上海交通大学
SHANGHAI JIAO TONG UNIVERSITY

SJTU
SUMMER
RESEARCH INTERNSHIP
PROGRAM

2020

S J T U
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SUMMER RESEARCH
INTERNSHIP
PROGRAM
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Shanghai Jiao Tong University (SJTU) is a higher education institute in China, which enjoys a long history and a world-renowned reputation. Through 123 years of unrelenting effort, SJTU has become a comprehensive and research-oriented top international university in China. SJTU enjoys an ever-increasing level of scientific research excellence and technological innovation. During 2015, SJTU was named the leading institute in the nation, in terms of project numbers and amount of money issued by the National Natural Science Foundation of China, for the 6th consecutive year. SJTU also ranks second in the nation for sponsored research grants.

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 around the world the opportunity to spend a summer studying at world-class research laboratories, 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 enjoying lectures with topics such as "How to Write a Research Essay", "How to Cooperate in a Project". Participants will also learn about Chinese language and culture, which will enhance their intercultural awareness and communication.

What Participants will receive?

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

Eligibility Requirements

> Students from overseas, Hong Kong, Taiwan, and Macao are eligible to apply.
> Students must have completed at least one year of an undergraduate program and be enrolled as a current 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 no less than 6.0 or a TOEFL with a score no less than 78 points. If you are studying in a fully English taught program, you must provide the relevant certificates.
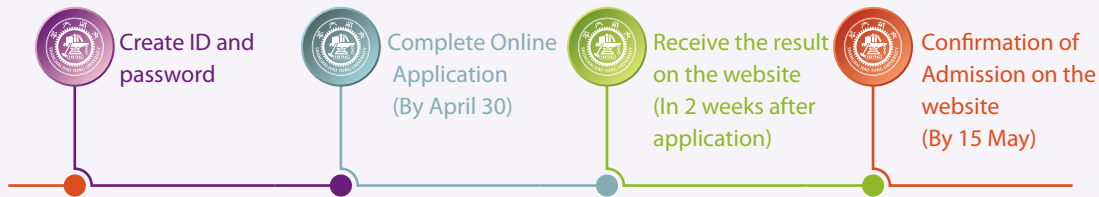> Additional requirements vary per laboratory.

Duration

9 July, 2020-21 August, 2020

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

Create ID and password → Complete Online Application (By April 30) → Receive the result on the website (In 2 weeks after application) → Confirmation of Admission on the website (By 15 May)

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
Tuition fee	8000RMB

* Tuition fee will be waived for students who are successfully selected to attend 2020 summer research internship program.

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

Online Application Deadline

30 April, 2020

Announcement

You will be notified of the results through our website and an email within two weeks of completing the application.

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 to the mailing address you provided in the application in September, 2020. Students who wish to transfer credits need to obtain pre-approval from the relevant authorities at your home universities.

Accommodation

SJTU Summer Research Internship Program will be conducted at two campuses: Xuhui and Minhang. Students are able to choose on-campus and off- campus accommodation dependent on the location of the lab.

For on-campus accommodation, room reservations should be made online at dorm.sjtu.edu.cn in June and the accommodation fee should be paid online. As the on campus accommodation is limited, you can also choose the off-campus accommodation.

More detailed information regarding the accommodation reservation will be released once you have been admitted to Summer Research Internship.

For more information, please contact the International Student Service Center
Minhang Campus: issc_minhang@sjtu.edu.cn +86-21-34203955
Xuhui Campus: issc_xuhui@sjtu.edu.cn +86-21-62933305

Visa

SJTU will provide students with a JW 202 and an admission notice. Applicants should bring the visa paperwork, admission notice, JW 202 form and a valid passport to the local Chinese embassy or consulate to apply for a short-term student visa (usually the visa type "X 2"). Students from visa-waiver-country shall also hold valid student visa (X2 type visa) for entry. Those who are already in China need to submit a copy of the visa page, residence registration notice and the above application documents to the PCB in Shanghai after registering at SJTU.

The JW 202 form and the admission notice will be sent to the applicant via an international courier within two weeks after April 30, 2020.

* If you are a local student from Hong Kong, Macao or Taiwan, you do not need the JW202 form.

Insurance

Students who plan to attend this program should obtain insurance before coming to study in China. Each student needs to present the insurance certificate to the administrative staff on the day of registration.

Timeline

Preparation for the application	*September to December, 2019*
Completion of the online application	*January to April, 2020*
Notification of the application result	*February to May, 2020*
Visa application and insurance	*May to June, 2020*
Online accommodation reservation	*June, 2020*
Check-in at the dormitory and Registration	*9 July, 2020*
Opening Ceremony	*10 July, 2020*
Internship	*9 July- 21 August, 2020*
Finishing the program survey of issuing of certificates	*30 August, 2020*
Check-out at the dormitory	*22 August, 2020*
Transcript delivery	*September, 2020*

Contact

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

PROJECT LIST

PROJECT LIST

MECHANICAL ENGINEERING

PROJECT 01

The Digital Twin Technology in Workshop

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 is to make full use of physical models, sensor updates, and other data to display the condition of equipment in workshops.

Eligibility Requirements:
Interested students from Germany should be very proficient in C++ programming and have basic knowledge of medical image.
Computing.

Main Tasks:
> Finish a research report.
> Develop a 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 from Germany should be very proficient in C++ programming and have basic knowledge of medical image.
Computing.

Main Tasks:
> Finish a research report.
> Develop a software.

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

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 real motions, which can be utilized to realize human-machine interactions under convert 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 motionless gesture recognition technique should be given, for example, 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 journal as a co-author.

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

04

Chemistry in Clean Combustion

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

Project Description and Objectives:
Combustion provides over 85% of global primary energy supply nowadays. Clean combustion is one of the most important approaches to achieve an environmental-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. 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.
> Knowledge of physical chemistry is necessary.
> 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: http://202.120.53.238/English/Default.aspx

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 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 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 CH_2O/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 CO_2/ H_2O. 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 is necessary.
> Interested students should have basic knowledge of laser and photonics.

Main Tasks:
> Measurement of swirling flames 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: http://202.120.53.238/English/Default.aspx

Hand-Eye Coordination Algorithm for 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 used with remote operation, that is, doctors according to the endoscopic image use a main hand device to control the distal surgical robot to carry out operations. 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's very useful for surgeries that need to be operated in the X-ray environment, such as some orthopedic surgery. 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 is to establish a mapping between hand movements and endoscopic images to enhance the surgeon's presence. Hand-eye coordination involves the control of the robot, the coordinate system transformation, etc. This is one of the core technologies of the remote operation problem.

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

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

Mechanism Design of Medical 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. It was mainly used to accomplish puncturing or drilling operations accurately. In order to meet the requirement 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

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:
As a 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. 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 musculo-skeletal 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 journal as a co-author.

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

09
The 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 for mankind. As the treatment of oral diseases, oral and maxillofacial surgery, aims to treat the entire craniomaxillofacial complex: 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 be guaranteed. 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 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, 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 the 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 a software.
> Finish a research report.
> Give two research presentations (a. references review; b. technical presentation).
> Submit one paper to journal as a co-author.

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

10
Efficient Usage of Low Grade Heat

our green building lab

Contact Information:
Asso.Prof. 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 the building on the primary energy, several studies on energy-saving technologies have been done worldwide. On the other hand, renewable energy utilization was regarded as reasonable solutions to global warming, air pollution, and energy security. Through integrating the technologies of energy-efficient and renewable energy utilization in building, net-zero energy building is an innovative concept for a high-performance building.

Eligibility Requirements:
> Lab safety.
> The interested student should have basic knowledge of renewable energy, air-conditioning, green building, sorption cooling technologies, etc.
> The interested student should be at ease with CAD or 3D software.
> Excellent writing and speaking communication are mandatory.

Main Tasks:
> Be familiar with different building energy saving technologies, such as adsorption, absorption, dehumidification, etc.
> Can propose a new design, analyze it and optimize the designs.
> 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

11

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

Contact Information:
Assistant 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 on metrology and/or CMNC machine tool is highly desired.

Main Tasks:
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

12

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

Contact Information:
Assistant 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 on metrology and/or CMNC machine tool is highly desired.

Main Tasks:
Participants 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 experiment using contaminated workpiece, and determining the extent of contamination on the stylus tips.

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

13

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

Contact Information:
Assistant 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 cannot 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 on metrology and/or CMNC machine tool is highly desired.

Main Tasks:
Participant will carry out 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

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 fuel cell field. And the hope to improve the hardware facilities for students learning, to do experiments and discuss. In the meanwhile, we would build a team of instructors with an international perspective to guide engineers, and consider the characteristics of overseas students to teach, to ensure effective teaching management and communication for overseas students.

Eligibility Requirements:
> Be interested in new energy.
> Have basic knowledge of electrochemistry.
> Have experience in chemical experiments in lab.
> Ability to write a regular experimental report.

Main Tasks:
> Develop students' interest in electrochemistry.
> Let students enjoy the process of basic scientific research in SJTU.
> Explore a new mode of communication with overseas students.

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

Computer Vision for Intelligent Vehicles

Contact Information
Asso.Prof. Xuesong Li
Email: xuesonl@sjtu.edu.cn

Project Description and Objectives
Automotive engineering and related technologies have gained substantial attention and investment in this information era, surprising or not. With the technology of hybrid vehicle, electric vehicle, vehicle-to-everything (V2X), assisted driving and autonomous driving, etc., new insights and rapid growth are seen in this industry, with the embrace of both traditional technologies and new methodologies. This summer research program will focus on some of the hot 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 build up 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
(1) Traditional computer technology study such as camera calibration, color space conversion, edge detection, etc. for lane line detection.
(2) 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.
(3) 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/

Optical Diagnostics for Optical IC Engines

Contact Information
Asso.Prof. Xuesong Li
Email: xuesonl@sjtu.edu.cn

Project Description and Objectives
Although renewable energy vehicle is attracting increasing attention, traditional energy conversion scheme, such as a gasoline internal combustion engine, is 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
(1) Perform optical/laser based experiments for fuel spray diagnostics
(2) Work on an actual optical engine and adjust operation parameters to vary the performance of the optical engine
(3) 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/

17
Knowledge Graph Construction and Its Application in Individual Relationship Analysis

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

Project Description and Objectives:
A knowledge graph is a promising method of representing semantic of information formally, which is mainly used in Web search engine development. For Web searching, knowledge graph acts as knowledge bases providing relationships between searched objects to enhance the searching 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 searching results could be refined.
There exist several NLP toolkits to process sentences of natural language. But they need to be tailored for knowledge graph construct. Also for the recognition of relationships of concepts in the knowledge graph, open linked data need to be involved in to build a bridge between insolated entities. Based on the setup knowledge graph, individual information on 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 journal or conference as a co-author.

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

18
Cloud-Based Model-Driven Service Development

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

Project Description and Objectives:
A knowledge graph is a promising method of representing semantic of information formally, which is mainly used in Web search engine development. For Web searching, knowledge graph acts as knowledge bases providing relationships between searched objects to enhance the searching 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 searching results could be refined.
There exist several NLP toolkits to process sentences of natural language. But they need to be tailored for knowledge graph construct. Also for the recognition of relationships of concepts in the knowledge graph, open linked data need to be involved in to build a bridge between insolated entities. Based on the setup knowledge graph, individual information on 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 journal or conference as a co-author.

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

19
Energy Router for Future Energy Internet

Contact Information
Prof. Miao Zhu
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Project Description and Objectives
With the development of energy and internet technologies, energy router has been 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 router is 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 the energy router for future networks. First, the basic concept and functions of energy router will be investigated. Typical energy internet scenarios for energy routers will be summarized and presented afterward. Then key technologies, restraints and development trend of energy router will be studied respectively. A general report will be presented as the final achievements.

Eligibility Requirements:
Basic knowledge of EE.

Main Tasks:
> Investigation on the concept of energy router and energy internet.
> Summarization on the typical scenarios of energy router in energy internet.
> Investigation on key technologies of energy router for the typical scenarios.
> Discussion on the restraints and the development trend of energy router.
> Finish a research report in this project.

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

20
Wind Power Generation and Grid-Integration Control

Contact Information:
Associate 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 grid-friendly integration of wind turbine generators. This project will study the advanced control for the wind turbine generators to meet the strict grid codes, i.e., frequency support, inertial response, high-voltage fault ride-through and so on.

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 in this project.

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

21

Design and Control of Haptic Systems for Robot Surgery

Contact Information:
Asso.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 between 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/

22

Research on Attack and Defense of the Platform of Multi-robot Cooperative Control

Contact Information:
Asso.Prof. Jianping He
Email: jphe@sjtu.edu.cn

Project Description and Objectives:
In recent years, more and more people focus on multi-robot cooperative control systems, for their excellent abilities to finish complex tasks. However, the safety problem of the system is also fierce, due to its high distributed fashion and openness to the outside world while operating in real environments.

In this research, we aim at designing smart and efficient attack towards the multi-robot system via local information and learning-based methods and then propose defense strategy through a systematic approach. In the end, we'll test our algorithm in simulation and real robot platforms to verify the effectiveness of the proposed theory.

Eligibility Requirements:
Interested students should be proficient in python/C++ programming and have basic knowledge of robot control. And proficiency in writing and speaking is mandatory.

Main Tasks:
> Propose a new idea for the attack /defense of multi-robot system.
> Present the result with either a simulation or an experiment.
> Finish a report of the internship.

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

23

High Speed Integrated Optical Interconnects

Contact Information:
Asso.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 by an in-depth understanding of the connection of the algorithm and physical implication.

Eligibility Requirements:
Basic understanding of photonics, communication principle.

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 experiment.

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

24

Mode Restruction in Few Mode Fiber Using Digital Holography

Contact Information:
Asso.Prof. Qingwen Liu
Email: liuqingwen@sjtu.edu.cn

Project Description and Objectives:
Few mode fibers (FMF) can transmit several individual modes. The cross-talk between modes is very weak and each mode can carry information. Therefore, FMF can realize high-density information transmission. The modes of the FMF overlap in space and time and the information of each mode cannot be directly detected. In this project, holographic technology will be used to obtain the intensity and phase information of the output light field of the FMF, and then each mode of the FMF can be separated and reconstructed by calculation.

Eligibility Requirements:
Basic understanding of photonics, 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;
>   Setup 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 fiber.

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

25

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

Contact Information:
Asso. 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. 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 developing countries for diabetes complications worldwide under the leadership of the international diabetes federation (IDF).

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

26

A Diabetes Monitoring and Health Management System Based on Machine Learning

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

Project Description and Objectives:
The incidence of long-term complications of type 2 diabetes is also 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 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

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

Digital Artist: Creating ART with Deep Learning

Contact Information:
Asso. 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

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 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 the researches 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 for cartoon black-white pictures. However, there are some bugs in the final results of the previously proposed method, such as the disability of their methods in showing a smooth background for some images and some special kind of reference colors.
In this project, our purpose is presenting an efficient and robust solution to the problem of generating a plausible cartoon-style picture and colorizing the cartoon sketches, thereby giving more inspiration to the original painting that could be accepted as the human vision conception.

Eligibility Requirements:
An Ideal candidate is expected to
> have experience in deep learning, as well as excellent programming skills esspecially 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 by 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/

29

Quantum Computation for Wireless Communications

Contact Information:
Asso. Prof. Zhiyong Chen
Email: zhiyongchen@sjtu.edu.cn

Project Description and Objectives:
Recently, quantum computation technology is making great breakthroughs and is part of triggering the next technological revolution. Specifically, quantum computation is now widely used in machine learning design for speeding up, the quantum hardware-based machine learning algorithms, 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/

30

Active Device Detection in MIMO Massive Access Communication

Contact Information:
Asso. 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 higher compared to the current state-of-the-art. A typical application for massive access is a distributed sensor network which intelligently monitors and manages a large number of devices. Normally, the activation of these devices is intermittent, i.e., each device is periodic 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 on 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/

31

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

Contact Information:
Prof. Keyou Wang
Email: wangkeyou@sjtu.edu.cn

Project Description and Objectives:
In the power system research, the hardware experiment is an accurate testing method at the cost of the high expenditure and poor flexibility. The software simulation is flexible and efficient, but the accuracy is limited by the 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 with more and more renewable energy generations, which have a great impact on the dynamic characteristics of the power system. The internet-distributed hardware-in-the-loop simulation for renewable energy generations is to simulate the main grid on the simulation platform and interact with the actual renewable energy system in real-time via a cloud server.

Eligibility Requirements:
Interested students should have the basic knowledge of the electrical engineering and master 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/

Virtual Power Grid

Data Flow

Cloud Sever

Data Flow

Wind Turbine   Data Flow   Data Flow   Power Load

Photovoltaics
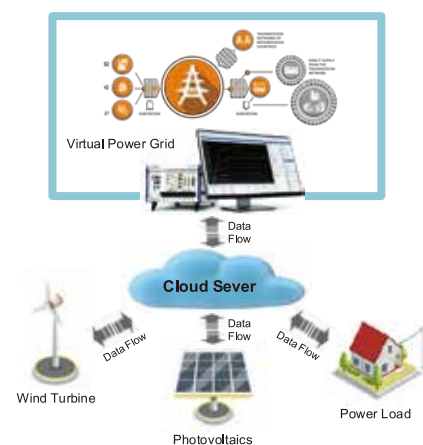
32

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

Contact Information:
Asso.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 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 damp 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/

33

Learning-Driven Power Maps

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

Project Description and Objectives:
Using machine learning tools 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-demanded 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 to apply 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 inter-disciplinary study of machine learning and power engineering. Background knowledge with both is required as well as interest in them and willingness to do hands-on programming work. In-term oral presentation and a final written report is required for a mark to be given.

Main Tasks:
> Learning the background knowledge of power system: its history, the cutting-edge research topics with a focus on power system operation and planning.
> Reviewing machine learning tools: different algorithms, basic math it requires, typical problems it can solve.
> Implementing a machine learning tool, which can be either supervised or unsupervised learning; targeting a specific group data of the power system, which can either be operational or planning data.
> Training 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/

34

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
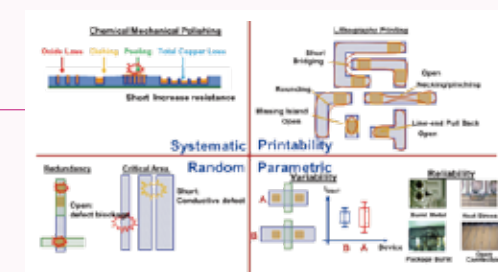
Project Description and Objectives:
With the increasing demand for more integrated circuit chips, ranging from automotive vehicles, computers/servers, and mobile devices, it has been reported that the cost of producing new bleeding-edge chips in the latest technology now cost more than $500 million. To lower down the barriers to design chips, reduce design cycle and increase 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 which prevent any catastrophic failure in the chip. The intern will need to have a basic understanding of CMOS process, deep learning techniques, and python programming language. The intern will explore different deep learning model 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/

Study of Information Security Test and Analysis for Intelligent and Connected Vehicles

Contact Information:
Prof. Yue Wu
Email: wuyue@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 vehicle networks face are also increasing. The information security of intelligent and connected vehicle networks has attracted more and more attention all over the world. This project focuses on the target of special project "Shanghai Intelligent and Connected Vehicle Information Security Research and Development and Public Service Platform", which is funded by transformation and up-gradation of Shanghai's industry in 2018. It mainly studies the verification technology and testing tools of information security for intelligent and connected vehicles, including onboard application testing tools, on-board automatic network scanning tools, and so on. Open source scanning or testing tools are investigated to develop an integrated penetration tool in-vehicle networks. It is used to discover security vulnerabilities hidden in a vehicular network. And it also supports penetration tests of remote access, physical access, CAN bus protocol, and other interfaces. The main goal is to achieve active security defense, that is to say, to discover security vulnerabilities and fix them before a security accident occurs.

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

Main Tasks:
> Do a survey of background and significance of the project topic: information security testing and analysis of intelligent and connected vehicle networks.
> Read references related to information security of intelligent and connected vehicle networks to summarize existing security defense mechanisms and existing security problems, including security threats, and hidden dangers of vehicular networks.
> Investigate existing wireless WiFi, CAN bus protocol, OBD remote diagnosis port, ECU chip, and cloud security detection tools for intelligent vehicular networks.
> Assemble, optimize and redevelop several open source tools, design security penetration testing, and vulnerability detection tools for intelligent network CAN (Controller Area Network), and implement the framework for analyzing the security of CAN and ECU devices.
> Carry out the penetration testing and security analysis tool based on the testbed of vehicle network, located in Nanqiao, Fengxian district, Shanghai.
> Organize and write the internship report.

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

Study of Biometric Identification Including Face Recognition and Gait Recognition

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

Project Description and Objectives:
Face recognition is mainly used for identity recognition. Due to the rapid popularization of video surveillance, many video surveillance applications urgently need a fast identification technology under the condition of long-distance and uncooperative users, to quickly confirm the identity of personnel in long-distance and realize intelligent early warning. Face recognition technology is undoubtedly the best choice. Fast face detection technology can be used to find faces in real-time from surveillance video images and compare them with face database in real-time, to achieve rapid identification.
Gait recognition is a new biometric authentication technology which attracts more and more researchers' attention in recent years. It is a method of identifying people by walking. Gait recognition is a new biometric recognition technology, which aims to identify people by their walking posture. Compared with other biometric recognition technologies, gait recognition has the advantages of non-contact, long-distance, and not easy to disguise. In the field of intelligent video surveillance, it has more advantages than image recognition.

Eligibility Requirements:
> Have professional knowledge of Computer, Communication, Computer vision, Machine learning, or Deep learning.
> Good working attitude and self-learning ability.
> Good team spirit.

Main Tasks:
> Do a survey of background and significance of the project topic: Biometric identification, including face recognition or gait recognition with deep learning networks.
> Read references related to face recognition or gait recognition to summarize existing recognition mechanisms and existing problems, including the adaptiveness, cross-view, and the recognition speed.
> Investigate and run codes of existing key methods for face recognition or gait recognition. For example, feature extraction such as OpenPose, deepFace, FaceNet, etc. Deep learning network such as C3D, GAN, etc. Collect open source datasets.
> Assemble, optimize, and redevelop several open source tools, design network for face recognition or gait recognition. Build network structures and train models.
> Carry out the recognition in open source datasets and in other surveillance videos under real scenes.
> Organize and write the internship report.

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

37

Content-Aware Software-Defined Security Mechanism against Threat Propagation in Smart Grid

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

Project Description and Objectives:
This program focuses on the application of next-generation networking in smart grid. Firstly, participators will be assigned to investigate the research evolution of information-centric networking (ICN) and software-defined networking (SDN) in smart grid. Secondly, participators should try to design and realize a dynamic multicast scheduling algorithm based on ICN or SDN to mitigate security threat propagation in smart grid, some tests or simulations should be done to demonstrate the feasibility of the proposed algorithm. Besides, dynamic security service configuration is another available sub-project, participators can select to develop an application to enforce network security involved (such as access control, data encryption and authentication protocol) based on SDN, each application should be designed to provided guarantees for smart grid security.

Eligibility Requirements:
> Mathematical modeling.
> Network and computer knowledge.
> Programming.
> Scientific writing.
> Good team spirit.

Main Tasks:
> Literature reading.
> Programmable assignments.
> PPT presentation.
> Organize and write the internship report.

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

38

Optimization for the Multi-layer Convolutional Sparse Coding

Contact Information:
Asso. 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 suffers from a degraded reconstruction performance for multi-layer cases. This project aims at developing 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.
> Mastering 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/

39

Optimal Coding for 360-degree Video Streaming

Contact Information:
Asso. Prof. Chenglin Li
Email: LCL1985@sjtu.edu.cn

Project Description and Objectives:
For 360-degree spherical images and videos, current methods to directly encode them into a bitstream are not yet mature. Therefore, the state-of-the-art 360-degree video streaming systems usually seek an alternative way by exploiting the advantages of two-dimensional video coding technology (e.g., H.264/AVC, HEVC), which first projects the 360-degree spherical surface onto a rectangular image/frame and then applies the advanced two-dimensional video coding encoder to encode the rectangular image/frame into a bitstream. To support the pixel resolution of the displayed viewport as 4K (3840 X 2160), the resolution of the rectangular projection should be at least 12K (11520 X 6480), which indicates that the viewport area covers roughly 14% of all pixels in the rectangular projection. This leads to recent researches on an efficient streaming technique for 360-degree videos, namely tile-based approach, where the two-dimensional projection is divided spatially into small rectangular tiles and each temporal sequence of these small rectangular tiles in the same spatial location is treated as an individual source for video encoding. In this way, only the tiles that cover the viewport will be transmitted to the user.
The size of the tiles affects conversely coding efficiency and transmission efficiency. If we decrease the tile size, the transmission efficiency is improved since the non-overlapped area between the viewport and the transmitted tiles becomes smaller. On the other hand, a smaller tile size results in a larger number of tiles per frame, which in turn increases the number of headers for the tiles and results in efficiency reduction in the intra- (spatial) and inter- (temporal) prediction. Therefore, we need to study the optimal determination of the tile size, by considering both the video content statistics and the viewports (and viewport prediction) of users. Another promising research direction is that, instead of fixed tiling, we may want to cover the whole rectangular frame with some sub-rectangular tiles with different sizes, which, if encoded together, could achieve the optimal tradeoff between coding and transmission efficiency.

Eligibility Requirements:
> Basic knowledge of video codec (e.g., H.264 and HEVC), signals and systems, digital signal processing, digital image processing, matrix analysis, optimization theory.
> Mastering of more than one programming language, C/C++ and MATLAB preferred.

Main Tasks:
> Develop the overall adaptive video streaming system framework for tile-based 360-degree videos.
> Formulate the relationship between the coding efficiency and the tile size, and the relationship between the transmission efficiency and the tile size.
> Solve the optimal trade-off between the coding efficiency and the transmission efficiency, by determining the optimal tile size.

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

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Performance Evaluation of Visual Tracking on Encoded Videos

Contact Information:
Prof. Hongkai Xiong
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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 (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 is 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 of 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/

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Blockchain and its Application in Energy Internet

Contact Information:
Asso.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 society.

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 joined by a large number of European utilities. Hopefully, it will revolutionize the way that energy transactions and power system asset tracking is 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 language and have basic knowledge of energy/power systems.

Main Tasks:
> Learn 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/

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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 approach 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 problem of multi-vector energy system design and operation is to identify 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:
> Majored in energy systems engineering and relevant subject.
> Mathematical programming skill (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/

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

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

Eligibility Requirements:
> Majored 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 models proposed.

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

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Intelligent Data Security in Optical Networks

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

Project Description and Objectives:
Fiber optical networks are becoming more and more important for current large-capacity, high-rate data transmission, however, the challenge of data security is severe. Based on our long-term experiences in fiber optical networks, we will integrate the recent-developed artificial intelligence technologies in fiber optical networks, to investigate the new methods of data security technologies, including:

1. Intelligent data security in fiber optical transmission;
2. Intelligent data security for fiber optical networks.

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 a solid knowledge of optical fiber communication, optical networks.

Main Tasks:
> Investigate the intelligent data security technologies for optical network transmission, by incorporating the artificial intelligence technologies into the decision core in application plane, control plane and transmission plane, and to optimize the network control and management, in order to meet the requirements of high burst, variable bandwidth and long distance for future optical fiber networks.
> Combined with the artificial intelligence technologies, the secure data transmission will be explored and developed for fiber optical networks. 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/

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Multimodal Event Detection under Unparalleled Situations

Contact Information:
Assistant 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/

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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 sentence 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/

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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 have 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/

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

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 regarded as a new kind of oil, has been paid a great amount of attention from people across the globe. However, due to the lack of effective data trading platforms, the existing data sets 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 experiment.

Main Tasks:
>   Propose a novel idea in the scope of project.
>   Present the design result with either 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/

Remote Sensing Image Classification with Deep Learning Methods

Contact Information:
Asso.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. For example, classify 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/

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Radar Based Human Gesture and Movement Detection and Classification

Contact Information:
Asso.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 classification of the tagged radar echo wave data.

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

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Autonomous Quadrotor Landing on a Moving Platform

Contact Information:
Prof. Wang Hesheng
Email: wanghesheng@sjtu.edu.cn
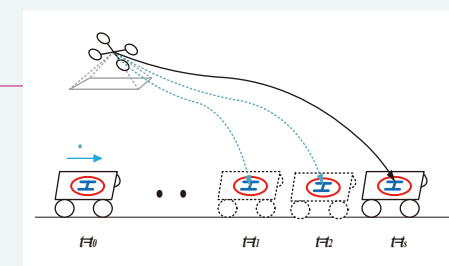
Project Description and Objectives:

This project focuses on the research of autonomous quadrotor landing on moving platforms. The autonomous landing of the quadrotors on moving platform is one of the recent research hotspots. Due to under actuation of the quadrotor dynamical system and difficulties of estimating the states of the quadrotor, this problem remains a challenge to be further investigated. The project plan is to use the down-facing camera and IMU to accurately estimate the states of the quadrotor. At the same time, the down-facing camera is also used to estimate and predict the motion states of the moving landing platform. Taking dynamical under actuation as well as visibility issue into account, the project can optimize landing trajectory planning work and thus realize the task of autonomous quadrotor landing performance.

Eligibility Requirements:
> Basic ability in C++ programming.
> Basic knowledge of robot control and optimizations.

Main Tasks:
> Complete numerical analysis of landing performance.
> Conduct physical experiments.
> Complete a technical report.

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

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Fabrication and Modeling of Underwater Bio-inspired Soft Robot

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

Project Description and Objectives:
The project aims to explore the capacity of the soft robot in a specific underwater operating environment by learning the morphology and motion mode from the marine organisms. Bio-inspired soft robots have been gaining a lot of attention due to their optimal performance in specific environments stemming from their unique morphology and sensorimotor capabilities. The project intends to complete both fabrication and modeling work of the newly constructed soft robot. The students will first cooperate on mechanical design and select appropriate actuators to realize autonomous motion of the robot in an underwater environment. Thereafter, mathematical modeling work is required. Discrete and continuous modeling methods are alternative depending on the morphology and mechanism characteristics of the prototype. The contribution of control algorithm aims to realize specific control tasks such as positioning, tracking, and so forth. The lab provides diverse hardware facilities such as silicone molding tools, visual measuring system, optical motion capture system, etc. Students can also cooperate with our researchers who specialize in soft robotics.

Eligibility Requirements:
> Basic knowledge SolidWorks and other modeling software.
> Basic knowledge of MATLAB and C++.
> Basic knowledge of robot modeling and control.

Main Tasks:
> Complete design, fabrication and modeling of a soft robot.
> Cross validate the performance of the prototype.

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

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Unmanned Delivery Robot

Contact Information:
Prof. Wang Hesheng
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Project Description and Objectives:
The unmanned delivery robot is one of the most popular research fields, which is acknowledged as an important channel to realize the commercialization of the driverless car. This can effectively change the conventional lifestyle of humans overall. Despite the smaller size than a real car, the unmanned delivery car includes different kinds of sensors such as 3D-lider, stereo camera, RTK-GPS, sonar radar, and so forth. These can help to realize real-time highly accurate localization, road area, and lane detection as well as obstacle detection and classification. The project aims to realize autonomous package delivering tasks by the unmanned delivery robot. The main parts of the project are self-localization, perception in both interior, and the exterior environment through multisensory fusion, trajectory planning, and motion control. The project also emphasizes path planning algorithms to realize obstacle, avoid overloading, and stable self-driving performance on the specific and required road.

Eligibility Requirements:
> Basic knowledge of robot control and coordinate transformation.
> Basic knowledge of ROS is preferred.
> Carefulness, patience, accountability, and interest in the work.

Main Tasks:
> Finish a research report.
> Choose one research direction (localization, perception and navigation) and propose the optimization scheme.
> Realize the proposed scheme with ROS in the robot.

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

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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 more and more important. Advances in artificial intelligence and medical imaging technology will greatly contribute to the diagnoses of many diseases. Especially, computer-aided diagnoses that can reduce the disequilibrium of medical resources in China, where there is a significant difference between the main top hospitals 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 the First Hospital), Alzheimer's disease (with Chalmers University of Technology), and chromosome mutation (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 for the neural networks that trained for computer-aided diagnosis.

Eligibility Requirements:
>   Basic knowledge of artificial intelligence and image processing.
>   Programming skills on python, C; experience on TensorFlow, PyTorch is preferred.

Main Tasks:
>   Processing on clinical images and AI methods implantation.
>   Experiments on clinical data for one particular disease.
>   Interpretation analysis for the neural networks for clinical applications.

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

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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 serval key issues for 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 investigation on 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) 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 toolbox for the developed methods.

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

Machine Learning for Optical Communications

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

Project Description and Objectives:
Machine learning and neural network 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, 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 on 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/

Cross-Culture Emotion Recognition from EEG and Eye Tracking Data

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

Project Description and Objectives
Emotion plays a significant role in our daily life 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 peculiarity, the way humans think, 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; programming skills on python
> Experience on 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/

Cross-Subject Emotion Recognition with Transfer Learning

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

Project Description and Objectives:
Emotion plays a critical role in human lives, which affect our behavior and thoughts. As a signal which directly reflects brain activity, electroencephalography (EEG) has been demonstrated to be a reliable and promising indicator of human mental state. However, due to the physical and mental variance of the human brain, traditional machine learning models may fail when training data and testing data are from different subjects. Recently, transfer learning has attracted the attention of many researchers, which has a high potential in developing cross-subject brain-computer interface systems.

In this project, we will investigate cross-subject emotion recognition using EEG and eye movement signals with transfer learning methods. Based on the existing research and dataset, the study aims to classify five basic emotions (happy, sad, neutral, fear, disgust) among different subjects and to discover more facts about human emotions.

Eligibility Requirements:
> Interested students should have basic knowledge of machine learning; programming skills on python
> Experience on TensorFlow or PyTorch is preferred.

Main Tasks:
> Explore cross-subject emotion recognition with transfer learning methods.
> 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/

Cross-Domain Vigilance Estimation with Transfer Learning

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

Project Description and Objectives:
In this project, we will recruit subjects to take part in lab and real driving tasks. We use dry electrodes to collect EEG signals and implement different domain adaptation models. The goal is to build cross-domain vigilance estimation models.

Eligibility Requirements:
> Interested students should have basic knowledge of machine learning; programming skills on python
> Experience on TensorFlow or PyTorch is preferred.

Main Tasks:
> Finish a research report.
> Conduct experiments.
> Master different domain adaptation methods.

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

NAVAL ARCHITECTURE, OCEAN AND CIVIL ENGINEERING

61
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 for 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 journal as a co-author.

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

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Dynamic Damage of Geotechnical Structures

Contact Information:
Asso. 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 a good dexterity and be familiar with manual works in a laboratory.

Main Tasks:
> Understanding basic theory.
> Learning basic skills in experimentation.

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

63

Model Tests on Marine Renewable Energy Devices

Contact Information:
Prof. Ye Li
Email: ye.li@sjtu.edu.cn

Project Description and Objectives:
Renewable energy has occupied the forefront of energy supply studies around the world. With the advancement of science and technology, the use of renewable energy has expanded towards being done in the ocean in the last decade. Particularly, tidal current and wave energy are regarded as the two kinds of marine renewable energy with the greatest prospects. In this project, models of tidal current turbines and/or wave power generators will be tested in a ship model towing tank to measure their hydrodynamic performance. This performance is the key to marine renewable energy extraction.

Eligibility Requirements:
> Have a basic knowledge of ocean engineering, mechanical engineering, energy engineering and/or similar fields.
> Proficiency in speaking and writing is essential.

Main Tasks:
> Preparation of the facilities and instruments.
> Model test of the tidal current turbines and/or wave power generators.
> Data acquisition and analysis.

Website:
Lab: http://towingtank.sjtu.edu.cn/En/Default
School: http://naoce.sjtu.edu.cn/en/

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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 spend their time monitoring traffic pollution, collecting the original data, and conducting statistical analysis and mathematical modeling. The transportation and environment team aspires to foster leadership, problem-solving skills, and hands-on field experience. Team members will be able to utilize their classroom knowledge in order to optimize and solve real-world transportation environment problems.

Eligibility Requirements:
> Be good at communication.

Main Tasks:
> Learn how to use environmental monitoring equipment.
> Learn traffic emission models.
> Participate in projects about transportation and the environment.
> Participate in the measurement of traffic pollutants.
> Complete a project presentation and a project report.

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

65

Green Building Materials

66

Modular Construction

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 wastes 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 the 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, being 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/

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

Project Description and Objectives:
The technology and application of modular construction is 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 were 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, being for schools, hospitals, offices, and even to high-rise residential buildings. This demand has been driven by the off-site nature of the of the construction process, which leads to quantifiable economic and sustainability 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/

67
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 the high-rise buildings in the urban city. The favorite benefits this type of system can offer include significant reduction in wastes, improved safety at sites, and a more controllable quality of construction projects. This project aims to develop a virtual control system for the automated construction equipment by utilizing the 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 the 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:
> To become familiar with BIM software.
> To complete a research report.
> To submit one paper to a journal as a co-author.

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

68
Study on the Microstructure and Mechanical Properties of the Laser Additive Manufactured CrCoNi Medium Entropy Alloy

Contact Information:
Asso.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 on materials science, solidification, mechanics of metallic materials etc.
> Should know about the selective laser melting.
> Candidates who have related experience is 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: lpl.sjtu.edu.cn
School: http://smse.sjtu.edu.cn

69

The Joining Between Polymer and Metal for Biomedical Application

Contact Information:
Asso. 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 proved 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 is 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, being a literature review and a technical presentation.

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

70

Microstructural/Phase Evolution and the Mechanical Property of Wire-Arc Additively Manufactured Nickel-Titanium Shape Memory Alloy

Contact Information:
Assistant Prof. Chen Shen
Email: cshen486@sjtu.edu.cn

Project Description and Objectives:
Nickel-titanium (NiTi) has been continuously attractive for applications in aerospace and medical devices industries due to the excellent functional features such as shape memory and super-elasticity effect which are based on the solid-solid phase transformation between martensite and austenite. Besides the low stiffness, biocompatibility, and excellent erosion it has, corrosion and wears resistance of NiTi are what truly make this alloy the most competitive candidate for biomedical applications such as artificial bones and bio-parts. The Current Additive Manufacturing (AM) method (selective-laser-melting, SLM) for NiTi always brings a porosity defect which is unacceptable for a structural component. Because of this, Wire-Arc Additive Manufacturing (WAAM) has currently been introduced for the AM of NiTi due to its full-density manufacturing nature. The present research project aims to: (1) systematically characterize the microstructural performance and mechanical properties of the WAAM fabricated NiTi alloy under both as-fabricated and heat-treated conditions; (2) analyze the phase evolution of WAAM fabricated NiTi alloy during heat treatment using in-situ diffraction method.

Eligibility Requirements:
> Applicant should have a basic knowledge of metal additive manufacturing.
> Applicant should have a basic knowledge of crystallography and diffraction experiments (XRD, EBSD).

Main Tasks:
> Finishing a research thesis.
> Giving two presentations (1. Literature review; 2. Technical presentation).

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

71

Design and Application Research of Bio-inspired Hierarchical Hygroscopic Material

Contact Information:
Research Assistant 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, 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

72

Design and Fabrication of Wood-inspired Monolithic Porous Carbon Material

Contact Information:
Research Assistant 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 toward a sustainable future. In this project, we utilize the unique structure of the wood to fabricate wood-derived monolithic porous carbon materials by changing the conditions of the experiment to cater for 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 for different uses.

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

73

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

Contact Information:
Research Assistant 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 the smart color shifting materials, can be tuned by the 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 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 naked eyes, providing an effective and intuitionistic detection for the stimuli signals.

During the billions of years' evolution, nature has formed diverse kinds of tiny structures which match with the functions of the creatures. 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

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High performance HEA (High Entropy Alloy) Composite

Contact Information:
Asso. Prof. Mingxu Xia
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Project Description and Objectives:
High entropy alloy has attracted more and more attentions due to its unique properties. Due to the nature of the complex atomic structure, most HEAs are too brittle to be used as a structural material. In order to enhance the ductility, a heterogeneous structure of bimodal grains was developed in conventional alloys and in HEAs through alloying element addition and cold rolling. In this project, we will utilize the self-oxidation technique to strengthen HEAs with higher ductility. The effect of in situ formed oxide particles on the strength and ductility will be discussed based on the results of metallurgical analysis and transmission electronic microscopy analysis. The interface between oxides and the HEA matrix will be profoundly investigated. The interaction of the movement of the dislocations with oxide particles will be discussed in detail. The obtained results will extend the understanding of the deformation mechanism of particle enhanced HEA composite and a new high performance HEA is expected to be fabricated.

Eligibility Requirements:
>   Interested students should have a basic knowledge of composite.
>   Interested students should be familiar with SEM and EBSD.

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

75

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

Contact Information:
Associate Prof. Bai Jing
Email: Bai_jing@sjtu.edu.cn

Project Description and Objectives:
Natural gas is an important clean energy source. However, the large number 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 are difficult to remove CO2 and H2S simultaneously. This is because that apart from consuming lots of chemical reagents, the separated CO2 and H2S require subsequent processing which 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/

76

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 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 challengeable 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), to working on the above projects. The students need to attend the regular lab meetings, and make a weekly report to the mentor(s). By the end of the intern, a project report should be submitted.

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

77

Ecotoxicity Assessment of Emerging Environmental Containments

Contact Information:
Asso. Prof. Yanbin Zhao
Asso. Prof. Kun Zhang
Email: zhaoyanbin@sjtu.edu.cn ; kunzhang@sjtu.edu.cn

Project Description and Objectives:
With the development of modern chemical industries, more and more chemicals are synthesized and released into the environment. Many pieces of evidences have shown that environmental contaminants exposure is one of the important factors that affect human and ecological health. In recent years, the contamination of emerging organic pollutants in our environment has attracted people's attention. Normally, they occur in surface and ground waters in low ng/L-several μg/L range. In influent/effluent of wastewater treatment plants, higher concentrations of up to hundreds of μg/L occur. However, their potential reproductive and developmental effects on aquatic organisms are largely unknown. Therefore, the objective of this study is to investigate the developmental effects and cardiovascular and neurodevelopmental toxicities of emerging organic pollutants on a zebrafish model.

Eligibility Requirements:
> Basic knowledge of chemistry/biology.
> Self-motivation and the enjoyment of lab work.
> Majors in environmental science, biology or Chemistry are preferred.

Main Tasks:
> Systematically assess the toxicity of environmental contaminants.
> 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/

78

Mechanism Analysis of the Difference in the Separation and Rejection Performance of Metal-organic Composite Membrane

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

Project Description and Objectives:
Nanofiltration (NF) is a kind of precise membrane separation process under low pressure conditions. It has high retention efficiency for multivalent ions and organic small molecules (150-2000Da). In our previous study, Metal-polyphenol nanofiltration membranes were prepared by a layer by layer (LBL) method and spin-LBL method on PES membranes. The membranes prepared by spin-LBL method showed higher rejections to dyes and water permeability than those of LBL method. However, mechanisms of the difference in separation and rejection performance between the two membranes still need to be investigated.

Eligibility Requirements:
> Major in environmental engineering, chemical engineering, polymer or other related areas.
> Motivation to work.
> The computational method of the molecular modeling is preferred.

Main Tasks:
> Mechanism analysis of the difference in separation and rejection performance.

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

BIOMEDICAL ENGINEERING

79
Effects of Freeze of Gait Prediction with Laser Cue Intervention on Patients with Parkinson's Disease

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

Project Description and Objectives:
Freezing of gait (FoG) is one of the most common disabling symptoms among patients with Parkinson's disease (PD). A possible way to prevent FoG is by providing pre-emptive cueing when FoG is predicted. We have developed a machine learning algorithm to predict the FoG event with impaired gait acceleration patterns and personalized labeling. This project aims at investigating the effects of the FoG prediction with a laser cue on PD patients for future clinical translation. A portable device through the detection of FoG and intervention with lasers will be developed.

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/

80
Smart Imaging-Based Functional Evaluation for Contemporary Arthroplasty

Contact Information:
Prof. TsungYuan 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 is 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 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 minimal 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/

81

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

Contact Information:
Asso. 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:
Within the 8 six weeks, the 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 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/

82

bFGF Genetically Engineered Endothelial Progenitor Cells for Ischemic Stroke Treatment

Contact Information:
Prof. Yongting Wang
Email: ytwang@sjtu.edu.cn

Project Description and Objectives:
Stem cells are being tested in several clinical trials for the treatment of Ischemic Stroke. The genetic engineering of stem cells takes advantage of the stem cells not only as a therapeutic moiety but also as a factory and cargo for the gene product. In addition, genetic modification of stem cells can also augment the survival and function of the transplanted stem cells. Previously, our lab had identified that bFGF plays a key role in tissue protection after ischemic insult. In this project, we aim to investigate the potential of the bFGF genetically engineered endothelial progenitor cells in treating ischemic injury. The students will join a team of graduate students and research faculty members. Techniques used in this project will include but not limit to stem cell culture, exosome preparation, animal surgery, and data analysis.

Eligibility Requirements:
> Must be at least in their sophomore year.
> Skills desirable but not required: cell culture, molecular cloning.

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/

Developing Molecular Probes for Tracking Stem Cell Derived Exosomes in Live Animals

Contact Information:
Asso. Prof.Yaohui Tang
Email: aohuitang@sjtu.edu.cn

Project Description and Objectives:
Stem cell derived exosomes were beneficial for treating Ischemic Stroke, which is a major cause of disability and the second cause of death worldwide. However, quantitatively tracking exosomes and investigating their therapeutic efficacy and mechanism are still challenging. This project aims to develop multi-functional molecular probes to dynamically track exosomes that are intravenously or intra-arterially injected into mice as well as explore their therapeutic efficacy and underlying mechanisms. The students will join a team of graduate students and research faculty members. Techniques used in this project will include but not limit to stem cell culture, exosome preparation, animal surgery, and data analysis.

Eligibility Requirements:
> Must be at least in their sophomore year.
> Skills desirable but not required: cell culture.

Main Tasks:
> Attend weekly lab meetings and carry out experiments.
> Give two research presentations, (one on literature review, one on research progress).
> Test 2-3 molecular probes.
> Finish a research report.

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

Development of Microsphere Hydrogel as Stem Cell Carrier for Treating Ischemic Stroke

Contact Information:
Asso. Prof. Yaohui Tang
Email:yaohuitang@sjtu.edu.cn

Project Description and Objectives:
Stem cells-based therapy has shown great potential for treating Ischemic Stroke. However, most stem cells that are injected into the brain have died quickly thus significantly reduced their therapeutic efficacy. Recently, biomaterials such as hydrogel have been demonstrated as a cell carrier that could improve stem cell viability and differentiation. In this project, we will develop a microsphere hydrogel by using a microfluidic technique and we will test the effects of microsphere as a stem cell carrier for treating ischemic stroke. The students will join a team of graduate students and research faculty members. Techniques used in this project will include but not limit to stem cell culture, hydrogel development, animal surgery, and data analysis.

Eligibility Requirements:
> Must be at least in their sophomore year.
> Skills desirable but not required: cell culture, molecular cloning.

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/

PHYSICS

85

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 becomes a top priority for the scientist who works in either atomic scale physics, chemistry or material science. Topology, a special kind of advance 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 Bi_2Te_3, 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 is mandatory.

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

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

86

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 hot topic and also a frontier of condensed matter physics research in recent years. This project aims to show the interested student how to use 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/

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 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 catalysis usually 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 to form useful building blocks, existing extensively in bioactive molecules and pharmaceuticals.

Eligibility Requirements:
> Basic knowledge of organic chemistry.
> Motivation to work and with 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/

Synthesis and Self-Assembly of Asymmetric Organic Cages

Contact Information:
Asso.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 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…), 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://www.thezhanggroup.com
School: http://scce.sjtu.edu.cn/en/

PROJECT
89

Monitor the Tryptophan and Fluorescence through Fluorescence Spectroscopy

Contact Information:
Asso.Prof. Bei Ding
Email:bei.ding@sjtu.edu.cn

Project Description and Objectives:
Fibrillar amyloid proteins are known to be related to neurodegenerative diseases such as Alzheimer's disease, Parkinson's disease and Amyotrophic Lateral Sclerosis (ALS). Recently, researchers have determined a novel corkscrew-like structure of a cytotoxic segment of an ALS-related protein superoxide dismutases 1 (SOD1) (PNAS, 2017, 114, 33). This five-month intern project will be focused on understanding how this corkscrew-like structure is formed. The student is expected to use fluorescence spectroscopy to monitor the tryptophan fluorescence during the aggregation process for the purpose of unveiling the mystery of this novel structure.

Eligibility Requirements:
> Interest in physical chemistry or biological chemistry.

Main Tasks
> Synthesize a short ALS peptide segment.
> Use fluorescence spectroscopy to monitor the tryptophan fluorescence during the aggregation process.

Website
Lab: http://scce.sjtu.edu.cn/en/jiaoshi.php?aid=475&c=3
School: http://scce.sjtu.edu.cn/en/

PROJECT
90

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) major in Biological Sciences.

Main Tasks:
> To generate double knock-out mutants by crossing or targeted genome editing (CRISPR-Cas).
> To grow the mutants and verify the double mutants by genomic PCR and RT-PCR.
> To 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/

91

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

Contact Information:
Asso.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 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 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/

92

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 the 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/

93

Molecular Mechanisms Controlling Inflorescence and Spikelet Development in Rice and Barley

Contact Information:
Prof. Dabing Zhang
Email: zhangdb@sjtu.edu.cn

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 the society.

Eligibility Requirements:
Applicants are expected to possess 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/

94

Cloning and Functional Characterization of Rice Male Sterile Genes

Contact Information:
Prof. Dabing Zhang
Email: zhangdb@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:
The student will be involved in all stages of the project:
1）Design experimental scheme
2）Perform experiment
3）Analyze experimental results
4）Write the experiment report
5）Finish a research report
6）Give two presentations: one literature review and one on research progress.

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

95

Molecular Characterization of GMOs

Contact Information:
Prof. Dabing Zhang
Email: zhangdb@sjtu.edu.cn

Project Description and Objectives:
As more and more transgenic crops like transgenic maize and soybean have been approved and consumed as foods 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:
1）Design experimental scheme
2）Perform experiment
3）Analyze experimental results
4）Write the experiment report
5）Finish a research report.
6）Give two presentations: one literature review and one on research progress.

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

PROJECT

96

Characteristics of Air Pollutants in Plantation Stands along the Urban-Rural Gradient in Shanghai

Contact Information:
Prof. Chunjiang Liu
Email: chjliu@sjtu.edu.cn

Project Description and Objectives:
There are three observation sites for monitoring air pollutants ($PM2.5$、 $PM10$, CO, $NO2$, $SO2$ and $O3$) in plantation stands from the city center (Zhongshan Park), to the out-loop highway (Jinhai Park), and to the rural area (Chongming Island) in Shanghai. With this data, the concentrations of air pollutants and the variation along the urban-rural gradient will be analyzed and compared with those in other parts of Shanghai. The results would show to what extent the concentrations of the air pollutants are reduced to inside different plantation stands.

Eligibility Requirements:
1. Basic or brief knowledge of biology, environmental science, or ecology.
2. Basic statistics knowledge.
3. A Doubt-and-question mind.
4. Proper writing skills.

Main Tasks:
1. Checking the equipment and machines in the stations
2. Analyzing the data of the air pollutants at the three monitoring sites
3. Comparing the results with those obtained from the other parts of Shanghai

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

97

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

98

Phyllo Sphere Microbial Communities in Shanghai Region: Responses to Typical Tree Species and Urban-rural Gradient

Contact Information:
Assoc. 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 focused 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:
1. With basic or brief knowledge of Environment or Ecology.
2. With strong perseverance.
3. With doubt-and-question mind.
4. Punctuality.
5. Able to reflect from experiments and conclusions.
6. With proper writing skills.

Main Tasks:
1. Finish experiment assigned.
2. Give research presentations.
3. Compose one science paper.

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

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

Project Description and Objectives:
Tree phyllo sphere serves as an independent micro-environment, providing habitat for microorganisms such as bacteria, fungi, and archaea. In the field of urban ecology, phyllo sphere microbial community diversity and composition draw increasing attention. These microorganisms not only contribute to plant growth, metabolism, and protect their hosts from pathogenies, but also are responsible for many ecosystem services and functions in an urban environment, such as degrading and adsorbing atmosphere pollutants, maintaining biodiversity, etc. However, our current understanding of phyllo sphere microbes among different tree species remains relatively poor in urban areas. To screen phyllo sphere bacterial and fungal communities in high resolution, we will employ high-throughput DNA sequencing and characterize 16s (bacteria) and ITS (fungi) ribosomal rRNA gene. We will also quantify microbial population based on the same ribosomal gene utilizing qPCR. Our results will provide city managers with insights in tree selection in urban green space development which may improve the efficiency of atmosphere pollutant degradation.

Eligibility Requirements:
1. Interests in academic works.
2. Basics in molecular technology, ecology and statistics.
3. Good communication skills in English.

Main Tasks:
1. Tree leaf sampling and physical-chemical analyses.
2. Total DNA extraction, ribosomal rRNA gene amplification, qPCR and Ilumina Miseq sequencing.
3. Bioinformatics and statistical analysis – introduction to R., mothur and JMP.

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

99 Viticulture and Enology

100 Plant Synthetic Biology Techniques for Natural Products from Medical Plants

Contact Information:
Prof.Jiang Lu
Email: Jiang.lu@sjtu.edu.cn
Dr. Yu Gao
Email:yugao@sjtu.edu.cn

Project Description and Objectives:
This project includes all the processes in the standard winemaking procedure. The students who joined the project will participate in each step to gain the experiences, including the ripening analysis before the harvest, berry harvest, selection and crushing, yeast inoculation and the start of fermentation, etc. Furthermore, the students will also be trained how to taste the wine professionally.

Eligibility Requirements:
> Basic knowledge of Plant Science and Food Science.
> Preferred: Interest in Grapes and Wine.

Main Tasks:
> Participate in all the steps in wine fermentation.
> Finish a practical report.

Website:
Lab:N/A
School: http://www.agri.sjtu.edu.cn/eng/

Contact Information:
Prof. Kexuan Tang
Email: kxtang@sjtu.edu.cn or kxtang1@163.com
Associate Prof. Qifang Pan
Email : panqf@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: N/A
School: http://www.agri.sjtu.edu.cn/eng/

PHARMACY

PROJECT 101
Introduction to Biotechnology and Antibody Medicine

Contact Information:
Prof. Dawei Li
Email: daweili@sjtu.edu.cn

Project Description and Objectives:
This general project aims at familiarizing students with basic theory and genetic engineering trend in biomedicine using up-to-date techniques.

Eligibility Requirements:
Level 1: Students must have passed basic biology classes.
Level 2: Student must have passed basic molecular cell biology.
Level 3: Students must have biology laboratory experience.

Main Tasks:
(Recommended for level 1 or level2 students)
>   Understand the goals of your projects (dry-lab)
      - This general project aims at familiarizing students with basic theory and genetic engineering trend in biomedicine using up-to-date techniques. Classes will be conducted with a brief lecture of related therapeutic theory and key notes in practice before each laboratory section.
>   Hands-on experimental training (wet-lab)
      - This project includes basic gene design, cloning and testing to finish a basic but complete hands-on project to produce recombinant antibodies and proteins with techniques commonly used in R&D of biomedicine.
>   Report–Analyze-Present your data in PPT format.

Website:
Lab: http://lilab-pharmacy.sjtu.edu.cn/EN/Default.aspx
School: http://pharm.sjtu.edu.cn/

PROJECT 102
R&D in Basic Antibody Medicine and Antibody Engineering

Contact Information:
Prof. Dawei Li
Email: daweili@sjtu.edu.cn

Project Description and Objectives:
The experience in this specialized project is in hot demand- from biotech startups, research institutes and established biopharmaceutical companies alike.

Eligibility Requirements:
Level 1: Students must have passed basic biology classes.
Level 2: student must have passed basic molecular cell biology.
Level 3: Students must have biology laboratory experience.

Main Tasks:
(1)   Understand goals of your projects (dry-lab)
        The experience in this specialized project is in hot demand from biotech startups, research institutes and established biopharmaceutical companies alike. This project will focus on various current aspects in the research and development of antibody medicine, including engineering designs.
(2)   Hands-on experimental training (wet-lab)
        This project focuses on the monoclonal or bi-specific antibody generation and manipulation as well as tumor cell culture and antitumor testing.
(3)   Report–Analyze-Present your data in PPT format.

Website:
Lab: http://lilab-pharmacy.sjtu.edu.cn/EN/Default.aspx
School: http://pharm.sjtu.edu.cn/

MEDICINE

PROJECT 103

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 biopharmaceutics 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 104

Genetic Toxicity Evaluation of Human Induced Hepatocytes (hiHeps) Induced by Aristolochic Acid

Contact Information:
Asso.Prof. Yang Luan
Email: yluan@sjtu.edu.cn

Project Description and Objectives:
Be familiar with the lab, attend and pass the training of new staff, read and memorize the rules and regulations.
Read literature on aristolochic acid and human induced hepatocytes and be familiar with cell culture and passage methods.
Study the genetic toxicity evaluation method and routine combination experiment. It includes the principle, operation, observation and judgment of each experiment.
The cells were treated with aristolochic acid. According to the guiding principles and literatures, the appropriate toxic dose was found through preliminary experiments for the next formal experiment, so as to avoid false positive results caused by excessive toxicity. According to the pre-experimental dose, a formal experiment was conducted. Get the results of all experiments, analyze the results through statistics and biology, write conclusions and write experimental reports and summaries.

Eligibility Requirements:
Fundamentals of chemistry and biology.

Main Tasks:
Understand the principle of genetic toxicity evaluation.

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

Discovery of Relative Biomarkers Using Modern Analytical and Bioinformatics Methods

Contact Information:
Research Assistant Juanjuan Ren
E-mail: juanerren@126.com

Project Description and Objectives:
Schizophrenia and bipolar disorders are severe mental illnesses, which are often accompanied by high mortality rates, comorbidity and economic burdens that result from suicide and other syndromes. Currently, the diagnosis of severe mental illness remains subjective because of its complex spectrum of symptoms. It is urgent to identify biomarkers for their diagnosis. This program is mainly about the discovery of relative biomarkers using modern analytical and bioinformatics methods.

Eligibility Requirements:
If you know about Chinese society, culture, tradition and language, it would be preferred. It will help you grow faster and live a more interesting life during the training period in China. Simple Chinese is preferred, but not required.

Main Tasks:
> Participate in a monthly group seminar.
> Learn the operation of analytical instruments such as LC-MS and electrochemical analyzer.

Website:
Lab: http://www.smhc.org.cn/yixue/shsjswsyjs/info_606.aspx?itemid=747&id=215
School: http://www.smhc.org.cn/index_en.aspx

Study on Pathogenic Genes of Bipolar Disorder in Two-phase Family of Chinese Han Population with the Large Sample Using a Family Cohort Study and Study in MDD Animals

Contact Information:
Research Assistant Hongmei Liu
E-mail: meijiok@163.com

Project Description and Objectives:
Our research focuses on bipolar disorders (BD) and major depressive disorders (MDD). At present, there are few reports of foreign bipolar disorder families and the results are not consistent. There is no research report on the large sample family of Chinese Han population in China. Therefore, it is necessary to expand the family sample size and combine with new genetic research methods in the Han population. Thus, we intend to find out the pathogenic genes of bipolar disorder by collecting the two-phase family of Chinese Han population with the large sample using a family cohort study design, combined with the new generation of high-throughput sequencing technology and Whole Genome Sequencing (WGS), Proteomics, bioinformatics analysis, etc., which is expected to be clarified at the genetic level.
Another research project is about MDD, which is a serious chronic mental disease with high morbidity, high recurrence rate, high suicide rate and high disability. We intend to research the role of transcription factor Nr4a2 played in the mechanism of impaired working memory in the brain and to explore the effective intervention for cognitive dysfunction of depression disorders by adopting male C57BL/6 mice to establish the chronic unpredictable mild stress animal model of depression.

Eligibility Requirements:
If you know about Chinese society, culture, tradition and language, it would be preferred. It will help you grow faster and live a more interesting life during the training period in China. Simple Chinese is preferred, but not required.

Main Tasks:
> Help to understand the mechanism of MDD and BD.
> Close contact and observation of clinical patients of MDD and BD.
> Understanding the process and operation of clinical research.
> Learning the model preparation, research methods and research steps for animal research.

Website:
Lab: http://www.smhc.org.cn/yixue/shsjswsyjs/info_606.aspx?itemid=747&id=215
School: http://www.smhc.org.cn/index_en.aspx

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Determination of Targeted Metabolomics of Amino Acid, Short-Chain Fatty Acid, Neurotransmitter and Determination of Psychoactive Drug Substance in Hair by LC-MS/MS

Contact Information:
Research Assistant Xiujia Sun
Email: sxj013@163.com

Project Description and Objectives:
This research is about Chromatography analysis in biology. One direction that can be taken is through the determination of targeted metabolomics of amino acids, short-chain fatty acids, neurotransmitters, etc. Targeted metabolomics is a quantitative method for the characterization and quantitation analysis of targeted metabolic compounds in organisms. It offers relative or absolute quantitation results of targeted metabolomics. The absolute quantitation results are received through the use of an internal standard. The targeted metabolomics technology has an advantage of high specificity and accuracy. Thus, this method has been widely used to analyze and compare multiple targeted metabolites under different physiological states.
Another direction is the determination of psychoactive drug substance in hair by LC-MS/MS.

Eligibility Requirements:
If you know about Chinese society, culture, tradition and language, it would be best. It will help you grow faster and live a more interesting life during the training period in China. Simple Chinese is preferred, but not required.

Main Tasks:
> Participate in the analyzation of biological samples of Amino acid by LC-MS/MS.
> Participate in the analyzation of biological samples of Neurotransmitter by LC-MS/MS.
> Participate in the analyzation of drugs in hair by LC-MS/MS.
> Take part in weekly seminars and do some paperwork.

Website:
Lab: http://www.smhc.org.cn/yixue/shsjswsyjs/info_606.aspx?itemid=747&id=215
School: http://www.smhc.org.cn/index_en.aspx

108

The Effect on Awareness Rate of Mental Health Knowledge in Shanghai Community Residents

Contact Information:
Research Assistant Ping Jiang
E-mail: jiangping413@126.com

Project Description and Objectives:
This research is about science communication in mental health and other medical fields. One program is the Effect on Awareness Rate of Mental Health Knowledge or other medical knowledge (regulating smoking, osteoporosis) in community residents and remote audiences online. Another program is Organizing Foreign Volunteers (from more than 5 countries: Russian, US, Turkey, Burma, Pakistan……) to Participate in Community Science Communication Services in Shanghai with Talk Show. These new shows in Science Communication are welcomed by both foreign volunteers and resident. The research objective is improving the medical scientific literacy in Chinese with international cooperation. Papers in this field are being written in English and Chinese.

Eligibility Requirements:
If you know something about Chinese society, culture, tradition and language, it would be preferred. It will help you grow faster and live a more interesting life during the training period in China. Simple Chinese is preferred, but not needed.

Main Tasks:
> Participate in 1-2 community popularization science activities with their mentor
> Take part in weekly seminars and do some paperwork
> Try to apply a small program in science popularization with the help of their mentor
> Take part in weekly seminars and do some paper works.

Website:
Lab: http://www.smhc.org.cn/yixue/shsjswsyjs/info_606.aspx?itemid=747&id=215
School: http://www.smhc.org.cn/index_en.aspx

A Histological Study for Acute Stress Affecting Sucrose Self-Administration

Contact Information:
Asso.Prof. Tifei Yuan
Email: ytf0707@126.com

Project Description and Objectives:
Acute stress-induced relapse has been widely verified in clinical studies and animal experiments, but it remains unclear that the effect of acute stress on reinstatement behavior after natural reward (sucrose solution) withdrawal, and its mechanism remains to be investigated. In our previous result, we found that acute stress may affect the sucrose reinstatement. In this project, we will conduct sucrose self-administration (SA) to establish a sucrose-seeking model in mice. We will focus on the differences between the two groups that received acute stress or not before reinstatement test and also search for regions that respond to this acute stress and thus have an impact on the reinstatement of sucrose SA.

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: Shanghai Jiao Tong University

The Neural Circuits for Reward and Aversive Neural Ensembles in the Nucleus Accumbens

Contact Information
Asso. 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. However, due to the heterogeneity of the nucleus accumbens, different neural subpopulations respond to rewarding or aversive stimuli differently. It has not been tested whether these two subpopulations of neurons have a different neural circuit. This project intends to utilize retrograde tracer to label the subpopulation of neurons activated by morphine, investigate the neural circuit, and provide morphology evidence for the neural basis of drug addiction. This project is important for elaborating the circuit basis of addiction in the nucleus accumbens and it is also important for exploring new targets and approaches for addiction treatment.

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

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

Website
Lab: http://tfyuan-lab.strikingly.com
School: Shanghai Jiao Tong University

111

Quality Control Improvement Program of Clinical Laboratory

Contact Information:
Asso. Prof. Huiming Sheng
Email: SHM2783@shtrhospital.com

Project Description and Objectives:
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 420 projects have been carried out. There is 1 master's supervisor, 1 post-doctor, and there are also 11 masters and doctors. There have been several Research projects hosted including the National Natural Science Foundation of China and more than 10 municipal-level or district-level projects. We have more than 100 papers in SCI or Chinese journals published, and one patent has been approved.
This program is going to promote international cooperation and communication as well as share experiences in improving quality control of the clinical laboratory. Through this program, students will have a deeper understanding of quality control and laboratory management.

Eligibility Requirements:
> Willing to learn about quality control of the clinical laboratory.
> Interested in experimental operations.

Main Tasks:
> Learn about mechanism and protocols of various projects carried out by 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

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

Contact Information:
Prof. Kun Tao
Email: taokun20119@163.com

Project Description and Objectives:
The application of IL-38 is the precise target therapy of colorectal cancer based on single cell analysis and clinic pathological study. In this study, we will start with the single cell analysis of colorectal cancer cells and tissue samples and explore the value of IL-38 in the target treatment of colorectal cancer by cell culture, RT-PCR, Western Blot and other methods.

Eligibility Requirements
Students should master some experimental techniques such as cell culture, tissue preparation, immunohistochemistry, FISH, RT-PCR, Western blot and so on.

Main Tasks:
Starting with cell culture, protein extraction, gene isolation, purification and identification, protein localization and so on, we can help students master the commonly used experimental methods and skills in pathological research. Based on this, students will have an overall grasp of the application and significance of molecular biology methods. What's more, we will provide a variety of experimental materials for students to design and prepare experiments on their own, so as to cultivate independent scientific research ability.

Website:
Lab: http://blk.shtrhospital.com
School: http://www.shtrhospital.com

Mechanisms of Long Non-coding RNA FENDRR Affecting Metastasis of Colon Cancer by Regulating PBXIP1 Expression

Contact Information:
Prof. Kun Tao
Email: taokun20119@163.com

Project Description and Objectives:
Mechanisms of long non-coding RNA FENDRR affect the metastasis of colon cancer by regulating PBXIP1 expression. In this study, we will study the changes of FENDRR and PBXIP1 gene and protein expression in colon cancer cell lines and fresh tissues and the changes of invasiveness of colon cancer cell lines before and after gene knockout, so as to reveal the relationship between FENDRR and PBXIP1 and the mechanism of colon cancer metastasis.

Eligibility Requirements:
Students should master some experimental techniques such as cell culture, tissue preparation, immunohistochemistry, FISH, RT-PCR, Western blot and so on.

Main Tasks:
Starting with cell culture, protein extraction, gene isolation, purification and identification, protein localization and so on, we can help students master the commonly used experimental methods and skills in pathological research. Based on this, students will have an overall grasp of the application and significance of molecular biology methods. What's more, we will provide a variety of experimental materials for students to design and prepare experiments on their own, so as to cultivate independent scientific research ability.

Website:
Lab: http://blk.shtrhospital.com
School: http://www.shtrhospital.com

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 a 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

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, and tumorigenic observation, karyotype analysis, etc.
2. Construction of human xenograft model: Humanized tumor models were constructed and transplanted into immunodeficient mice by patient-derived ones. These tumor models were 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 model.

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

Mapping New Causal Genes for Glomerulonephritis

Contact Information:
Prof. Jingyuan Xie
Email: nephroxie@163.com

Project Description and Objectives:
This lab is focusing 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 researching 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) were performed for novel mutations to reveal their exact pathogenic mechanism. Through the above works, we aim to better understand the genetic basis of glomerulonephritis and contribute to the precision medicine in the near future for the patients.

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
117

Molecular Biology of Leukemia and Targeted Cancer Therapies

Contact Information:
Prof. Ruibao Ren
Email: rbren@sjtu.edu.cn

Project Description and Objectives:
The laboratory is working to delineate the molecular mechanism in the pathogenesis of leukemia, create precision diagnostics of leukemia, as well as the develop novel targeted cancer therapies. The major research areas include: (1) Intergrading the whole genome deep sequencing hotspot panel sequencing, and with this aim to reveal the composition and evolution pattern of leukemia clones, to identify the molecular targets that drive drug resistance and disease relapse, and eventually to establish a novel molecular diagnostic system based on the leukemia clonal evolution patterns; (2) Identification of therapeutic targets and development of targeted therapies for RAS-related cancers. Hyperactivation of RAS is common in human cancers, including in hematological malignancies. However, RAS protein itself has been difficult to "target", making the cancers harboring RAS mutations the most difficult to treat. By using molecular biology and chemical biology approaches, we aim to identify therapeutic targets and develop novel targeted therapies for RAS related cancer; (3) Mechanisms of anti-tumor activity of innate immune system and novel drug discovery and development. We study the roles of Interferon Response Factors IRF4/8 in leukemogenesis and try to develop novel anti-tumor immunotherapies.

Eligibility Requirements:
Basic knowledge of genetics and molecular biology.

Main Tasks:
Bioinformatic analysis, identification and characterization of anti-cancer compounds.

Website:
Lab: N/A
School: http://www.sih.org.cn

PROJECT
118

Research on Spatial Experience Design based on the Study of User Needs

Contact Information:
Prof. Linong Dai
Email: Lndai@126.com

Project Description and Objectives:
To design a spatial experience, we should first understand the user's need for this space. By investigating the behavior of users and finding out their physiological and psychological needs, we can formulate the design goals of spatial experience. By comparing with other countries it will become a cross-cultural comparative study.

Eligibility Requirements:
All students having design a background can apply. Students who have attended design research or design psychology are preferred. Students with backgrounds in architecture and interior design might do better than students major in other design areas. Students from other area are acceptable but should contract by e-mail beforehand.

Main Tasks:
>   Conduct the behavior observation to the user.
>   Interview users to understand their needs.
>   Figure out the relationship between user needs and spatial experience design.
>   Understand cross cultural comparison.

Website:
Lab: http://dschool.sjtu.edu.cn/home/international/enroll/detail/e9225c60-3973-493d-8ebc-fe5f60459c6b
School:
http://dschool.sjtu.edu.cn/en/index
http://dschool.sjtu.edu.cn/home/international/enroll/research

Research on User Experience Design Based on the Study of User Needs

Contact Information
Prof. Linong Dai
Email: Lndai@126.com

Project Description and Objectives
To design user an experience, we should firstly understand the user's need for the product. By investigating the behavior of users and finding out their physiological and psychological needs, we can formulate the design goals of user experience. By comparing with other countries, it will become a cross-cultural comparative study.

Eligibility Requirements
All students having a design background can apply for. Students who have attended design research or design psychology are preferred. Students with backgrounds in product design and media design might do better than students major in other design areas. Students from other area are acceptable but should contract by e-mail beforehand.

Main Tasks
Conduct the behavior observation to the user.
Interview users to understand their needs.
Figure out the relationship between user needs and user experience design.
Understand cross cultural comparison.

Website
Lab: http://dschool.sjtu.edu.cn/home/international/enroll/detail/e9225c60-3973-493d-8ebc-fe5f60459c6b
School: http://dschool.sjtu.edu.cn/en/index
http://dschool.sjtu.edu.cn/home/international/enroll/research

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 great influence in 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 by urban planning in architectures. 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: http://dschool.sjtu.edu.cn

UM-SJTU

121

Elderly Care Robot Development and Deployment

Contact Information:
Dr. Mingjian Li
Email: mingjian.li@sjtu.edu.cn

Project Description and Objectives:
According to the latest reports, China has 15.8 million residents aged more than 65, and 24.1 million aged more than 60 (as of 2017). Its population aging speed is number one and has been for many years. As the populations 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 service like medicine delivery etc.

Eligibility Requirements:
Basic knowledge of:
> Mechanical engineering
> Programming language

Main Tasks:
> To build a simple "elderly care" scenario using KT board etc.
> To program and practice a brand new service robot.
> Deploy the robot in "elderly care" scenario and perform medicine delivery task.

Website:
Lab: http://umji.sjtu.edu.cn/about/administrative-offices/teaching-lab-service-office/
School: http://umji.sjtu.edu.cn/

122

Numerical Solution of the Phonon Boltzmann Transport Equation: Algorithm Development and Optimization

Contact Information:
Asso. 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:
1. Develop highly efficient hybrid Fourier-BTE solver to handle large non-gray transport problem.
2. Implement and optimize advanced algorithms to optimize the code, including but not limited to sparse matrix solver, parallel computing (using MPI/OpenMP).
3. Assist graduate students to conduct some calculations.

Website:
Lab: http://caces.sjtu.edu.cn/
School: http://umji.sjtu.edu.cn/

CHINA-UK LOW CARBON

PROJECT 123

Research on the Coordinated Control of SOFC/GT Hybrid System Based on Safety Margin

Contact Information:
Asso. Prof. Xiaojing Lv
Email: lvxiaojing@sjtu.edu.cn

Project Description and Objectives:
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 safety margin, operation characteristics, electrochemical reaction characteristics, develop an 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 hybrid system from theory research to actual application.

Eligibility Requirements:
> Knowledge of laboratory safety should be mastered.
> Basic knowledge/coursework in advanced energy systems, thermodynamics, or electrochemistry engineering.
> Students who have experiences in labs is 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 124

Preparation of Biodegradable Plastics from Waste Shells

Contact Information:
Asso. 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 may be applied to solve problems in the projects mainly including 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 relevant backgrounds (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
125

Performance Enhancement of a Novel CO2 based Refrigerating System Using Nano-coated Heat Pipes

Contact Information:
Asso.Prof. Yanping Du
Email: yanping.du@sjtu.edu.cn

Project Description and Objectives:
Refrigerating systems in the current market suffer from restrains with a bottleneck of low coefficient of performance (COP) due to the inefficient heat transfer ability resulted from conventional cooling strategies adopted in the systems. Not only that, but the conventional refrigerants used have a severely negative influence on the ozonosphere (O3) of the earth, which urgently needs to be substituted. In this regard, the research team led by Dr. Du developed a nano-coated heat pipe for an enhanced heat transfer and used carbon dioxide (CO2) as the substitute, aiming to improve the cooling as well as the wicking in the condenser and the evaporator, respectively. Thermodynamic properties of different refrigerants including R22, R410a and CO2 are to be tested. The cooling effect will be evaluated using the principle of energy conservation. The variation of the refrigerating capacity needs to be calculated in corresponding scenarios. A special focus will be given on the comparison of the systematic COP using dominant compressors that have a big difference in cost. Overall, the project is towards researching a highly-efficient, low-cost and environment-friendly product leading to a green and sustainable future.

Eligibility Requirements:
> Proficient English skills.
> Major in Energy and Power Engineering or relevant subjects.
> Proactive, responsible and easy to work with.

Main Tasks:
> Experimental system construction.
> Experiments implementation to obtain the thermodynamic properties of different refrigerants including R22, R410a and CO2.
> Evaluation of the refrigerating capacity, power consumption and COP under different conditions.
> Simulation using ANSYS should be done to compare with experiments
> Final report to be submitted at the ending of the research program.

Website:
Lab:N/A
School: http://lcc.sjtu.edu.cn/En/Default

⊃ **SYSTEMS BIOMEDICINE**

PROJECT
126

Mechanisms of New Targets in Tumor Metastasis and Development of Therapeutic Methods

Contact Information:
Prof. Fang Guo
Email: fguo@sjtu.edu.cn

Project Description and Objectives:
Our lab focuses on searching for drug targets which can inhibit tumor metastasis. The earlier work has indicated that AEP had a great effect on breast cancer metastasis. Thus, the later work will focus on searching for small molecule inhibitors of AEP, antitumor prodrugs, and therapeutic antibodies. In addition, the later work will provide depth on the mechanism of AEP in a tumor microenvironment and a tumor-associated macrophage.
This project mainly focuses on searching for the inhibitors of Bcl-2 (including natural products and derivatives) and setting up appropriate tumor animal models to study the efficacy and molecular mechanism of microwave hyperthermia chemotherapy and microwave hyperthermia immunotherapy. With clinical trials, our research will provide theoretical support for the new tumor therapy.

Eligibility Requirements:
The interested student should have a basic knowledge of Molecular biology technology.

Main Tasks:
> Finish a research report.
> Give two research presentations (1. References review; 2. Technical presentation).
> Submit one paper to journal as a co-author.

Website:
Lab: N/A
School: http://scsb.sjtu.edu.cn/xtswyx/homeen.do?method=getHomeList

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 closely associates 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 the efficient biomarkers for immunotherapy response is of great importance for precise medicine. In this project, we are combining the advanced glycomics technologies with other approaches such as glycobiology and cell biology to find the 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/