> Learn about organic chemistry experiments and total synthesis.
> Synthesize some structures by the established route.
> Explore the following synthetic steps.

Website:

Lab: N/A
School: http://scce.sjtu.edu.cn/en/jiaoshi.php?aid=502&c=2

PROJECT
111

High-Efficient Low-Platinum Catalysts for Hydrogen Fuel Cells

Contact Information:

Prof. XinHao Li
Email: xinhaoli@sjtu.edu.cn

Project Description and Objectives:

Hydrogen fuel cells using hydrogen and air to generate electricity with water as the only by-product are an extremely promising zero-emissions technology. However, fuel cell technology has been stagnant for decades in terms of scalability because of the high cost. Current hydrogen fuel cells require platinum catalysts to electrochemically reduce oxygen at the cathode and oxidize hydrogen at the anode, which accounts for over 50% of the total cost of fuel cells. In response to these challenges, the development of low-platinum electrocatalysts has emerged as a critical area of research with major industrial applications. In this project, low-loading high-efficiency heterojunction low-platinum catalysts for hydrogen fuel cells will be developed to improve efficiency and decrease cost.

Eligibility Requirements:

Basic knowledge of inorganic chemistry and electrochemistry
Interest in chemistry and catalysis

Main Tasks:

Synthesis and basic characterization of the electrocatalysts.
Performance test of the electrocatalysts.

Website:

Lab: https://scce.sjtu.edu.cn/en/Faculty_Directory/269.html
School: https://scce.sjtu.edu.cn/en/
Oceanography

PROJECT
112

Microalgae and Ecosystem Sustainability

Contact Information:

Assoc. Prof. Ji Li
Email: Liji81@sjtu.edu.cn

Project Description and Objectives:

Marine biology internships offer you the opportunity to learn how to become a marine biologist while getting experiences and skills in marine ecosystem research. In the midst of many global environmental challenges (melting ice caps, declining species, climate change, eutrophication, plastic pollution, yikes), marine biology and ecology is a field that is not only increasing with opportunities and positions, but also is desperate for more people to join and find solutions for the future. The field can quite literally save the world.
This internship is for students interested in marine science. The program includes lectures, lab training, field trips, and hands-on activities. This internship will give you the opportunity to gain hands-on experience in microalgae-related marine ecological research, data collection, educational techniques, and greater insight into the work of a marine biologist.

Eligibility Requirements:

> Have a cumulative GPA of 3.0 or higher.

Main Tasks:

> Propose a novel design/application of microalgae in the scope of project.
> Give two research presentations (a. references review; b. technical presentation).
> Finish a research report in this project.

Website:

Lab: http://soo.sjtu.edu.cn/en/szTeachers/3638.html
School: http://soo.sjtu.edu.cn/en

PROJECT 113

Interpreting and Understanding Dolphins and Other Marine Mammals in a Sea Park

Contact Information:
Assoc. Prof. Ji Li
Email: Liji81@sjtu.edu.cn

Project Description and Objectives:
The Summer Program with work with Haichang Sea Park, one of the largest sea parks in China, and offers a unique opportunity for students to engage in groundbreaking research and conservation efforts. This hands-on program, hosted in collaboration with the School of Oceanography, focuses on the study of marine life, particularly dolphins and whales, using cutting-edge technology and artificial intelligence. Participants will work closely with professors to observe marine mammals, record their sounds and activities, and analyze their behavior through modern technologies such as acoustic sensors, drones, and AI-driven data analysis tools. By studying the complex communication patterns and activities of these majestic creatures, students will contribute to important environmental research aimed at understanding and protecting marine biodiversity.
In addition to scientific research, participants will engage in science education initiatives, where they will have the chance to interact with visitors at the Sea Park. Through guided tours and educational workshops, students will help raise awareness about ocean conservation and inspire the public to take action to protect marine ecosystems. This program provides a platform for students to develop skills in scientific research, data analysis, and public outreach, while fostering a global community of young scientists passionate about the environment.

Eligibility Requirements:
Fluent English in writing and speaking
Have a great heart that cares about nature and the ocean

Main Tasks:
1. Hands-on research experience in marine science, with a focus on marine mammal behavior and acoustics.
2. Promote citizen awareness and action on ocean conservation through education and outreach activities.
3. Foster cross-cultural collaboration among international students and Chinese students.

Website:
Lab: http://soo.sjtu.edu.cn/en/szTeachers/3638.html
School: http://soo.sjtu.edu.cn/en

PROJECT 114

Taxonomy and Identification of Polar Marine Benthos

Contact Information:
Assoc. Prof. Cong Zeng
Email: congzeng@sjtu.edu.cn

Project Description and Objectives:
The polar regions harbor unique communities of benthic organisms due to their constant low temperature. These uncommon creatures not only provide abundant resources to the polar regions, but are also important for the stability of polar ecosystems and the blue carbon cycle. Knowledge of unique creatures is mainly dependent on traditional taxonomic identifications, but taxonomic work in the polar regions is still very scarce. With the rapid decline of taxonomists worldwide, this limitation poses an even greater challenge to polar biodiversity assessment. Therefore, this project aims to explore the taxonomical identification of polar benthic organisms through molecular tools, which is expected to provide new technical support for polar marine conservation.

Eligibility Requirements:
Background in Biology
Basic knowledge of taxonomy and molecular biology
Good communication skills in English or Chinese

Main Tasks:
Basic morphological identification of polar benthic megafauna
DNA barcoding analysis of polar benthic megafauna
Phylogenetic analysis of polar benthic megafauna

Website:
Lab: N/A
School: https://soo.sjtu.edu.cn

PROJECT 115

Velocity change of Helheim Glacier from multi-source remote sensing data

Contact Information:

Assoc. Prof. Xianwei Wang
Email: xianwei.wang@sjtu.edu.cn

Project Description and Objectives:

Polar glaciers are changing rapidly under the background of climate warming and ocean change. The glacier and ice shelf calving front may change under different forces, such as surface water penetration, warm ocean water intrusion, tidal forcing, etc. Understanding the rapid change and variability of polar glaciers is important to forecast global sea level rise. This project aims to extract the long-time series' glacier velocity change using satellite, terrestrial and interferometric remote sensing data. Some algorithms will be developed to extract glacier velocity. The background mechanism of glacier change will be investigated by using physical oceanographic data and computer modeling.

Eligibility Requirements:

Programming skills with Python
Data analysis skills with ArcGIS, and ENVI
Good English speaking and writing skills

Main Tasks:

Develop algorithms to extract glacier velocity using remote sensing data
Investigate the relationship of velocity change with ocean change

Website:

Lab: N/A
School: https://soo.sjtu.edu.cn

PROJECT 116

Detection and Characterization of Microbial Life in the Deep Ocean Crust

Contact Information:

Prof. Fengping Wang
Email: fengpingw@sjtu.edu.cn

Project Description and Objectives:

The ocean's dark, high-pressure environments harbor a vast deep biosphere, with microbial cells in ocean sediments estimated at 102?, comparable to those in global seawater and soils. Oceanic crust, five times the volume of sediments, offers unique habitats due to its mineral composition and porous structure, potentially hosting diverse microbial communities even at depths of 5 km. During The International Ocean Discovery Program (IODP) expedition 399, a record-breaking 1.2 km mantle-derived rock core was retrieved, providing a good opportunity to explore microbial abundance, activity, and survival in the deep oceanic crust. This project aims to detect microbial life within these rock samples. Microbial cells will be visualized and counted using staining techniques. DNA will be extracted using modified protocols tailored to these challenging samples, followed by high-throughput sequencing to uncover their genomic potential.

Eligibility Requirements:

Basic knowledge of microbiology

Main Tasks:

> Visualize and count the number of microbial cells in rock samples
> Extract DNA from the rock samples
> Submit a research report at the end of the program

Website:

Lab: https://icdli.sjtu.edu.cn/cn/
School: https://soo.sjtu.edu.cn/

PROJECT
117

Assessment of the Blue Carbon Potential in the Marine Ecosystem

Contact Information:
Asso. Prof. Yonghui Gao
Email: ygao80@sjtu.edu.cn

Project Description and Objectives:
Global CO_2 levels have risen dramatically due to fossil fuel combustion, deforestation, and industrial processes since the Industrial Revolution. This has been leading to climate change, ocean acidification, and economic loss. Coastal and marine organisms take up atmospheric carbon dioxide with high efficiency and convert it into organic carbon, which has a long storage time. We would help you understand the process, activity, and mechanism of the blue carbon ecosystem. The field and lab experience include evaluation of photosynthesis and water quality, which improves the consciousness of environmental protection. Blue carbon ecosystems are integrated into carbon trading schemes, providing financial incentives for conservation. We offer learning opportunity of global policy and the economic potential of carbon removal.

Eligibility Requirements:
> 3rd year and above undergraduate students majoring in Biology/ Chemistry/ Oceanography/ Environmental Science.
> Understanding of lab safety.
> Students with laboratory experience are preferred.

Main Tasks:
> Propose a novel design/application of microalgae in the scope of project.
> Give two research presentations (a. references review; b. technical presentation).
> Finish a research report for this project

Website:
Lab: https://soo-old.sjtu.edu.cn/en/szjyry/3632.html
School: https://soo.sjtu.edu.cn/en/

PROJECT
118

Genetic Analysis of the Arabidopsis Hippo Homolog SIK1 and SIK1-interacting Partners

Contact Information:
Prof. Qingqiu Gong
Email: gongqingqiu@sjtu.edu.cn; gongq2@gmail.com

Project Description and Objectives:
How organ size is controlled is a fundamental question in developmental biology. In animals, the Hippo pathway restricts cell proliferation and promotes apoptosis to negatively regulate organ size. Our lab had previously characterized the Arabidopsis protein kinase SIK1 and its scaffold protein MOB1 as the Hippo-Mats signaling circuit in plants. In order to establish a complete plant Hippo/SIK1 pathway, we carried out protein-protein interaction screens with SIK1-GFP plants and obtained many candidates. The objective of this project is to verify the genetic interactions between SIK1 and some of these candidates by generating double mutants and by doing subsequent genotype and phenotype analyses. The results will contribute to our understanding of plant organ size control, development, and yield.

Eligibility Requirements:
> Undergraduate student (senior) majoring in Biological Sciences.

Main Tasks:
> Generate double knock-out mutants by crossing or targeted genome editing (CRISPR-Cas).
> Grow the mutants and verify the double mutants by genomic PCR and RT-PCR.
> Observe and document the phenotypes of the double mutants.

Website:
Lab: https://www.researchgate.net/profile/Qingqiu_Gong?ev=prf_highl
https://scholar.google.com/citations?user=E1gLh-EAAAAJ&hl=en
School: http://life.sjtu.edu.cn/

PROJECT
119

Assessment of Dopamine Neuron Number in the Mouse Models of Parkinson's Disease

Contact Information:

Assoc. Prof. Ilya A. Vinnikov
Email: i.vinnikov@sjtu.edu.cn

Project Description and Objectives:

Parkinson's disease is the most prevalent neurodegenerative movement disorder with tremor, rigidity, bradykinesia and postural instability. These symptoms develop upon progressive degeneration of dopaminergic neurons in the substantia nigra pars compacta. MicroRNAs are essential during the development of most tissues, including the dopaminergic system. The rapidly emerging field of microRNA has already suggested several molecular mechanisms relevant to the pathogenesis of PD. However, the comprehensive functional analysis of specific microRNAs in dopaminergic neurons is still missing.

The objective of the proposed project is to identify the physiological and pathophysiological functions of midbrain-expressed microRNAs in a neurodegenerative context. The project will involve the counting of adult dopaminergic neurons in the in vivo models of Parkinson's disease. In particular, we will implement genetically engineered mice with over-expression of Dicer, the endonuclease crucial for microRNA maturation. The data generated as a result of this project might aid both neurologists and researchers studying the mechanisms of neurodegenerative diseases.

Eligibility Requirements:

Background knowledge in image analysis, computer sciences, molecular biology, biochemistry or neuroscience is an asset.

Main Tasks:

Image analysis and neuronal number quantification.

Website:

Lab: http://vinnikov.science
School: http://life.sjtu.edu.cn/

PROJECT
120

Production of Autophagy Regulating Peptides by Yeast

Contact Information:

Prof. Zhiping Xie
Email: zxie@sjtu.edu.cn ; cnxzpum@gmail.com

Project Description and Objectives:

When too much damage and waste materials accumulate in our cells, they may undergo programmed cell death, or even worse, mutate to become cancer cells. Normally, large structures like dysfunctional mitochondria or protein aggregates need to be cleared by the autophagy/lysosome system. This project aims to produce autophagy regulating peptides by budding yeast. Our research will help provide safe and economical peptide-based medicine for society.

Eligibility Requirements:

Applicants are expected to possess a good understanding of basic biochemistry and cell biology concepts.

Main Tasks:

This project involves working with yeast and human cells. Participants will learn to design and construct plasmids and yeast strains to produce peptides that can cross the cell membrane of recipient cells and regulate autophagy. The efficacy of the peptides will be accessed using a variety of biochemical assays and live cell imaging techniques. Based on initial results and further optimization of the design, expression and purification of the peptides will be performed.

Website:

Lab: http://cbi.sjtu.edu.cn/En/Data/List/ZhipingXie
School: http://life.sjtu.edu.cn/

PROJECT 121

Molecular Mechanisms Controlling Inflorescence and Spikelet Development in Rice and Barley

Contact Information:

Prof. Wanqi Liang
Email: wqliang@sjtu.edu.cn

Project Description and Objectives:

Rice and barley, the model grass plants, form specialized morphology of inflorescence and spikelet, which determine grain yield. Using a variety of approaches, such as forward and reverse genetics, biochemistry, and cell biology, we are investigating the molecular mechanisms and the regulatory network involved in the morphogenesis and development of inflorescence and spikelets in rice and barley. We are going to use the cutting-edge technologies, including Single-cell sequencing and Spatial Transcriptomics, to identify the key regulators controlling the grain number and floral organ identities, which will provide new resources and novel strategies for genetic improvement of current used rice and barely varieties.

Eligibility Requirements:

Applicants should have basic knowledge of biology.
Experience in biological research would be an advantage.

Main Tasks:

> Learn methods of inflorescence observation and perform SEM observation.
> Learn the principles and methods of Single-cell sequencing and Spatial Transcrip tomics.
> Collect rice and barley inflorescence and learn how to prepare samples for high-throughput sequencing.

Website:

Lab: http://zhanglab.sjtu.edu.cn/Default.aspx
School: http://life.sjtu.edu.cn/

PROJECT 122

Cloning and Functional Characterization of Rice Male Sterile Genes

Contact Information:

Prof. Wanqi Liang
Email: wqliang@sjtu.edu.cn

Project Description and Objectives:

The life cycle of flowering plants alternates between diploid sporophyte and haploid gametophyte generations. Male gametophytes develop in the anther compartment of the stamen within the flower which requires cooperative functional interactions between gametophytic and sporophytic tissues. The male reproductive development is highly complicated, involving numerous biological events, including cell division, differentiation and degeneration of somatic tissues consisting of four concentric cell layers surrounding and supporting reproductive cells as they form mature pollen grains through meiosis and mitosis. To understand the mechanism of plant male reproduction, we are combining systematic biology (genomics, transcriptomics, proteomics, metabonomics) with other approaches such as genetics, cell biology, biochemistry, and structural biology to elucidate the molecular mechanisms underlying each biological event of male reproduction.

Eligibility Requirements:

> Applicants should have basic knowledge of biology.
> Experience in biological research would be an advantage.

Main Tasks:

> Learn the methods of anther and pollen observation, perform DAPI staining, semi-thin section and SEM observation.
> Learn the principle of gene cloning by map-based cloning and Mut-map analysis, perform plant DNA extraction and PCR detection.
> Learn the methods of bioinformatic analysis of gene functions, perform phylogenetic analysis and RNA-seq data analysis.

Website:

Lab: http://zhanglab.sjtu.edu.cn/Default.aspx
School: http://202.120.63.177:8884/english/

PROJECT 123

Molecular Characterization of GMOs

Contact Information:

Prof. Litao Yang
Email: yylltt@sjtu.edu.cn

Project Description and Objectives:

As more and more transgenic crops like transgenic maize and soybean have been approved and consumed as food and feed, more and more people have become concerned about the safety of transgenic organisms. The molecular characterization of transgenic organisms is the basis for assessing the safety of transgenic organisms. We are developing new detection methods to identify changes that occur at the genomic, transcriptomics, proteomics, and metabolic levels. We are also currently comparing changes between transgenic lines and non-transgenic control lines, as well as between transgenic lines and conventional cultivated lines. This research will lay the foundation for the safety assessment of GMOs.

Eligibility Requirements:

> Applicants should have basic knowledge of biology.
> Experience in biological research would be preferred.

Main Tasks:

The student will be involved in all stages of the project:

> Design experimental scheme.
> Perform experiment.
> Analyze experimental results.
> Write the experiment report.
> Finish a research report.
> Give two presentations: one literature review and one on research progress.

Website:

Lab: http://zhanglab.sjtu.edu.cn/Default.aspx
School: http://202.120.63.177:8884/english/

PROJECT 124

Research of Genomics Analysis and Genetic Mechanism of Complex Diseases

Contact Information:

Prof. Yongyong Shi
Email: shiyongyong@vip.163.com

Project Description and Objectives:

This lab is focusing on developing new analytical tools for genetic studies, and discovering new genetic mechanisms of cancers, mental disorders, heart diseases and endocrine diseases. The major research interests include: (1) development of new experimental methods and data analysis algorithms in molecular genetics; (2) identification of common/rare variants associated with complex diseases such as schizophrenia by genome-wide association studies; (3) perform in vivo and in vitro functional studies for novel mutations to reveal their exact pathogenic mechanisms; (4) development of the correlated new drug and/or minimally invasive diagnosis for target therapies. Through this research, we aim to identify risk genes, pathways and mechanisms of drug action for complex diseases and contribute to precision medicine in the near future.

Eligibility Requirements:

> Basic knowledge of genetics, statistics and molecular biology.

Main Tasks:

> Bioinformatics
> Chip/sequencing data analysis
> In vivo/vitro functional experiments

Website:

Lab: http://www.bio-x.cn
School: http://life.sjtu.edu.cn

PROJECT 125

Developmental Regulation Mechanism of Germline Stem Cells and Embryonic Stem Cells

Contact Information:

Prof. Ji Wu
Email: jiwu@sjtu.edu.cn

Project Description and Objectives:

Germline stem cells are a type of cell with the ability to self-renew and differentiate, responsible for producing gametes, that is, sperm and eggs, thereby participating in the reproductive process. Germline stem cells play a crucial role in maintaining the genetic diversity of populations and propagating offspring. Embryonic stem cells, on the other hand, originate from early embryos and possess totipotency, being able to differentiate into any type of cell in the body. As a frontier area of life science research, germline stem cells and embryonic stem cells are of great significance for understanding the basic mechanisms of life development, promoting the development of regenerative medicine, and disease treatment. This project aims to delve into the developmental mechanisms of germline stem cells and embryonic stem cells, revealing their differentiation, proliferation, and regulatory patterns in both in vivo and in vitro environments, providing a theoretical foundation and technical support for stem cell therapy and regenerative medicine.

Eligibility Requirements:

> Good English communication skills.
> Theoretical analysis ability, logical thinking ability, teamwork ability.
> Interested in reproductive biology and stem cell biology.

Main Tasks:

> Midterm technical presentation.
> Final project report.

Website:

Lab: http://www.bio-x.cn/
School: http://www.bio-x.cn/

PROJECT 126

The Mechanisms of Depression and Memory Process

Contact Information:

Prof. Weidong Li
Email: liwd@sjtu.edu.cn

Project Description and Objectives:

There is an increasing risk of mental disorders, such as acute stress disorder (ASD), post-traumatic stress disorder (PTSD) and depression among survivors trapped in rubble during earthquakes. Such long-term impaction of acute restraint stress has not been extensively explored. Learning to contend with threats in the environment is essential for survival, but dysregulation of memories of traumatic events can lead to disabling psychopathology. Our studies found subjected mice to 24-hour-restraint to simulate the trapping episode, and also we discovered a potential target gene LHPP which plays a critical role in depression. In this project, we will explore the neuron function of depressive-like mice induced by acute stress (24-hour-restraint) and LHPP knock-out using multi-channel recording, voltage-sensitive detection image, transcranial magnetic stimulation and whole-cell recording. Also, we will study the extinction mechanisms of traumatic memories by targeted recombination in active populations, DREADDs (designer receptors exclusively activated by designer drugs) and optogenetics strategies. This project may provide a clue for the study of the pathogenesis of depression and related memory processes.

Eligibility Requirements:

> Understanding of lab safety.
> Interested students should have basic knowledge of Neurophysiology and signal processing.

Main Tasks:

> Finish a research report.
> Give two research presentations.

Website:

Lab: https://lwdlab.sjtu.edu.cn/
School: https://life.sjtu.edu.cn/, http://www.bio-x.cn

PROJECT
127

The Role of Macrophage During the Very Early Stage of Tumor Progression

Contact Information:

Assoc. Prof. Donglei Sun
Email: Dongleisun@sjtu.edu.cn

Project Description and Objectives:

Tumors are one of the biggest challenges to human health, the metastasis of which threatens the lives of millions. Macrophage contributes significantly to the development of tumors, but how macrophage and other myeloid cells interact with a tumor at the very early stage is unknown. In this research project, we use intravital microscopy and other related immunological approaches to address the development of tumor-associated macrophage and characterize their functions.

Eligibility Requirements:

Responsible undergraduate students following lab rules are welcome.
GPA ≥ 3.0 in a 4.0 scoring system, or ≥80 in a 100 scoring system.

Main Tasks:

> Learn about fluorescence microscope and macrophage;
> Learn to analyze macrophage population by flowcytometry and immunofluorescence;
> Creation of tumor models;
> Macrophage depletion and function evaluation;
> Essay writing.

Website:

Lab: https://life.sjtu.edu.cn/teacher/En/dongleisun
School: https://life.sjtu.edu.cn/En

AGRICULTURE AND BIOLOGY

PROJECT
128

Particulate Coagulation Effect on Leaf Surfaces of the Typical Tree Species in Shanghai

Contact Information:

Prof. Shan Yin
Email: yinshan@sjtu.edu.cn

Project Description and Objectives:

Atmospheric particulate matter has become the primary air pollutant in China's cities and the use of urban greening tree species to absorb the particulate matter is one of the effective ways to alleviate urban air pollution. The study focuses on the assumptions of three coagulation effects on the leaf, including the wind coagulation, the vapor phase coagulation, and the thermal diffusion coagulation.
Through the above experiments, we will explore the law of condensation and deposition of particulate matters at the interface between the atmosphere and plant leaves under dry sedimentation conditions, filling the gap between vegetation and atmospheric research, and laying a foundation for the mechanism of plant-particle retention. The study will provide a scientific basis to build high efficiency and dust prevention of urban forests and green spaces.

Eligibility Requirements:

> Basic knowledge of Environmental Science or Ecology.
> Strong perseverance.
> Inquisitive mind.
> Punctuality.
> Able to reflect from experiments and make conclusions.
> Formal writing skills.

Main Tasks:

> Finish experiment assigned.
> Give research presentations.
> Compose one science paper.

Website:

Lab: http://www.agri.sjtu.edu.cn/Data/View/3255
School: http://www.agri.sjtu.edu.cn/En/Default

PROJECT 129

Airborne Microbial Communities in Shanghai Neighborhoods: Responses to Garden Age and Urban-rural Gradient

Contact Information:

Assoc. Prof. Nan Hui
Email: nan.hui@sjtu.edu.cn

Project Description and Objectives:

Aerosols typically consist of organic compounds and biological particles, including polycyclic aromatic hydrocarbons, volatile organic compounds, bacteria, fungi, and pollen. Prolonged exposure to gas exchange results in significant uptake of airborne microorganisms by the human body. The diversity of microorganisms presents in aerosols, along with the prevalence of potentially pathogenic microorganisms, plays a crucial role in triggering non-infectious immune-mediated diseases such as asthma and allergies. Therefore, understanding the composition and transmission dynamics of airborne microbial communities in neighborhoods is essential for the prevention and control of diseases. To accurately identify airborne bacteria, fungi, and viruses, we will utilize high-throughput DNA sequencing, metagenomic, and metaviromic approaches to investigate the characteristics of airborne microbial communities. Additionally, we will apply qPCR to identify pathogenic microbes and quantify microbial functional genes. Our results are expected to provide valuable insights for neighborhood planning, which can contribute to urban ecological development and disease prevention.

Eligibility Requirements:

> Interests in academic work.
> Basics in molecular technology, ecology and statistics.
> Good communication skills in English.

Main Tasks:

> Environmental microbial sampling and physical-chemical analyses.
> Total DNA extraction, rRNA gene amplification, qPCR and Illumina Miseq sequencing.
> Bioinformatics and statistical analysis, R, Mothur and JMP

Website:

Lab: https://www.agri.sjtu.edu.cn/Data/View/4605
School: https://www.agri.sjtu.edu.cn

PROJECT 130

Plant Synthetic Biology Techniques for Natural Products from Medical Plants

Contact Information:

Prof. Yuliang Wang/ Asso. Prof. Qifang Pan /Prof. Kexuan Tang
Email: wangyuliang@sjtu.edu.cn/panqf@sjtu.edu.cn/kxtang@sjtu.edu.cn

Project Description and Objectives:

Plant synthetic biology uses enabling approaches from engineering and plants as platforms to produce self-sustaining and photosynthetic-driven traits and bio-production of natural products. Chinese traditional medical plants produce a rich and diverse array of natural products, such as artemisinin from Artemisia annua, paclitaxel from Taxus chinensis, santalol from Santalum album, and so on. Our project aims to develop plant synthetic biology techniques for natural products, including the design and construction of new biological parts, devices and systems and the re-design of existing natural biological systems.

Eligibility Requirements:

> Basic knowledge of molecular biology.
> Preferred: Experience in plant biotechnology.

Main Tasks:

> Clone a functional structural gene, construct the vector and express in plant or yeast system.
> Finish a research report.
> Give one presentation (Experiment Design, Progress & Results).

Website:

Lab: https://plantbiotech.sjtu.edu.cn/
School: http://www.agri.sjtu.edu.cn/eng/

PROJECT
131

Viticulture and Enology

Contact Information:

Dr. Peining Fu
Email: fupeining@sjtu.edu.cn

Project Description and Objectives:

This project includes all of the processes in the standard winemaking procedure. The students who join the project will participate in each step to gain experience in viticultural practice, grapevine physiology and electrophysiology, ripening analysis before the harvest, berry harvest, selection and crushing, yeast inoculation and start of fermentation, wine stabilization and clarification, etc. Furthermore, the students will also be trained in how to taste the wine professionally.

Eligibility Requirements:

Basic knowledge of plant science and food science.

Main Tasks:

Complete a small-scale wine fermentation process, learn the necessary analytical skills of wine chemistry and wine sensory evaluation.

Website:

Lab: http://cve.sjtu.edu.cn
School: http://www.agri.sjtu.edu.cn/En

PROJECT
132

Functional Analysis of Proteins Interacting with the Key Factor of Light Signaling Pathway

Contact Information:

Assoc. Prof. Ruohe Yin
Email: ruohe.yin@sjtu.edu.cn

Project Description and Objectives:

Light is a key environmental factor affecting plant growth and development. Photoreceptors can sense light signals and trigger downstream signal transduction pathways, which regulate many physiological processes in plants. The objective of this project is to screen the interacting proteins of the important factor in the light signal transduction pathway, and investigate the function of the interacting proteins. The results will contribute to our further understanding in light regulating plant growth and development.

Eligibility Requirements:

> Applicants should have basic knowledge of genetics, molecular biology and basic biochemistry.
> Experience in biological research would be preferred.
> Able to document experimental results and draw conclusions.

Main Tasks:

> Perform protein-protein interaction assays with Y2H, BiFC etc.
> Grow and verify the transgenic plant lines and mutants by genomic PCR, RT-PCR and western-blot.
> Observe and document the phenotypes of the transgenic lines and mutants.
> Analyze protein subcellular localization by confocal microscope.

Website:

Lab: https://rhyin.sjtu.edu.cn/
http://www.agri.sjtu.edu.cn/En/Data/View/4091
School: http://www.agri.sjtu.edu.cn/En/Default

PROJECT 133

Bacterial Effectors for Plant Immunity

Contact Information:

Prof. Gongyou Chen
Email: gyouchen@sjtu.edu.cn

Project Description and Objectives:

To know how bacterial effectors trigger plant immunity (ETI) and susceptibility (ETS) via their targets in plants and then to generate durable broad-spectrum resistant plants against bacterial infection. Our working systems include not only Xanthomonas-rice pathosystems, but also other bacterial-plant pathosystems as well. Currently, we have generated an effector-free strain of a model bacterium PXO99A which may elucidate PTI, ETI and ETS.

Eligibility Requirements:

> Students of Master's or PhD degree programs, who have undertaken similar research projects, are welcome.

Main Tasks:

> Try to understand what is(are) the core effector(s) of plant bacteria for water-soaking in plants
> Try to understand what is(are) the core effectors of a pathogenic bacterium for basic pathogenicity in plants is (are)
> Try to understand what are bacterial core effectors and their targets in plants.

Website:

Lab: https://researchgate.net/profile/Gongyou-Chen
School: http://www.agri.sjtu.edu.cn/Data/View/2270

PROJECT 134

Optimization of Germinated Conditions with Hydrogen Rich Water for Improving Nutritional Properties in Hulless Barley

Contact Information:

Prof. Zhongquan Sui
Email: zsui@sjtu.edu.cn

Project Description and Objectives:

With the aging of the world population structure, the incidence of chronic diseases such as hyperlipidemia is increasing. Reasonable dietary nutrition can effectively prevent or delay the occurrence of chronic diseases. Hulless barley contains more nutrients and antioxidants than rice. Regular consumption can effectively reduce the occurrence of chronic diseases such as cardiovascular and cerebrovascular diseases. However, due to the presence of cellulose, it takes time to cook and tastes bad. Germination can improve the taste and increase the content of functional active substances. Hydrogen-rich water (HRW) is an active water that uses pure water electrolysis and nano-bubble mixing technology to dissolve hydrogen in water to make it rich in hydrogen molecules (H). It has many applications in the medical field, but less in the processing of germinated grains. Therefore, the aim of this project is to germinate hulless barley using hydrogen-rich water. The results of this study will improve the nutritional value of hulless barley.

Eligibility Requirements:

Applicants are expected to possess good understanding of basic chemistry and food science concepts

Main Tasks:

The student will be involved in all stages of the project:

> Design experimental scheme.
> Perform experiment.
> Analyze experimental results.
> Write the experiment report.
> Finish a research report.
> Give two presentations: one literature review and one on research progress

Website:

Lab: https://www.agri.sjtu.edu.cn/En/Data/View/4358
School: https://www.agri.sjtu.edu.cn/En

PROJECT
135

The mechanism of microplastics increasing and reducing the absorption of cadmium by Solanum nigrum through "soil-root-leaf"

Contact Information:

Prof. Pei Zhou
Email: zhoupei@sjtu.edu.cn

Project Description and Objectives:

This project references recent research advances on the impact of emerging pollutants on the soil-plant system, focusing on the interactive effects of microplastic pollution and Cd contamination. It aims to investigate their influence on plant growth and Cd uptake mechanisms. Students should have a strong interest in environmental pollution control and ecological remediation and be eager to address practical issues through experimental approaches. The research goal is to elucidate the interaction mechanisms between different types of microplastics and Cd in soil and their effects on Cd uptake and physiological traits in plants, thereby providing scientific evidence for the remediation of contaminated soils and the safe production of crops.

Eligibility Requirements:

Has a certain foundation in plant cultivation experiments

> Possesses the ability to review literature and operate certain experimental instruments
> Strong analysis and design capability
> Fluent in English.
> Proper reading and writing skills.

Main Tasks:

> Students are required to conduct cultivation experiments under supervision to study the impact of microplastics on the mechanism of cadmium uptake in plants.
> Provide research presentations and make weekly reports.
> By the end of the internship, compose one research paper.

Website:

Lab: ua.sjtu.edu.cn
School: www.agri.sjtu.edu.cn

PROJECT
136

Comparative Study on Urban Agriculture among Global Cities: Based on Economic Framework and Typical Cases

Contact Information:

Assi. Prof. Zhengwei Cao
Email: zhengweiskylark@sjtu.edu.cn

Project Description and Objectives:

This project refers to Economic Analysis on Global Urban modern Agriculture and Case Studies. The students should desire to use economic and technologies to solve the related academic problems.
Urban modern agriculture means an agricultural form located within or on the outskirts of cities, relying on urban natural and social resources, serving the diverse needs of cities, and characterized by high quality, high efficiency, multifunctionality, and sustainability. It includes not only agricultural production activities but also encompasses ecological, leisure, educational, and other multifaceted functions, representing the manifestation of modern agriculture in urban settings.

Eligibility Requirements:

> Majored in agricultural economics, or related.
> Strong analysis and design capability.
> Fluent in English.
> Proper writing skills.

Main Tasks:

> Students are required to work under the supervision on conducting literatures and analyzing data on urban agriculture.
> Provide research presentations and make weekly reports.
> By the end of the internship, compose one research paper.

Website:

Lab: ua.sjtu.edu.cn
School: www.agri.sjtu.edu.cn/En/Default

PHARMACY

PROJECT
137

Practice and Training Base for Biopharmaceuticals

Contact Information:
Prof. Jianwei Zhu
Email: jianweiz@sjtu.edu.cn

Project Description and Objectives:
Antibodies have been a rapidly growing field as it has demonstrated an outstanding outcome in clinical treatment for cancer therapy. We have developed a novel platform 'Bispecific Antibody by Protein Trans-splicing, BAPTS' in our lab. In this project, we will apply this technology platform to construct novel bispecific antibodies and bispecific antibody drug conjugates (bsADCs) and bispecific immunotoxins. This research will provide promising biopharmaceuticals for clinical drugs.

Eligibility Requirements:
Basic knowledge and experience in molecular biology and cell culture.

Main Tasks:
> Construct bispecific antibodies, bsADCs and bispecific immunotoxins.
> Finish a research report.

Website:
Lab: http://www.sjtumabcenter.org/
School: http://pharm.sjtu.edu.cn/

PROJECT
138

Practice and Training of Biotechnology and Antibody Medicine

Contact Information:
Assoc. Prof. Feng Qian
Email: fengqian@sjtu.edu.cn

Project Description and Objectives:
Antibodies are ideal for therapeutic interventions in part owing to their high specificity, high tolerance, long half-life and amenability to manipulation. Antibody-based therapeutics is at the center stage of drug discovery with antibodies being the fastest growing class of drugs. In this project, we will prepare detection antibodies and therapeutic antibodies using mouse hybridoma technology, phage display technology, antibody humanization technology and engineered cell expression antibody technology. We also plan to develop new antibody drugs that regulate inflammation and control tumors, and prepare new CAR-T cells to treat tumors and immune diseases.

Eligibility Requirements:
Basic biology and basic molecular cell biology.

Main Tasks:
> Understand goals of the project.
> Generate monoclonal or bi-specific antibody, manipulate tumor cell culture and do antitumor testing.
> Report-Analyze-Present your data in PPT format.

Website:
Lab: https://pharm.sjtu.edu.cn/ktz/2811.html
School: https://pharm.sjtu.edu.cn/

PROJECT
139

Establishment of an Autism Model in Zebrafish and Evaluation of Drug Efficacy

Contact Information:

Assoc. Prof. Lili Jing
Email: lilijing@sjtu.edu.cn

Project Description and Objectives:

This project aims to establish an autism model using wildtype and mutant zebrafish. This model will then be used to study the effects of different drugs on autistic behavior and innate immune cells in zebrafish, as well as the relationship between the two.

Eligibility Requirements:

The student needs to have basic knowledge of molecular biology, microbiology, and pharmacology, and have basic laboratory skills in microbiology, molecular biology, and cell biology. Knowledge of zebrafish model organisms is a big plus.

Main Tasks:

> Establish the zebrafish autism model.
> Study the effects of 5 drugs on zebrafish autism behavior.
> Study the effects of 5 drugs on innate immune cells and the relationship to the autism behavior.

Website:

Lab: https://pharm.sjtu.edu.cn/en/pharmacology/2701.html
School: School of Pharmacy

PROJECT
140

Study on Screening Active Ingredients of Natural Drugs Using Caenorhabditis elegans

Contact Information:

Dr. Jing Xi
Email: xijing@shsmu.edu.cn

Project Description and Objectives:

The content of this project is to screen the active ingredients in natural medicines based on the high-throughput test method of Caenorhabditis elegans (C. elegans). Students participating in the project will be involved in each step to gain experience, including the cultivation of C. elegans, the basic operation and method optimization of the C. elegans high-throughput testing experiment, the extraction method of the components of natural medicines, and the use of C. elegans high-throughput testing methods to experiment with natural medicines and screen out the active ingredients with protective effects.

Eligibility Requirements:

Basic knowledge and experimental techniques of C. elegans.

Main Tasks:

Complete a natural compound active ingredient screening.

Website:

Lab: N/A
School: https://www.shsmu.edu.cn/sph-en/

PROJECT
141

The Effect of Electrical Stimulation on Reward Learning with Nucleus Accumbens Intervention

Contact Information:

Prof. Tifei Yuan
Email: ytf0707@126.com

Project Description and Objectives:

The nucleus accumbens is the key brain structure for addiction. Exposure to addictive drugs causes an increase in dopamine release in the brain, leading to neuronal activation and changes in synaptic plasticity in the nucleus accumbens, which are considered as an important mechanism of addiction. The effect of electrical stimulation on reward learning with nucleus accumbens (NAc) intervention isexplored in the context of neurobiological target for restoring reward motivation andresponsiveness in individuals with anhedonia. Activation of D1R or D2R MSNs inthe NAc promotes self-stimulation and increases motivation. Computer-basedtasks are used to investigate different subdomains of anhedonia. Intracranial self-stimulation (ICSS) is employed to identify patterns of brain stimulation that arerewarding when applied to the NAc. This project aims to explore the effect of the electrical stimulation on reward learning with NAc intervention in human.

Eligibility Requirements:

> Fluent English writing and speaking.
> Undergraduate student of biology, neuroscience, or medicine.
> Animal behavior experiment experience.

Main Tasks:

> Perform experiments, analyze experiments, and write a research report.
> Give a research presentation: technical presentation.

Website:

Lab: http://tfyuan-lab.strikingly.com
School: https://www.shsmu.edu.cn/english/

PROJECT
142

Transcriptional and Epigenetic Mechanisms of Drug Addiction in Nucleus Accumbens

Contact Information:

Prof. Tifei Yuan
Email: ytf0707@126.com

Project Description and Objectives:

Relapse after long-term withdrawal of addiction is one of the important features of addictive behavior, and its mechanism is not fully understood. Increasing evidence implicates the mechanisms of gene regulation in the lasting changes that relapse induce in brain. In recent years, epigenetics, as a key mechanism that regulates gene expression and mediates long-term changes, has gradually attracted attention in the study of addictive behavior and offer novel inroads for addiction therapy. This project intends to investigate the epigenetic changes in nucleus accumbens, a critical center for affective and reward processing, by using transcriptome sequencing and epigenome sequencing techniques. The project will reveal the the underlying mechanisms of mechanism of relapse after addiction, and explore the novel targets for addiction treatment.

Eligibility Requirements:

> Fluency in English writing and speaking.
> Undergraduate student of biology, neuroscience, or medicine.
> Animal behavior experiment experience.

Main Tasks:

> Perform experiments, analyze experiments and write a research report.
> Give a research presentation: technical presentation.

Website:

Lab: http://tfyuan-lab.strikingly.com
School: https://www.shsmu.edu.cn/english/

PROJECT 143

Screening of New Targets of Clinical Metabolites in Autoimmune and Inflammaging & Quality Control Improvement Program of Clinical Laboratory

Contact Information:

Prof. Huiming Sheng
Email: hmsheng@shsmu.edu.cn

Project Description and Objectives:

Generally speaking, the dysregulation of immune cells (especially T cells) underlies the pathological mechanism of aging, autoimmune diseases (such as rheumatoid arthritis, glomerulonephritis) and autoinflammatory diseases (such as gout). We are focusing on the regulation of metabolites on immune cells (especially T cells). Purinergic signaling widely exists in immune cells, composing of ectonucleotidases (such as CD39 and CD73), P1 and P2 receptors, associated metabolites as well as downstream signaling. We are studying how purinergic signaling modulates T cell function and differentiation. We also applied single cell sequencing technology to capture the change of T cell subset composition and the differential gene expression profile in pathological scenarios. In the past, people do not consider the role of adaptive immune cells in the pathogenesis of autoinflammatory diseases. However, such viewpoints are challenged by the emerging evidences. We found the hyperuricemia could erode the T cell community, thereby disrupting the whole immune system. These findings warrant the further in-depth research. At last, welcome all the students joining in our program for these interesting researching journey.

The Clinical Laboratory is one of the key departments of TongRen Hospital. There are 7 sub-groups including immunology, biochemistry, microbiology, molecular biology, etc. More than 500 items have been carried out. There are 2 doctoral supervisor, and several senior experienced postgraduates lead the research and education teams. Ongoing research projects include the National Natural Science Foundation of China(NSFC) and more than 10 municipal-level or district-level projects. We have more than peer-reviewed 100 papers in SCI or Chinese journals published, and five patents have been approved.

This program is going to promote international cooperation and communication inspiring the youth generation scientific passion as well as share experiences in improving quality control of clinical laboratories. Through this program, students will have a deeper understanding of quality control and laboratory management.

Eligibility Requirements:

> Undergraduates with some lab experience with basic research; Interested in immunological research.
> Willing to learn about quality control of the clinical laboratory.
> Interested in experimental operations.

Main Tasks:

> Completion of a small topic from a big project. Learn how to operate immunological experiments (especially flow cytometry) and do data analysis; join the weekly discussions with the mentor; learn how to search the references and come up with a logical solution when encountering a problem.
> Learn about the mechanism and protocols of various projects carried out by the clinical laboratory.
> Understand the concept of quality control and learn about operations and precautions.

Website:

Lab: https://www.shtrhospital.com/index.aspx
School: N/A

PROJECT 144

Application of IL-38 in Precise Target Therapy of Colorectal Cancer based on Single Cell Analysis and Clinicopathological Study

Contact Information:

Prof. Yongchun Yu
Email: yyc2166@sjtu.edu.cn

Project Description and Objectives:

Ferroptosis is a type of programmed cell death which is tightly associated with cell metabolism. Overload of lipid ROS would lead to cell ferroptosis. However, the ferroptosis status of cells and whether ferroptosis inducing could be used as a tumor treatment strategy in lung cancer remains to be further investigated. Our laboratory will search for target genes and target proteins related to ferroptosis through high-throughput combined bioinformatics methods and we will explore relevant mechanisms in cell lines and primary cells and finally verify the conclusions in tumor specimens and transgenic animals. We anticipate to find a series of target genes, target proteins and metabolites related to ferroptosis and understand the mechanism of ferroptosis promotion or inhibition in lung cancer. We also anticipate exploring whether ferroptosis might be used as a new type of treatment for lung cancer and find the relevant potential therapeutic targets. In this project, the participant will perform various types of molecular biology experiments, including Western Blotting, immunohistochemistry, immunofluorescence, real-time fluorescent quantitative PCR, molecular cloning, transgenic animal manipulation, and clinical specimen testing. In addition, the participant will understand the classical molecular mechanism of ferroptosis and have research ideas on ferroptosis studies and other basic research related to metabolism or signaling pathways.

Eligibility Requirements:

> Basic knowledge of molecular biology.
> Preferred: Experience in biology and medical research.

Main Tasks:

Gaining proficiency in Western Blotting, real-time fluorescent quantitative PCR, animal experiments, immunohistochemistry, immunofluorescence and other molecular experiments, and basic research ideas for ferroptosis.

Website:

Lab: http://www.shxkyy.com
School: N/A

PROJECT 145

Construction of Primary Cell Lineage and Human Transplanted Tumor Model of Tumor Tissue

Contact Information:

Prof. Liming Lu
Email: lulunew2003@163.com

Project Description and Objectives:

Collect fresh lung cancer specimens, and carry out the following:
1. Primary cell culture and identify cell lines, including STR detection, phase contrast microscopy of tumor cells, identification of HE and immunohistochemical staining, plotting tumor cell growth curve, cell cycle analysis, tumorigenic observation, karyotype analysis, etc.
2. Construction of human xenograft models: Humanized tumor models will be constructed and transplanted into immunodeficient mice by patient-derived ones. These tumor models will be used to deeply study the mechanism of tumorigenesis and to understand the pharmacology of drugs in tumor tissues of patients as well as pharmacodynamic response, guiding patients to clinical medication.

Eligibility Requirements:

> Basic knowledge of medicine or biology.

Main Tasks:

> Primary cell culture and identify cell lines.
> Construction of human xenograft models.

Website:

Lab: http://www.shxkyy.com
School: N/A

PROJECT 146

Mapping New Causal Genes for Glomerulonephritis

Contact Information:

Prof. Jingyuan Xie
Email: nephroxie@163.com

Project Description and Objectives:

This lab focuses on mapping new causal genes in patients with glomerulonephritis based on our large biobank for glomerulonephritis during the last decade. The laboratory has three major research interests, including: (1) Identification of rare variants for glomerulonephritis including FSGS and IgA nephropathy (IgAN) by next-generation sequencing, (2) Identification of common variants associated with glomerulonephritis such as focal segmental glomerulosclerosis (FSGS) and Membranous nephropathy (MN) by genome-wide association studies, (3) In vivo (trans-genetic animal models) and in vitro functional studies (variant cultured cell lines) that are performed for novel mutations to reveal their exact pathogenic mechanism. Through the above research, we aim to better understand the genetic basis of glomerulonephritis and contribute to precision medicine for patients in the near future.

Eligibility Requirements:

Basic knowledge of genetics, statistics and molecular biology.

Main Tasks:

The familial study, sequencing data analysis, and an in vitro functional study (cell experiment)

Website:

Lab: N/A
School: N/A

PROJECT

147

Molecular Biology of Lymphoma and Targeted Therapies

Contact Information:

Prof. Weili Zhao

Email: zhao.weili@yahoo.com

Project Description and Objectives:

The laboratory is working to delineate the molecular mechanism in the pathogenesis of lymphoma, precision diagnostics of lymphoma, as well as the development of novel targeted cancer therapies. The major research areas include: (1) Comprehensive investigation of lymphoma pathogenesis and identification of molecular markers. We conduct studies on the mechanisms of lymphoma development from multiple perspectives, including genomics, epigenetics, and metabolomics. Our goal is to identify molecular markers closely associated with disease progression and to reveal their roles in lymphoma biology. (2) Development of molecular classification systems and innovative diagnostic technologies. By tailoring molecular classification systems to Chinese patients, we aim to address the unique characteristics of lymphoma in this population. We also focus on advancing precision molecular pathological diagnostic technologies to provide more accurate and reliable tools for lymphoma diagnosis. (3) Translation of biological findings into targeted clinical therapies. Building on our studies of the biological functions of molecular markers and their regulation through key cellular signaling pathways, we aim to develop novel strategies for targeted lymphoma therapies. These efforts bridge the gap between fundamental research and clinical applications, ultimately contributing to improved treatment outcomes for lymphoma patients.

Eligibility Requirements:

Basic knowledge of genetics and molecular biology.

Main Tasks:

Bioinformatic analysis, animal model establishment, identification and characterization of anti-cancer compounds.

Website:

Lab:http://daoshi.shsmu.edu.cn/Pages/TeacherInformationView.aspx?uid=81632D99-E972-4C32-BE57-BEB38105B212&from=s&pId=105101&tId=

School: https://www.shsmu.edu.cn

PROJECT
148

Pre-Clinical Investigation into an Endogenously Expressed Micropeptide MiRPEP155 with Immunomodulatory Functions

Contact Information:

Prof. Honglin Wang
Email: honglin.wang@sjtu.edu.cn

Project Description and Objectives:

Micro RNA precursors are generally considered to be non-coding. We recently published an article entitled "A Micropeptide Encoded by LncRNA MIR155HG Suppresses Autoimmune Inflammation via Modulating Antigen Presentation" in Science Advances, reporting that a previously annotated non-coding region of the human genome encodes a polypeptide named MIPEP155. MIPEP155 can regulate the antigen-presenting capacity of dendritic cells in the context of inflammation. MIPEP155 showed prominent therapeutic effects on two autoinflammatory disease models, namely imiquimod-induced mouse model of psoriasis and experimental autoimmune encephalomyelitis (EAE), highlighting the potential of miPEP155 to be a drug candidate of autoimmune diseases. In this project, we intend to study the dose-dependent therapeutic effects of miPEP155 on imiquimod-induced mouse model of psoriasis and a mouse model of inflammatory bowel diseases (IBD), taking antibody drugs including anti-TNF-α, anti-IL-17A and anti-IL-23p19 as positive controls. Moreover, we intend to study the pharmacokinetics of miPEP155 using mice, rats and rabbits. Overall, these results will help us evaluate the druggability of miPEP155 and assess the risk to continue the development of miPEP155 into a drug for autoinflammatory diseases.

Eligibility Requirements:

An eligible candidate should be self-motivated and have

> An excellent team spirit.
> Good English communication and writing skills.
> Basic knowledge of cell biology and immunology.
> Experience in working with animal models is preferred.

Main Tasks:

> Animal model establishment.
> Drug candidate application.
> Disease score evaluation.
> Druggability assessment.

Website:

Lab: http://sii.shsmu.edu.cn/DetailMemberInfo.php?pid=6&cid=22&num=22&id=11
School: http://daoshi.shsmu.edu.cn/Pages/TeacherInformationView.aspx-?uid=CC9DAA19-8AE4-4DFB-82EE-1A1BC05E3BA3&from=s&pId=&tId=710

PROJECT
149

Expression Pattern and Functional S tudy of a Novel Peptide Encoded by Pri-miR-31 on Clinical Sample and Murine Model of Psoriasis Pri-miR-31

Contact Information:

Prof. Honglin Wang
Email: honglin.wang@sjtu.edu.cn

Project Description and Objectives:

Recent evidence has revealed that small polypeptides (usually containing fewer than 100 amino acids) can be translated from noncoding RNA (ncRNA) which is usually defined as an RNA molecule that does not encode a protein. We have discovered a peptide, which we termed MIPEP31, that is encoded by pri-miRNA-31. Using CRISPR/Cas9, we introduced a point mutation leading to a deficiency of MIPEP31 without affecting MIRNA processing. Mice with MIPEP31 deficiency result in decreased regulatory T cell (Treg) frequency and spontaneous colonic inflammation. Our work reveals the indispensable roles of the peptide encoded by pri-miRNA in maintaining immune homeostasis by promoting Treg differentiation, and offers a potential means for modulating miRNA expression and treating autoimmune diseases. Psoriasis is a chronic inflammatory skin disorder affecting 2-3% of the general population. MIPEP31 could be a promising candidate to treat psoriasis by promoting the differentiation of Treg. In this project, we intend to study the clinical relevance of MIPEP31 expression on clinical samples of psoriasis patients. Moreover, we intend to study the expression of MIPEP31 in different tissues and its therapeutic effect on a mouse model of psoriasis. Our results will help us understand the pathogenesis of psoriasis and hopefully find a drug for psoriasis.

Eligibility Requirements:

An eligible candidate should be self-motivated and have

> an excellent team spirit.
> good English communication and writing skills.
> basic knowledge of cell biology and immunology.
> Experience in working with animal models is preferred.

Main Tasks:

> Animal model establishment.
> Clinical sample collection.
> MiPEP31 expression evaluation.
> Therapeutic effect assessment.

Website:

Lab: http://sii.shsmu.edu.cn/DetailMemberInfo.php?pid=6&cid=22&num=22&id=11
School: http://daoshi.shsmu.edu.cn/Pages/TeacherInformationView.aspx-?uid=CC9DAA19-8AE4-4DFB-82EE-1A1BC05E3BA3&from=s&pId=&tId=710

PROJECT
150

Discovery and Preclinical Studies of Anti-Psoriasis Small Compounds

Contact Information:
Prof. Honglin Wang
Email: honglin.wang@sjtu.edu.cn

Project Description and Objectives:
Psoriasis is a chronic inflammatory skin disorder affecting 2-3% of the general population. Importantly, psoriasis is not fatal but incurable, which means patients must live with the annoying disease throughout their lifetime. Natural compounds have become an important source for new drug discovery, and there is growing international interest in lead compounds found in plants. Therefore, it is an effective way to screen active anti-psoriasis natural products derived from plants, and to derivatize natural products to determine their structures, improve efficacy, specificity, and reduce toxicity.

In this program, we also aim to perform preclinical studies. Deciding whether a drug is ready for clinical trials (the so-called move from bench to bedside) involves extensive preclinical studies that yield preliminary efficacy, toxicity, pharmacokinetics, and safety information. Wide doses of the drug are tested using in vitro (test tube or cell culture) and in vivo (animal) experiments, and it is also possible to perform in silico profiling using computer models of the drug-target interactions.

Eligibility Requirements:
An eligible candidate should be self-motivated and have:
> An excellent team spirit.
> Good English communication and writing skills.
> Basic knowledge of cell biology and immunology.
> Experience in working with animal models is preferred.

Main Tasks:
> Animal model establishment.
> Small molecule screening.
> Drug candidate application.
> Disease score evaluation.
> Druggability assessment.

Website:
Lab: http://sii.shsmu.edu.cn/DetailMemberInfo.php?pid=6&cid=22&num=22&id=11
School: http://daoshi.shsmu.edu.cn/Pages/TeacherInformationView.aspx-?uid=CC9DAA19-8AE4-4DFB-82EE-1A1BC05E3BA3&from=s&pId=&tId=710

PROJECT
151

Developing New Glyco-Biomarkers for Immunotherapy Response in Lung Cancer

Contact Information:
Prof. Yan Zhang
Email: yanzhang2006@sjtu.edu.cn

Project Description and Objectives:
Glycosylation is one of the most important post-transcription modifications of proteins. Changes in glycosylation can significantly modulate the structure, stability and function of proteins and are closely associated with pathogenesis and progression of cancer. It is found that the most routinely used cancer biomarkers, including CEA, AFP, PSA, CA125, and CA19-9 are all glycoproteins. Currently, glycosylation-based biomarkers have emerged as promising candidates for early diagnosis, prognosis and real-time follow-up of tumor dynamics. Lung cancer is the leading cause of cancer incidence and mortality worldwide. In recent years, the rise of immunotherapy has significantly improved the prognosis of lung cancer. However, only 25-30% of patients could benefit from this therapy. Thus, the discovery of efficient biomarkers for immunotherapy response is of great importance for precision medicine. In this project, we are combining the advanced glycomics technologies with other approaches such as glycobiology and cell biology to find new predictors of response to immunotherapy.

Eligibility Requirements:
> Applicants should have basic knowledge of biology.
> Experience in biological research would be an advantage.

Main Tasks:
> Carry out experiments and analyze experimental results.
> Give two research presentations, (one on previously published papers, one on research progress).
> Finish a research report.

Website:
Lab: http://glycolab.sjtu.edu.cn/Default.aspx
School: http://116.62.6.201:8086/

TRANSLATIONAL MEDICINE

PROJECT 152

Construction of TCM Knowledge Graph

Contact Information:

Prof. Hui LU
Email: huilu@sjtu.edu.cn

Project Description and Objectives:

Our center is committed to cultivating undergraduate and graduate students at a high level as well as with interdisciplinary and international vision. The project "Construction of TCM Knowledge Graph" aims to cultivate special professionals in international potential disciplines and China's dominant disciplines, strengthen students' basic knowledge in interdisciplinary fields, deepen students' scientific research ability in frontier fields, improve their comprehensive quality with integration of medicine, science and engineering knowledge, make them have both Chinese and Western horizons and develop diversified thinking, and promote the output of innovative achievements.

Eligibility Requirements:

> Applicants must have the following academic background: medical background or computer background or biological background or the background of other related disciplines.
> being good at computer technology and proficient in Chinese

Main Tasks:

> Construction of TCM Knowledge Graph

Website:

Lab: N/A
School: https://life.sjtu.edu.cn

TSUNG-DAO LEE INSTITUTE

PROJECT 153

Fundamental and Applied Muon Physics

Contact Information:

Assoc. Prof. Kim Siang Khaw
Email: kimsiang84@sjtu.edu.cn

Project Description and Objectives:

Muon plays a significant role in the development of particle physics and has been providing physicists with important insights into the structure of matter. Precise measurement of muon's fundamental properties is one of the major directions in particle physics research. On the other hand, muons have numerous applications in various fields, such as muon tomography and radiography for imaging large-scale structures. A notable recent achievement is the use of cosmic-ray muons to image the Khufu Pyramid, providing new insights into its internal architecture.This project is focusing on particle detection (muon/electron) based on scintillators and photomultipliers (PMT/SiPM). In the duration of the project, students will learn the basics of particle physics and particle detection, the working principle of the detection system, the software tools for simulation and data analysis, participate in detector R&D, make detector response calibration, process raw and simulated data and turn data into physics results.

Eligibility Requirements:

> Proficiency in English writing and speaking
> Basics in Quantum mechanics and electromagnetism
> Basic programming skills (C++ or Python)
> Creativity, passion and patience for scientific research

Main Tasks:

> Complete a simulation design and detector design.
> Complete data analysis of simulated or experimental data.
> Finish a research report.
> Deliver oral presentations (literature review and completed work).

Website:

Lab: https://web.tdli.sjtu.edu.cn/kimsiang84/
School: https://tdli.sjtu.edu.cn/EN/

PROJECT
154

Climate Adaption in Architecture and Urban Research

Contact Information:

Prof. Wenjun Ma
Email: mwj@sjtu.edu.cn

Project Description and Objectives:

Urban climate and its change have a great influence on urban planning and development. More attention has been attracted to architecture and city research along with urban climates. This project is aimed at present climate situation and problems, such as urban heat island effect, air pollution, and unsatisfactory atmospheric conditions. The goal is to integrate urban climate into urban data models. We are eager to visualize urban dynamic data from various government departments or commercial institutes and organizations. We want to evaluate the urban climate carrying capacity. Thus, tentative experiments should be performed to analyze and summarize the root causes of urban problems. The ultimate goal is to explore and propose solutions of urban planning in architecture. During this project research, students will rediscover an urban phenomenon and master the methods of problem analysis.

Eligibility Requirements:

> Speaking and writing English fluently is essential.
> Interested students should have basic knowledge of urban planning.
> Experience in architecture and city research, especially in climate change research, would be an advantage.

Main Tasks:

> Literature reading, sorting and reviewing.
> Participating in and conducting at least two experiments.
> Writing a report or paper and presenting it.

Website:

Lab: N/A
School: https://designschool.sjtu.edu.cn/

PROJECT
155

Correlating Local Spatial Variability of Urban Warming and Pollution to 2D/3D Landscape Metrics Research Field: Mesoscale Climate Simulation

Contact Information:

Prof. Shengquan Che
Email: chsq@sjtu.edu.cn

Project Description and Objectives:

With the intensification of global climate change and frequent occurrence of extreme climate disasters, the research on the theory and technology of resilient city planning and design under climate change is of great significance to ensure the safety of human life and property. This research is focused on the physical and empirical investigation of the intensity and spatial variability of urban warming/pollution and its correlation with the 2D/3D urban landscape metrics. These metrics characterize, for instance, the urban morphology, the thermophysical properties of the urban structures, the land cover/use, the vegetation, and the water bodies. During this project research, students will learn about the software, methods and basic knowledge of urban climate research.

Eligibility Requirements:

> Speaking and writing English uently is essential.
> Experience in landscape architecture and urban planning research, especially in using geographic information systems, would be an advantage.

Main Tasks:

> Development of urban local climate zone map
> Generation and analysis of urban surface temperature
> Relationship model between urban surface temperature and local climate zone

Website:

Lab: http://fpc.ud.sjtu.edu.cn
School: https://designschool.sjtu.edu.cn/

PROJECT 156

Application of Energy Saving and Carbon Reduction Technology in Sewage Treatment Process Design and R&D of New Material

Contact Information:

Prof. Shengquan Che
Email: chsq@sjtu.edu.cn

Project Description and Objectives:

Global climate changes and environmental degradations are two critical factors influencing our sustainable future. Carbon footprint analysis is an emerging strategy to evaluate the sustainability of WWTPs. The potential of greenhouse gas (GHG) emissions from sewage management of metropolises is a critical concern in the water-energy-nexus. It is desired for the project to achieve the energy conservation and emission reduction of sewage treatment. The aim is also to understand the units of high energy consumption and high carbon emission of sewage treatment process, and learn the realization way of energy-saving and carbon reduction technology in the optimal design of sewage treatment process. The R&D process involves making building materials such as cattail boards and new environmental protection materials such as granular activated carbon from traditional biomass materials such as Acorus calamus. By studying these two typical examples, the students can preliminarily master the ways and research means of energy-saving and carbon reduction technology in their professional fields.

Eligibility Requirements:

> Speaking and writing English fluently is essential.
> Interested students should have basic knowledge of wastewater treatment plants, low-carbon technologies and functions of new materials.
> Experience in science and engineering research, especially in low-carbon technologies research would be an advantage.

Main Tasks:

> Literature reading, sorting and reviewing.
> Participating in and conducting at least two experiments.
> Writing a report or paper and presenting it.

Website:

Lab: http://fpc.ud.sjtu.edu.cn
School: https://designschool.sjtu.edu.cn/

PROJECT 157

Nature-Based Solutions to Mitigate Urban Thermal Environment

Contact Information:

Dr. Junxiang LI/Caiyan WU
Email: junxiangli@sjtu.edu.cn; caiyanwu@sjtu.edu.cn.

Project Description and Objectives:

This project aims to explore the relationships between urban land surface temperature and urban green and blue infrastructure using remote sensing and GIS technologies, in combination with field investigations. The objectives of the project are making participants to gain knowledge about nature-based solutions, how to use nature-based solutions to solve problems, and to learn the skills to extract necessary information from remote sensing images and spatial analysis.

Eligibility Requirements:

The participant needs to have basic background of geography, ecology, and environmental science, and have basic skills to operate GIS, such as Arc Map, etc., and image process software, such as ENVI, etc.?

Main Tasks:

The main tasks including extracting information of urban green and blue infrastructure (GI, BI), urban land surface temperature (LST), field investigation, GIS spatial analysis, and modeling of LST, GI and BI.

Website:

Lab: http://fpc.ud.sjtu.edu.cn
School: https://designschool.sjtu.edu.cn/

PROJECT
158

Elderly Care Robot Development and Deployment

Contact Information:

Prof. Gang Zheng
Email: gzheng@sjtu.edu.cn

Project Description and Objectives:

According to the latest reports, China has 15.8 million residents aged above 65, and 24.1 million aged above 60 (as of 2017). Its population aging rate is the faster than ever before. As the population grows older, we also see a decrease in young people prepared to take care of the elderly groups. This project is to develop and deploy an elderly care robot that can perform simple services like medicine delivery, etc.

Eligibility Requirements:

Basic knowledge of:

> Mechanical engineering
> Programming language

Main Tasks:

> Build a simple "elderly care" scenario using KT board, etc.
> Program and practice a brand-new service robot.
> Deploy the robot in an "elderly care" scenario and perform medicine delivery tasks.

Website:

Lab: http://umji.sjtu.edu.cn/about/administrative-offices/teaching-lab-service-office/
School: http://umji.sjtu.edu.cn/

PROJECT
159

Numerical Solution of the Phonon Boltzmann Transport Equation: Algorithm Development and Optimization

Contact Information:

Prof. Bao Hua
Email: hua.bao@sjtu.edu.cn

Project Description and Objectives:

Boltzmann transport equation (BTE) is the fundamental equation for sub-continuum scale electron or heat transport, which is important to model the temperature distribution in electronic devices. We already developed a C++ code to solve BTE by discrete ordinate method and finite volume method. We are now in the phase of optimizing the code and implementing advanced algorithms.

Eligibility Requirements:

> Basic knowledge of High Performance Computing.
> Familiar with C/C++.
> Previous knowledge in heat transfer, numerical analysis, numerical methods (e.g., finite volume method).

Main Tasks:

> Develop a highly efficient hybrid Fourier-BTE solver to handle large non-gray transport problems.
> Implement and optimize advanced algorithms to optimize the code, including but not limited to sparse matrix solver and parallel computing (using MPI/OpenMP).
> Assist graduate students in conducting some calculations.

Website:

Lab: http://caces.sjtu.edu.cn/
School: http://umji.sjtu.edu.cn/

PROJECT 160

Design of an High Voltage Integrated Batter Management Chip

Contact Information:

Asst. Prof. Xuyang Lu
Email: Xuyang.Lu@sjtu.edu.cn

Project Description and Objectives:

This project focuses on the design and development of a high voltage integrated Battery Management Chip. The coursework will cover fundamental and advanced concepts, including:

> Basics of analog circuit design
> Basics of digital circuit design
> Design and implementation of analog-to-digital converters (ADCs)
> High voltage cell balancing systems
> Design of analog amplifiers

Eligibility Requirements:

Enrollment as an ECE student with a solid understanding of analog and digital circuit design.

Main Tasks:

> Design and optimize a power controller chip using CMOS technology.
> This project provides an excellent opportunity to deepen knowledge and gain hands-on experience in high voltage circuit design and power management systems.

Website:

Lab: https://sites.ji.sjtu.edu.cn/xuyang-lu/
School: http://umji.sjtu.edu.cn/

PROJECT 161

Proactive Human-Robot Collaboration for Smart Manufacturing

Contact Information:

Assistant Prof. Youyi Bi
Email: youyi.bi@sjtu.edu.cn

Project Description and Objectives:

The escalating demand for personalization in modern production has positioned Human-Robot Collaboration (HRC) at the forefront of researchers' interests. Recent advancements in embodied AI, industrial digital twin, and human intent recognition bridge the knowledge and information gap between human operators, robots, and manufacturing systems. This project aims to introduce a multi-model strategy learning approach for proactive HRC. The main research objectives include:
(1) Collaborative Cognition Learning: Establishing a bi-directional cognitive model to enhance the robot's perception of human intentions.
(2) Collaborative Prediction Learning: Considering the procedural determinism and possible randomness in human-robot interaction.

Eligibility Requirements:

(1) With a background of mechanical engineering, electrical engineering or computer science.
(2) Use one of the following languages: C/C++, Python, C#.
(3) Be passionate about research, treat research work seriously and responsibly, and have good communication and presentation skills.

Main Tasks:

(1) Investigate the mainstream methods for Human-Robot Collaboration (HRC).
(2) Build HRC simulations using platforms such as Unity or NVIDIA Isaac Sim.
(3) Establish connections between the physical robot arm and the simulation platform.
(4) Develop multi-model strategy learning algorithms for proactive HRC.
(5) Validate the algorithms on the physical and simulation platform.

Website:

Lab: https://sites.ji.sjtu.edu.cn/youyibi/
School: https://www.ji.sjtu.edu.cn/

PROJECT 162

Hardware/Software Codesign for TinyML Chips

Contact Information:

Assoc. Prof. Xinfei Guo
Email: xinfei.guo@sjtu.edu.cn

Project Description and Objectives:

The field of computer engineering has been actively researching hardware acceleration technology. Multiple accelerators have been proposed to improve the energy efficiency requirements of AI applications. Examples include Google's TPU and Cambrian's AI accelerators. However, these accelerators are often designed for training or inference of large-scale models. As machine learning tasks are shifting towards the "edge", the development of customized edge AI chips plays a crucial role in optimizing energy efficiency and promoting AI adoption. In this project, we are exploring a software-hardware co-design approach specifically targeted at edge AI chips. At the software level, we are investigating efficient model compression techniques, such as mixed-precision quantization, to achieve high efficiency. At the hardware level, we are researching novel computing architectures, such as in-memory computation and reconfigurable computing, to further improve the energy efficiency and scalability of AI computing tasks.

Eligibility Requirements:

> Interested in the intersections of hardware and software for machine learning systems.
> Feel comfortable with scripting in C, C++ or Python.
> Prior experience of using Linux systems is required.
> Prior knowledge of computer organization and architecture is highly preferred.
> Prior experience of working with machine learning models is highly preferred.
> Prior research experience is highly preferred.

Main Tasks:

Week 1: Read relevant literature on edge intelligence software and hardware, study basics of quantization, computer architectures, and get familiar with popular machine learning frameworks such as PyTorch and commonly used edge intelligence models.
Week 2: Familiarize with inference frameworks like TVM, STM's CUBE-AI, understand the design process of commonly used on-chip systems like PULP and RISC-V architectures, and be able to run common use cases.
Week 3-4: Explore quantization and model compression techniques at the software level, test them using inference frameworks, and collect metrics such as accuracy, inference time, and storage space utilization.
Week 5-6: Deploy the researched algorithms on relevant platforms such as STM32 development board or PULP SoC development environment at the hardware level, collect actual hardware cost metrics such as power consumption and memory usage. Wrap up the project, and write the final report.

Website:

Lab: https://sites.ji.sjtu.edu.cn/icas/
School: https://www.ji.sjtu.edu.cn/

PROJECT 163

Theoretical Algorithm, Simulation, and System Implementation of Terahertz Integrated Sensing and Communication

Contact Information:

Assoc. Prof. Chong Han
Email: chong.han@sjtu.edu.cn

Project Description and Objectives:

The terahertz (0.1-10 THz) band holds enormous potential for supporting unprecedented data rates and millimeter-level accurate sensing thanks to its ultra-broad bandwidth. Terahertz integrated sensing and communication (ISAC) is viewed as a game-changing technology to realize connected intelligence in 6G and beyond systems. This project aims to explore the fundamental and key technologies of THz ISAC, including waveform generation, transmission and receiver processing of THz ISAC signals, as well as performance evaluation and optimization of THz ISAC systems. This project will combine theoretical analysis, simulation and experimental verification to provide new ideas and methods for the development of THz ISAC.

Eligibility Requirements:

> Students from highly-ranked universities.
> Interest in conducting cutting-edge and high-quality research.
> Solid background in mathematics, communication theory and programming.

Main Tasks:

> Complete the literature review and project design of THz ISAC.
> Investigate the channel models of THz communication and sensing based on the features of THz wave propagation.
> Investigate the waveform design for THz ISAC, including modulation, pilot design and waveform generation.
> Investigate the receiver algorithm design for THz ISAC, including sensing algorithm, channel estimation, and data detection.
> Build the simulation and experimental platform of THz ISAC, and evaluate the system performance.

Website:

Lab: https://sites.ji.sjtu.edu.cn/chonghan/
School: https://www.ji.sjtu.edu.cn/

PROJECT
164

Logic Synthesis for Large-Scale Approximate Circuits and Its Application in Deep Neural Network Accelerators

Contact Information:
Assoc. Prof. Weikang Qian
Email: qianwk@sjtu.edu.cn

Project Description and Objectives:
Designing approximate circuits is considered as an effective way to further improve circuit performance and energy efficiency in the post-Moore era. Its key idea is to exploit the error tolerance of applications so that we can design circuits with reduced area, delay, and power consumption by deliberately sacrificing a small amount of the accuracy. In order to design an approximate circuit automatically under any given specification, research on approximate logic synthesis (ALS) is attracting more and more attention recently. This project will develop a new ALS algorithm for large-scale digital circuits. Furthermore, with the new ALS tool available, we will also apply it to build hardware accelerators for an important error-tolerant application, the deep neural network.

Eligibility Requirements:
> Be self-motivated and hard working.
> Always pursue high quality work.
> Good at programming.

Main Tasks:
Read the related papers; develop new ideas; implement the new idea; improve the proposed idea and the implementation; write reports.

Website:
Lab: https://umji.sjtu.edu.cn/~wkqian/
School: https://www.ji.sjtu.edu.cn/

PROJECT
165

Research on the Coordinated Control of SOFC/GT Hybrid System Based on Safety Margin

Contact Information:
Assoc. Prof. Xiaojing Lv
Email: lvxiaojing@sjtu.edu.cn

Project Description and Objectives:
The Solid Oxide Fuel Cell/Gas Turbine (SOFC/GT) hybrid system has the advantages of high efficiency, low emissions and fuel flexibility. It is one of the most important development directions of power generation technology for the future.
However, the safe and stable operation and high-performance controls have always been the difficult technology question that restricts the development of hybrid systems because of its complexity. This project intends to establish a dynamic mathematical model of SOFC/GT hybrid systems with a safe boundary, reveal the coupling mechanism of the safety margin, operation characteristics, electrochemical reaction characteristics, develop a coordinated control method of performance indicators and multi-dimensional safety margin, and obtain the safe and efficient operation trajectory of the hybrid system from start-up to load regulation to shut-down. The results will be beneficial for providing theoretical and experimental support and data base for the optimization design, safety warning setting, and efficient control strategy formulation of hybrid systems, which has vital theoretical significance and practical value for promoting the process development of the hybrid system from theoretical research to actual application.

Eligibility Requirements:
> Knowledge of laboratory safety is necessary.
> Basic knowledge/coursework in advanced energy systems, thermodynamics, or electrochemistry engineering.
> Students who have experience in labs are preferred.

Main Tasks:
> Propose a new idea to improve the hybrid system performance based on the theory and experiment work.
> Make a presentation of the simulation or experimental study.
> Complete a final report of this program.

Website:
Lab: http://pmelab.sjtu.edu.cn/index.asp
School: http://lcc.sjtu.edu.cn/

PROJECT 166

Preparation of Biodegradable Plastics from Waste Shells

Contact Information:

Assoc. Prof. Xi Chen
Email: chenxi-lcc@sjtu.edu.cn

Project Description and Objectives:

Waste resources utilization is a pivotal topic for the sustainable development of the society to promote carbon circulation and reduce carbon emission. "Waste-to-wealth" is the idea to transform the waste materials generated in industrial activities and daily life activities into valuable products such as chemicals, materials, etc. This internship program focuses on the manufacturing of biodegradable plastics and other value-added chemicals from waste crab/shrimp shells or woody biomass such as wheat straws. Some tools that may be applied to solve problems in the projects mainly include catalytic techniques and simple machine learning skills to deal with the data. The objectives are to reinforce the awareness of the students on waste utilization, equip them with some frontier techniques to change the waste into useful products, and enable them to command basic skills in experimental design, data processing, and critical thinking so that they can contribute to relevant fields in the future to protect the environment and mitigate carbon emission.

Eligibility Requirements:

Have a relevant background (Environment, Chemistry, Engineering, etc.).

Main Tasks:

Establish a feasible process to transform waste shell-derived chitosan into biodegradable plastic bags with good properties.

Website:

Lab: N/A
School: http://lcc.sjtu.edu.cn/En/Data/View/763

PROJECT 167

Design Thermal Functional Materials via Materials Informatics

Contact Information:

Assoc. Prof. Shenghong Ju
Email: shenghong.ju@sjtu.edu.cn

Project Description and Objectives:

Designing functionalized materials with a desired thermal property holds its critical importance in applications of thermal interfacial materials, thermoelectrics, thermal barrier coatings and thermal insulators. Materials informatics (MI), which has been considered as the fourth paradigm of science in addition to theory, simulation, and experiment, is now gaining great attention in materials research. In this project, we will employ various intelligence optimization methods to solve the bottlenecks of material selection and structure designing which limit the design efficiency of thermal functional materials.

Eligibility Requirements:

> Familiar with or interested in machine learning and data science.
> Fundamental knowledge in heat transfer and materials science.

Main Tasks:

> Screening material database to find materials with ultimate high/low thermal conductivity
> Designing nanostructures to tune thermal transport via quantum annealing.

Website:

Lab: http://lcc.sjtu.edu.cn/En/Data/View/1158
School: http://lcc.sjtu.edu.cn/En

PROJECT
168

Plasma-Assisted Catalytic Green Ammonia Production

Contact Information:

Assoc. Prof. Chong Cheng Tung
Email: ctchong@sjtu.edu.cn

Project Description and Objectives:

Due to the potential role of ammonia in energy storage and fuel, ammonia production has received much attention. However, the Haber-Bosch process, which is widely used in industrial ammonia production, has consumed 2% energy in the world and released a significant amount of CO2. To solve these problems caused by the Haber-Bosch process, many novel ammonia production methods have been proposed, with the plasma-assisted ammonia production emerging as one of the most promising methods. As the 4th state of matter, the plasma has many unique physical and chemical properties which could be helpful for ammonia production. This project focuses on the ammonia production mechanism during the complex plasma-assisted ammonia process. The complex plasma-assisted ammonia process includes not only the reactions between catalyst and reactant, but also the interactions between plasma and catalyst and the interactions between plasma and reactant. The main goal of this project is to explore the reaction mechanism during the plasma-assisted ammonia process. Also, a series of experiments and simulations will be conducted to validate the proposed reaction mechanism.

Eligibility Requirements:

> Have sufficient knowledge in chemistry.
> Prior experience with chemistry experiments.
> Good working attitude and self-learning ability.
> Good team spirit.

Main Tasks:

> Review literature on the development of plasma-assisted green ammonia production in the past few years.
> Design and synthesize one type catalyst suitable for plasma-assisted ammonia production.
> Explore the ammonia production mechanism during the plasma-assisted ammonia process.

Website:

Lab: https://netzerocarbon.sjtu.edu.cn/
School: https://lcc.sjtu.edu.cn/

PROJECT
169

WASTE TO ENERGY: Biological Systems Towards Energy and Environmental Sustainability

Contact Information:

Assoc. Prof. Jingxin Zhang
Email: lcczjx@sjtu.edu.cn

Project Description and Objectives:

With the rapid urbanization and population explosion in the past decades, an increasing number of people are congregating in big cities, hence generating a massive amount of municipal solid waste (MSW) and consuming more energy than ever before. The major focus of this project is to develop a novel sustainable waste management system and energy recovery solutions suitable for energy and environmental sustainability. This project will examine a coupled problem at the nexus of energy and waste, accelerate waste recycling and reduce energy reliance on traditional fossil fuel sources and their emission of pollutants, at the same time.

Eligibility Requirements:

> Proficient English skills.
> Major in Environment, Biology, Chemistry, or other relevant subjects.

Main Tasks:

> Propose a research plan to improve the performance of a biological system for the conversion of organic wastes into energy/resources.
> Literature review and experimental work
> Prepare a final report

Website:

Lab: https://lcc.sjtu.edu.cn/En/Data/View/1165
School: https://lcc.sjtu.edu.cn/

PROJECT
170

Microscale Simulation for Life Extension of Reactor Pressure Vessels

Contact Information:
Assoc. Prof. Liang Chen
Email: liang.chen@sjtu.edu.cn

Project Description and Objectives:
The radiation embrittlement of reactor pressure vessel steels is of critical concern for the integrity and safety in long-life operation of light water reactors. To understand the mechanisms behind irradiation embrittlement for reliable margin-reducing prediction, it is imperative to understand the microstructural features formed under irradiation and their role in hardening and accompanying embrittlement. The main purpose of this project is to employ simulation method in the light of experimental evidence to investigate the microstructural evolution during irradiation.

Eligibility Requirements:
Interested students should have basic knowledge of programming, and material science or nuclear engineering.

Main Tasks:
Literature review, microscale simulation, research report.

Website:
Lab: https://speit.sjtu.edu.cn/faculty/10012
School: https://speit.sjtu.edu.cn

PROJECT
171

Machine Learning-Assisted Physical Field Reconstruction

Contact Information:
Assoc. Prof. Helin Gong
Email: gonghelin@sjtu.edu.cn

Project Description and Objectives:
This project aims to develop a machine learning-assisted framework for reconstructing physical fields in engineering contexts, such as temperature distribution in nuclear reactors or stress fields in structural engineering. The objective is to leverage machine learning algorithms to enhance the accuracy and efficiency of physical field reconstruction. This involves data preprocessing, model selection, training, and evaluation, with a focus on understanding the underlying physics and engineering principles. The project seeks to bridge the gap between traditional engineering methods and contemporary AI techniques, offering innovative solutions to complex engineering problems.

Eligibility Requirements:
> Undergraduate or graduate students in Engineering, Computer Science, or related fields.
> Basic knowledge of machine learning and data processing.
> Familiarity with engineering concepts related to physical field analysis.
> Proficiency in programming languages such as Python.

Main Tasks:
> Data collection and preprocessing for physical field analysis.
> Selection and training of appropriate machine learning models.
> Evaluation of model performance and analysis of results.
> Documentation and presentation of findings.

Website:
Lab: N/A
School: https://speit.sjtu.edu.cn/

PROJECT 172

Application of Simulated Data Assimilation Techniques in Small-Scale Models

Contact Information:

Assoc. Prof. Helin Gong
Email: gonghelin@sjtu.edu.cn

Project Description and Objectives:

This project is focused on the application of data assimilation techniques within small-scale engineering models. The primary objective is to enhance students' understanding of how data assimilation can improve model predictions in engineering contexts, such as fluid dynamics or structural analysis. Students will be tasked with integrating simulated observational data into existing computational models, thereby improving their accuracy and reliability. The project aims to demonstrate the practical importance of data assimilation in engineering and to provide students with hands-on experience in this emerging field.

Eligibility Requirements:

> Students majoring in Engineering, Applied Mathematics, Computer Science or related disciplines.
> Basic understanding of numerical methods and computational modeling.
> Proficiency in programming (preferably Python or MATLAB).
> Strong analytical skills and attention to detail.

Main Tasks:

> Study and understand the basic principles of data assimilation.
> Develop or modify small-scale computational models.
> Integrate simulated data into these models.
> Analyze the impact of data assimilation on model accuracy.
> Document and present the research findings.

Website:

Lab: N/A
School: https://speit.sjtu.edu.cn/

PROJECT 173

Application of Digital Twin Technology in Simulated Nuclear Reactor Monitoring

Contact Information:

Assoc. Prof. Helin Gong
Email: gonghelin@sjtu.edu.cn

Project Description and Objectives:

This project focuses on employing digital twin technology for the monitoring of simulated nuclear reactors. The primary goal is to provide students with practical experience in creating and utilizing digital twins for real-time monitoring and predictive maintenance in nuclear engineering. This includes understanding the fundamentals of digital twin technology, data integration from simulated environments, and the application of predictive analytics for reactor performance and safety enhancement. The project aims to foster a deep understanding of how digital twins can revolutionize monitoring and maintenance practices in nuclear reactors.

Eligibility Requirements:

> Students in Nuclear Engineering, Mechanical Engineering, Computer Science, or related fields.
> Basic knowledge of nuclear reactor operations and safety.
> Familiarity with computational modeling and simulation.
> Programming skills, preferably in Python or similar languages.

Main Tasks:

> Develop a basic digital twin model of a simulated nuclear reactor.
> Integrate simulation data into the digital twin for real-time monitoring.
> Implement predictive analytics for maintenance and safety purposes.
> Analyze and evaluate the effectiveness of the digital twin model.
> Document and present the project outcomes.

Website:

Lab: N/A
School: https://speit.sjtu.edu.cn/

PROJECT 174

Hydrogen Evolution of Electrolytic Water Based on Different Phase and Microstructures of MoS_2

Contact Information:

Assoc. Prof. Junfang Cheng
Email: chengjunfang@sjtu.edu.cn

Project Description and Objectives:

The hydrogen evolution reaction (HER) of proton exchange membrane water electrolysis often uses Pt precious metal catalysts, and the high cost to some extent limits its commercial development. MoS_2 is widely used in the field of electrocatalysis due to its unique layered structure, especially as a HER catalyst for water electrolysis. The HER performance of MoS_2 depends on its different phase compositions and microstructure. Previous studies have shown that 1T metal phase molybdenum disulfide rich in high conductivity has high HER performance, and the ultra-thin nano-layered MoS_2 structure rich in high active edges also exhibits good HER activity. However, obtaining highly stable 1T metal phase molybdenum disulfide is currently a challenge, and the intrinsic structure-activity relationship between the phase composition and microstructure of molybdenum disulfide and its hydrogen evolution activity is not yet clear. This study will focus on the different microstructures and phase transitions of 1T and 2H molybdenum disulfide, exploring the HER performance of molybdenum disulfide with different phase compositions and microstructures, and revealing its structure-activity relationship at the molecular and atomic scales. This project is of great significance for the development of non-precious metal catalysts in the field of electrolytic water hydrogen production.

Eligibility Requirements:

> Interested students should have a certain foundation in mathematics and chemistry.
> Interested in the field of new energy.

Main Tasks:

> Material synthesis, HER performance testing, and data analysis.
> Write an SCI manuscript based on the research.
> Finish a research report, deliver two presentations (literature review and technical presentation).

Website:

Lab: N/A
School: https://speit.sjtu.edu.cn/

PROJECT 175

Preliminary Study on Fuel Cell and DIY for its MEA

Contact Information:

Assoc. Prof. Guanghua WEI
Email: ghwei@sjtu.edu.cn

Project Description and Objectives:

This program aims to cultivate the interest and research ability of overseas students in the field of hydrogen and green energy utilization. A burgeoning global demand for clean, efficient, and sustainable energy sources makes fuel cells, especially hydrogen-based proton exchange membrane fuel cells (PEMFCs), has led to increased attention in alternatives to fossil-fuel-based power sources. A key component of PEMFC is the electrocatalyst, which catalyze the oxygen reduction reaction and directly determines the fuel cell performance. Platinum is the mostly used electrocatalyst, however, it suffers from the high cost and low reserve issue that limits its widespread application. Therefore, the development of alternative materials to replace platinum is necessary.

This project aims to introduce the basic design principle of electrocatalyst for fuel cells, and to practice the design, preparation and optimization of high-performance novel parts - membrane electrode assembly. In addition, the hope is to improve the hardware facilities for students' learning. In the meanwhile, we would like to build a team of instructors with an international perspective to guide engineers, and consider the characteristics of international students to teach, to ensure elective teaching management and communication for overseas students.

Eligibility Requirements:

> Interested students should have a basic knowledge of chemical engineering or material science.

Main Tasks:

> Develop students' interest in electrochemistry.
> Let students enjoy the process of basic scientific research in SJTU.
> To write a regular experimental report and give a research presentation.

Website:

Lab: https://speit.sjtu.edu.cn/research/laboratory.html
School: https://speit.sjtu.edu.cn/about-us.html

SMART ENERGY

PROJECT 176

Design and Optimization of Microchannel Structure for Heat Dissipation of High Heat Flow IGBT Chips

Contact Information:

Assoc. Prof. Chaoyang Zhang
Email: chaoyzhang@sjtu.edu.cn

Project Description and Objectives:

As the size of electronic devices decreases and their functions increase, there is an increasing demand for high heat flow density cooling technologies. In particular, the IGBT module in the motor inverter on electric vehicles causes a great deal of chip heat generation due to the high current working condition, which is an important factor affecting the safe and stable operation of electric vehicles. With the increasing current density and heat generation power of the IGBT module, its heat dissipation structure is necessary to study. This project is aimed at designing and optimizing the microchannel heat dissipation structure for IGBT chip modules with high heat flow to keep the temperature of the important IGBT chips stable.

Eligibility Requirements:

> Major in mechanical or thermal engineering.
> Good working attitude and team cooperation spirit.

Main Tasks:

> Participant will be trained to read related literature, and to understand some research methods and theoretical knowledge in experiments and simulations.
> Numerical modeling of three-dimensional flow channel for the actual working conditions, optimization of the physical model and numerical model setup, and adaptive optimization design of the flow channel.

Website:

Lab: N/A
School: https://speit.sjtu.edu.cn/English/Default.aspx

PROJECT 177

The development of Ni-based catalysts for Low-temperature Efficient Catalytic Hydrogen Generation from Ammonia Decomposition

Contact Information:

Assoc. Prof. Jia Yang
Email: jia.yang@sjtu.edu.cn

Project Description and Objectives:

Hydrogen is a prospective zero-carbon and high-energy-density fuel alternative to fossil fuels for power generation. NH_3 is a promising H_2 (17.7%) carrier, which can overcome the challenges associated with H_2 storage and transportation. Thermocatalytic ammonia decomposition reaction is an effective way to produce clean H_2 and Ni-based catalysts, due to their higher catalytic performance, are promising catalysts for this process. The objective of the project is to develop Ni-based catalysts with high activity and stability for low-temperature ammonia decomposition.

Eligibility Requirements:

> Can follow the lab safety routine
> Students with laboratory experiences are preferred
> Knowledge of basic chemistry and catalysis

Main Tasks:

> Literature review.
> Preparation and evaluation of catalysts.
> Finish a research report.

Website:

Lab: N/A
School: https://www.senergy.sjtu.edu.cn/