Research Exchange at Beihang University

Academic Year 2018-2019

International Division
Beihang University

List of Research Projects

Notes: These projects are all in English and based at 12 schools.

18F01: School of Materials Science and Engineering
18F02-07: School of Automation Science and Electrical Engineering
18F08-19: School of Mechanical Engineering and Automation
18F20-26: School of Economics and Management
18F27: School of Computer Science and Engineering
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18F31-36: School of Aeronautic Science and Engineering
18F37-39: School of Transportation Science and Engineering
18F40-41: School of Physics and Nuclear Energy Engineering
18F42-43: School of Law
18F44: School of Astronautics
18F45: School of Instrumentation Science and Opto-electronics Engineering

How to apply:

Applicants themselves should first contact prospective supervisors by sending a CV and a motivation letter. Please copy international@buaa.edu.cn when you contact a professor.

For detailed application procedures and assistance, please visit:
http://global.buaa.edu.cn

18F01 - Aniline oligomer derivatives with mechanochromic and aggregation-induced emission characteristics

Supervisor

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School

School of Materials Science and Engineering

SPECIALIZATION

Functional materials, special adhesives and composite materials development

PROJECT DESCRIPTION

Organic light emitting materials have advantages of small power consumption, large viewing area, organic molecules, non-electromagnetic radiation, processing performance, good environmental resistance, etc. Meanwhile, the organic light-emitting materials with molecular structure determination, which are easy to synthesis, are more conducive to study the relationship between structure and properties of materials.

Aggregation-induced emission (AIE) phenomenon can be a good solution to solve the fluorescence quenching effect, at the intersection of optoelectronic devices, photo storage, logic gates, and others which have a wide range of potential applications.

Our research will design and synthesis a series of aniline oligomer derivatives with various enamine fragments by amine-aldehyde reaction. Based on these aniline oligomer derivatives with specific molecular weight, we will further investigate their AIE properties with the effects of chain length, content and sequence structure of enamine fragments and types of end group.

Thus, as the system of aniline oligomer derivative materials are built, AIE luminous mechanism will be widely developed.

STUDENT ROLES

The student will learn to experiment independently and use material testing instrumentations.

REQUIRED SKILLS

Organic synthesis, polymer and/or optical chemistry

Students interested in this project should have a basic knowledge in organic chemistry and a strong work ethic and interest in learning a range of instrumentations.

18F02 - Distributed parameter modeling and control of flexible manipulator

Supervisor

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School

School of Automation Science and Electrical Engineering

SPECIALIZATION

I have published more than 100 research papers and eight books. My research interests include as follows.

(1) Intelligent Control and Sliding Mode Control;

(2) PDE modeling and boundary control;

(3) Application area is related to motion control, such as flight control and robotic control, etc. especially for under-actuated systems.

PROJECT DESCRIPTION

The optimal trajectory control problem for a two-link rigid-flexible manipulator is considered. Since the two-link rigid-flexible system is a distributed system, an ordinary differential equation and partial differential equation(ODE-PDE)dynamic model of the manipulator is established by Hamilton's principle. Energy consumption and deflection of the flexible link are chosen as performance indexes. The aim is to regulate two joints to follow the ideal trajectory and simultaneously suppress vibration of the flexible link. In simulations, the effectiveness of the optimal control scheme is verified by MATLAB. .

STUDENT ROLES

Distributed parameter modeling and advanced boundary controller design for the flexible manipulator system. Stability analysis for the proposed control is needed, for the control algorithm, the practical design examples and MATLAB codes are needed.

REQUIRED SKILLS

Students interested in this project should have a basic knowledge in control theory and control engineering. The project requires a

good foundation in Mathematics and a strong work ethic and interest in learning a range of robot control.

18F03 - Object detection and tracking based on deep learning and Unmanned Aerial Vehicle

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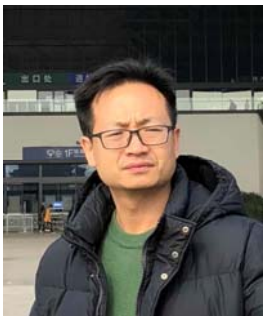
School

School of Automation Science and Electrical Engineering



SPECIALIZATION

I received the B.S., M.S. and Ph.D. degrees in Computer Science from Harbin Institute of the Technology, Harbin, China, in 1999, 2001, and 2006, respectively. From 2006 to 2008, I was a research fellow with the Chinese University of Hong Kong, Hong Kong, and with Griffith University, Brisban, Australia. From 2015 to 2016, I hold a senior postdoc position in IIT, Italy. Currently, I am an associate professor with the Science and Technology on Aircraft Control Laboratory, School of Automation Science and Electrical Engineering, Beihang University, Beijing, China. I am supported by the Program for New Century Excellent Talents in University of Ministry of Education of China. My current research interests include deep learning, UAV, pattern recognition, object tracking, Radar signal analysis, face recognition, and wavelets. I had published 80 papers on the top journals including IJCV, Automatica, IEEE Transactions, CVPR, IJCAI. More details can refer to our website: https://github.com/bczhangbczhang/ or mpl.buaa.edu.cn or google by my name.

PROJECT DESCRIPTION

The proposed research project is to design and implement an Image-Based Visual Servoing (IBVS) strategy for controlling a low-cost UAV to follow a detected object via monocular camera. The detection framework is based on deep learning to achieve the superior accuracy in detection task and will be optimized to work on real-time. To track the detected target, the tracking-by-detection approach is applied to analyze the spatiotemporal properties of the detected targets across video sequences. After tracking the target successfully, its geometry and location in the image plane are used as an IBVS to steer the UAV. Thus, it will keep the tracked target within a fixed distance and almost in the center of its Field of View (FoV). The whole system components

(The deep neural network detector, the tracker, and the IBVS) are built as nodes under the ROS (Robot Operating System) environment to ease the interaction with each other and the UAV. The system is verified to work off-board with a ground station machine with the Parrot bebop 2 micro UAV and onboard with the recently Jetson TX2 NVIDIA GPU board.

STUDENT ROLES

The student will be actively engaged in working on cutting-edge topics in a multi-disciplinary environment. During the Project sessions, students will apply their knowledge about deep learning to design and implement this UAV-target following system so they will interact with a real implementation of the system by programming it to control the UAV. This real implementation and UAV interaction will improve their motivation remarkably..

REQUIRED SKILLS

Computer Vision, and Programming.

Students interested in this project should have a basic knowledge in Computer Vision, at least at the fundamentals of the Digital Image Processing (DIP). Also, a basic knowledge of machine learning is required. The project needs your interest in learning a range of knowledge.

18F04 - Robotics and actuation technology

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School

School of Automation Science and Electrical Engineering

SPECIALIZATION

My research focuses on robotics and high performance actuation technology. Specifically, our research interests are mainly centered on following topics:

(1) Robotics: Industrial robots, Parallel and serial robots, Capsule robots, Entertainment robots, Modular robots.

(2) Unmanned aerial vehicle (UAV): Ornithopter with different sizes.

(3) Actuation technology: Multi-DOF spherical actuators, Permanent magnet linear machines, Reluctance-switching linear machines, Rotary machines, Micro-actuators, Piezoelectric actuators.

PROJECT DESCRIPTION

The students can join two types of research projects:

(We may accept two candidates if they are qualified.)

1. Development of hybrid robotic system: Parallel or serial robots are widely used in industries. Generally, parallel robot can achieve high-stiffness and high-precision motions. However, its workspace is relatively small. To solve this problem, we proposed one hybrid robot, i.e., combining both serial and parallel mechanisms. Coarse-fine manipulation technology will be employed for the control purpose.

2. Development of high-performance electromagnetic actuators: The output performance of electromagnetic machines is mainly determined by the magnetic flux density and current input in the system. The maximum current input is generally constrained by the thermal effect. Therefore, increasing flux density is one good option to achieve high force or torque output of electromagnetic devices. Our target is to increase the system power density, i.e., we

try to reorganize the magnet arrays in the machine so that the flux density can be increased in the same volume.

STUDENT ROLES

The student will be actively engaged in working on cutting-edge topics in a multi-disciplinary environment, and will receive significant training on robotics, electromagnetic, and electric machines. Specifically, the candidate will learn how to use mechanical software to design robotic systems and analyze their motions in three-dimensional space (for projects on robot design), or finite element software to analyze magnetic field distribution and force torque output of electromagnetic machines (for projects on actuation design). Control algorithm could be considered to complete various tasks of the robotic systems, or improve the output performance of electric machines.

REQUIRED SKILLS

Fundamentals of mechanical design

Students interested in this project should have a basic knowledge in mechanical design, at least at the second year level (general mechanical design knowledge, introductory mechanical components and some laboratory work are typical at this stage). Students in mechanical, electrical or automation engineering usually have the necessary background. The project requires a strong work ethic and interest in learning a range of instrumentation.

18F05 - Multi-sensor Integrated Navigation System

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School of Automation Science and Electrical Engineering
Director, Centre of Digital Navigation

SPECIALIZATION

My research focuses on the design of multi-sensor integrated navigation system, especially INS/GNSS integrated navigation system.

PROJECT DESCRIPTION

Multi-sensor integrated navigation system (MINS) is one of major development trends in the field of positioning and navigation, which can achieve accurate and reliable positioning and navigation on the fusion of multi-sensor information. It can make effective compensation for the drawbacks of the single navigation system, for which reason it has broad application in all aspects of modern society. However, the design and implement of MINS regarding data processing, the integrated model and fusion algorithm still face tremendous challenges.

Our team will carry out research activities mainly focused on INS/GPS integrated navigation system aided by other techniques, such as terrain-matching, context-awareness and vision navigation, etc. There is no doubt that fusion of the multi-resources information on the data level will lead to the great enhancement in performance of accuracy and reliability. It remains a compelling interest of many researchers home and abroad and numerous studies have been done in this area.

A qualified candidate should develop the integrated navigation system by improvement of the existing model and algorithm or fusion information from other sensors.

STUDENT ROLES

The student are actively encouraged to work on hotspots in the area of integrated navigation system. Specifically, the candidate will learn the basic knowledge of inertial navigation system, satellite navigation system and other necessary navigation

methods, and design the algorithm of INS/GPS integrated navigation system. Acknowledgement of various filtering methods is demanded as well. Above all, it is our first concern to realize the improvement of the positioning and navigation performance and its applications.

REQUIRED SKILLS

It is the basic requirement he/she should be equipped with adequate professional background and excellent programming capabilities (C/C++/MATLAB). Students holding a degree in related majors, such as especially automation, surveying and mapping, mathematics and computer science is welcome

18F06 - Indoor positioning and navigation

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SPECIALIZATION

My research focuses on the geophysical navigation, vision navigation and all source navigation.

PROJECT DESCRIPTION

WiFi devices are visible everywhere and the signals are easy to capture and thus WiFi positioning is a hot research in indoor positioning. The methods for indoor positioning are Time Of Arrival (TOA), Time Difference of Arrival (TDOA), Received Signal Strength Indicator (RSSI), Angle-of-Arrival (AOA). The WiFi positioning method is generally RSSI. However, to become commercially viable, WiFi positioning have to overcome the stable of signals and the cost of manpower and material resources.

Our research will apply interpolate method (Bilinear, Gaussian Process Regression, Kriging, Inverse Distance Weighted and so on) to address the cost of manpower and material resources and research signal propagation law in order to model the signal propagation law using mathematical formula, as much as possible to restore the signal to overcome the stable of signals. It is well accepted that the stable of signals could be greatly enhanced by modulating their propagation law.

The successful candidate will develop a WiFi signal processing and positioning system and publish a SCI article on the basis of this project.

STUDENT ROLES

The student will be actively engaged in working on this project from start to finish, and will receive significant training on positioning methods, signal propagation law, programming method and modeling ideas. Specifically, the candidate will learn how to model the signal propagation law and further to predict

the RSSI of unknown point on the basis of some known information.

REQUIRED SKILLS

Automation, Electronic Information, Statistics or Electrical Automation.

Students interested in this project should have a basic knowledge in data processing. Students in automation, statistics, electronic Information or electrical automation usually have the necessary background. The project requires a strong work ethic and interest in learning a range of instrumentation.

18F07 - Multi-Source information aided GNSS Precise Point Positioning

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SPECIALIZATION

My research focuses on the geophysical navigation, vision navigation and all source navigation.

PROJECT DESCRIPTION

Precise Point Positioning (PPP) is one of high precise positioning technologies based on global navigation satellites system, which has many advantages that high precision, simple structure, global and all weather and thus have the potential to provide precise positioning service in dynamic environments, however, to become more widely negotiated, PPP have to overcome the longer convergence time, continuity and stability issues.

Our research will apply multiple source information to address the above challenges in PPP. The proposed research project is to use the aided location information (e.g inertial navigation, wide-area difference information) and adaptive fusion algorithms for accelerating initial convergence and improving continuity and stability.

STUDENT ROLES

The student will be actively engaged in working on cutting-edge topics in a multi-source information fusion, and will receive significant training on satellites navigation, inertial navigation, and integrated both of them. Specifically, the candidate will learn how to use multiple sensor information to enhance the reliability and continuity of precise point positioning.

REQUIRED SKILLS

Navigation and guidance, Satellite Navigation or Inertial Navigation

Students interested in this project should have a basic knowledge in satellite navigation and inertial navigation, at least at the second year level (generalized l measurement principle, introductory satellite navigation and some laboratory work are typical at this stage). Students in mathematics, physics or control engineering usually have the necessary background. The project requires a strong work ethic and interest in learning a range of instrumentation.

18F08 - Wire + arc additive manufacturing (WAAM) for large scale aluminum alloy components

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School of Mechanical Engineering and Automation

SPECIALIZATION

Our research focus on high frequency pulsed welding of aluminum alloys, titanium alloys and stainless steels using gas tungsten/metal arc welding (GTAW/GMAW); welding metallurgy of aluminum alloys, titanium alloys and stainless steels; weld formation and solidification behavior. Currently we have a large research activity on additive manufacture (AM) using weld build up for aerospace applications.

This activity is led by Dr. CONG and we have three Ph.D. and several master students as well. The research is also partly carried out in collaboration with Prof. Stewart Williams in Cranfield University, UK. The focus for this work has so far mainly been high strength aluminum alloy but we are also moving on to titanium parts. The objective would be to contribute to the research effort with a view to pushing the technology.

PROJECT DESCRIPTION

Aluminum alloys have been widely applied in aeronautic and aerospace industry due to their excellent strength, fracture properties and good corrosion resistance. The conventional method of manufacturing aluminium alloy components is using subtractive processes which machine the component out of a solid alloy block. The massive amount of waste cannot satisfy the continuously increasing requirements of sustainable, clean and resource-efficient. Wire + arc additive manufacturing (WAAM) is becoming more popular due to its high deposition rate, low production cost and the capability for fabricating large-scale components, compared with other additive manufacturing (AM) processes. Nowadays, there is a requirement from aerospace industry to apply WAAM technology for manufacturing aluminum alloy structures.

The proposed research project is to apply WAAM technology to manufacture large scale aluminum alloy components. Different arc modes, such as VP-GTAW, HPVP-GTAW, CMT, pulsed CMT and pulse advanced CMT, and different filling wires, such as ER2319, ER5087, ER5356, ER6061 and some special materials, will be employed for building components. The characteristics, such as formation, microstructure, porosity and mechanical properties, of fabricated components will be investigated in detail. All these studies will contribute to the application of WAAM aluminum alloy in aerospace industry.

(1) Single-wire WAAM aluminum alloy with gas tungsten arc welding (GTAW) process: commercial and special materials;

(2) Double-wire WAAM aluminum alloy with GTAW process: Al-Cu + Al-Mg; Al-Mg + Al-Si, et al;

(3) WAAM aluminum alloy with hybrid pulse variable polarity gas tungsten arc welding (HPVP-GTAW) process, which was developed by our team;

(4) WAAM aluminum alloy with gas metal arc welding (GMAW) process, specially with different cold metal transfer (CMT) variants.

STUDENT ROLES

The student will be actively engaged in working on WAAM topics, and will receive significant training on aluminum alloy WAAM process and theoretical analysis of fabricated structure characteristics. Specifically, the candidate will learn how to build components using WAAM process, how to perform microscopic characterizations, including optical microscope (OM), scanning electron (SEM), electron backscatter diffraction (EBSD), X-ray diffraction (XRD) analysis, etc., and how to perform mechanical properties, including micro-hardness and tensile strength, etc.

REQUIRED SKILLS

Metal material science, and/or welding.

Students interested in this project should have a basic knowledge in metal material science or welding, at least at the second year

level (metal material welding and some laboratory work are typical at this stage). Students in materials processing engineering or metal materials science and engineering usually have the necessary background. The project requires a strong work ethic and interest in learning a range of instrumentation.

18F09 - Laser processing for novel micro-/nano-structures

Supervisor

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School

School of Mechanical Engineering and Automation

SPECIALIZATION

Prof. GUAN's current research interest focuses on laser material processing, laser-based additive manufacturing and hybrid laser fabrication for surface functionalization.

PROJECT DESCRIPTION

Laser surface processing has been considered as an advanced alternative over conventional counterparts to improve the surface properties of materials. Moreover, short processing time, flexibility in operation, economy in time/energy/material consumption, shallow heat affected zone, and precision are the important advantages of laser processing methods.

Our research will apply recent laser surface technologies to address main challenges including optical properties, corrosion protection, wear resistance, cell adhesion in both metallic materials and controlled features in nanomaterials. The proposed research project is to fabricate new types of surface and subsurface structure such as noble micro-/nano-structures (e.g. dots, groves, etc.) for both nanomaterials and Ti-based or Mg-based alloys. The successful candidate will develop two-dimensional (2D) and three-dimensional (3D) noble micro-/nano-structures for aerospace and biomedical applications.

STUDENT ROLES

The student will be actively engaged in working on cutting-edge topics in a multi-disciplinary environment, and will receive significant training on material processing, characterization, and properties measurement. Specifically, the candidate will learn how to use short pulse laser technology to fabricate various noble micro-/nano-structures and further to control their

morphology and how to perform microscopic characterizations, including scanning electron (SEM), transmission electron microscopy (TEM), high resolution transmission electron microscopy (HRTEM) imaging, X-ray diffraction (XRD) analysis, thermal measurement, process simulation and optimization, etc.

REQUIRED SKILLS

Metallurgy, Biomaterials, Mechanical Engineering, Materials Science and Engineering

Students interested in this project should have a basic knowledge in physics or materials, at least at the second year level. Students in material science, physics or chemical engineering usually have the necessary background. The project requires a strong work ethic and interest in learning a range of instrumentation.

18F10 - Flow and fluid-solid interaction in soft porous medium

Supervisor

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School

School of Mechanical Engineering and Automation
Center of Soft Matter Physics and its Applications

SPECIALIZATION

My research focuses on the understanding of the physics and mechanical behaviors of soft mater systems, including colloids, hydrogel, polymer composites, complex fluids, and biological materials, as well as the development of novel multi-function materials for emerging flexible electronic and soft robitics applications. Specifically, our research interests are mainly centered on four topics:

(1) Drying-induced structure formation and fracture in micro/nano particle colloidal suspensions;

(2) Self-assembly of anisotropic nanoparticles, i.e. nanorods, nanodisks, and nanowires;

(3) Fluid-solid interaction at soft interfaces and soft porous medium;

(4) Mechanics of hydrogels, cells, and tissues: heterogeneous deformation, adhesion, and friction

PROJECT DESCRIPTION

Fluid-saturated porous materials, including shales, clays, hydrogels, dense nanoparticle packings, and even biological tissues, span over a wide range of length scales. They serve as networks for fluid transport, and can swell or shrink under changing fluid pressure. This change can lead to localized stresses and even to mechanical failure. This phenomenon is of importance to oil industry, material design, and tissue engineering. Understanding the fracture mechanics in those materials is crucial to many applications such as improving hydraulic fracturing techniques, developing crack-free nanoparticle-based functional materials, and designing reliable biological tissues for regenerative medicine.

This project will utilize cutting-edge imaging techniques, including fluorescent imaging, confocal microscopy, X-ray microCT, to investigate the three-dimensional flow and deformation in model soft porous materials in real time. By quantify the effect of deformation of solid network on the flow behaviors, we aim to understand and control of flow in soft porous materials.

STUDENT ROLES

The student will be actively engaged in working on cutting-edge topics in a multi-disciplinary environment, and will receive significant training on optical imaging, image analysis, statistical analysis, micro/nanofabrications, materials characterization. Specifically, the candidate will learn the preparation of nanoparticle suspension, observation using fluorescent and polarized optical microscopy, digital image analysis with PIV and particle tracking, as well as mechanical measurements including rheometer and nano-indentation.

REQUIRED SKILLS

Physics, solid mechanics, fluid mechanics, or materials science

Students interested in this project should have a basic knowledge in physics, chemistry, and mechanics at least at the second-year level (general chemistry, introductory thermodynamics and some laboratory work are typical at this stage). Students majored in physics, materials science, mechanical engineering, or chemical engineering usually have the necessary background. The project requires a strong interest in learning new concepts and working in a multidisciplinary environment.

18F11 - Adhesion and friction at soft interfaces

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School of Mechanical Engineering and Automation
Center of Soft Matter Physics and its Applications

SPECIALIZATION

My research focuses on the understanding of the physics and mechanical behaviors of soft mater systems, including colloids, hydrogel, polymer composites, complex fluids, and biological materials, as well as the development of novel multi-function materials for emerging flexible electronic and soft robitics applications. Specifically, our research interests are mainly centered on four topics:

(1) Drying-induced structure formation and fracture in micro/nano particle colloidal suspensions;

(2) Self-assembly of anisotropic nanoparticles, i.e. nanorods, nanodisks, and nanowires;

(3) Fluid-solid interaction at soft interfaces and soft porous medium;

(4) Mechanics of hydrogels, cells, and tissues: heterogeneous deformation, adhesion, and friction.

PROJECT DESCRIPTION

Due to the low elastic moduli of soft materials, the contribution of interface energy is often comparable to, or sometimes even dominating, that of bulk strain energy. The interplay of surface and bulk elastic energy of soft materials gives rise of interesting and often surprising behaviors in wetting and adhesion that are different from their hard counterparts, as well as some unique interface phenomena such as wrinkling. The traditional understanding of interface mechanics often ``breaks down" in those cases. A more accurate understanding on interface mechanics of soft materials is essential in integrating soft materials into more applications including tunable water condensation for thermal transport, as well as biocompatible implantation materials.

The goal of this project is to better understand how soft materials interact with fluid, solids, and biological systems. This project will address this problem by exploring the microscopic details of complex fracture mechanics at those soft interfaces. Using Traction Force Microscopy (TFM), a technique adapted from cell mechanics, we will map out the stress and strain distribution at soft interfaces and understand the effect of geometry and heterogeneity on the adhesion and friction at soft interfaces.

STUDENT ROLES

The student will be actively engaged in working on cutting-edge topics in a multi-disciplinary environment, and will receive significant training on optical imaging, image analysis, statistical analysis, micro/nano-fabrications, materials characterization. Specifically, the candidate will learn the preparation of elastomer samples, setting up *in situ* mechanical testing system, observation using fluorescent and polarized optical microscopy, digital image analysis with PIV and particle tracking, as well as mechanical measurements including rheometer and nano-indentation.

REQUIRED SKILLS

Physics, solid mechanics, or materials science

Students interested in this project should have a basic knowledge in physics, chemistry, and mechanics at least at the second-year level (general chemistry, introductory thermodynamics and some laboratory work are typical at this stage). Students majored in physics, materials science, mechanical engineering, or chemical engineering usually have the necessary background. The project requires a strong interest in learning new concepts and working in a multidisciplinary environment.

18F12 - 3-D Magnetically Driven Microrobot for High-speed and High-precision Clone Technology

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School of Mechanical Engineering and Automation

SPECIALIZATION

Current Major Research Area: Micro- and Nano-Robotics and Intelligent Systems, Bio-Robotics, On-chip Robotics, Application to Bio-medical Science and Engineering

A micromechanical manipulator is widely used for medical and life science applications because of its capability for high accuracy, high power output, and flexibility of the manipulation. However, the manipulation is conducted in an environment open to the air due to the huge size of the manipulator and it leads to cell contamination issues. Therefore, based on the traditional microfluidic chip, microfluidic chip with microrobot operation is a major revolution in the true sense of the lab on a chip. The international challenge is to achieve non-contact micro-manipulation with high output power and high precision.

PROJECT DESCRIPTION

Non-contact magnetically driven microrobot on a microfluidic chip

Robot is one of the promising tools for the treatment of biological cell instead of human handling, due to its non-skill dependent, high throughput, and repeatable properties. Integration of the microfluidic chip and robotics based on micro and nanotechnology is key issue for biomedical innovations. In addition to the advantage of environmental control by microfluidic chip, robot enables physical operation to the cell with high throughput. In order to obtain advantages of both of microfluidic device and micromechanical manipulator, we have proposed micro and nano robot on a microfluidic chip. The on-chip robot has great potential to achieve accurate cell measurement and manipulation for broad range of biological applications with high throughput by taking advantage of flow control of microfluidic chip. In additions, the cost of the on-chip robot is generally low owing to the small size

of the probe and microfluidic chip, and thus some parts are disposable after the operation. Furthermore, closed or partially opened design of microfluidic chip also helps to prevent cell contamination as well as to provide stable and secure environment for the robot actuations.

STUDENT ROLES

The student will be actively engaged in working on design a microrobot and improve the current microrobot manipulation system. The students need to use the simulation software to make a robot, and try to analyze the function of the microrobot. On the other hand, a manipulation system using electromagnetic coil or permanent magnet will used for actuation system. The manipulation system is better to conduct the cell manipulation process automatically; therefore, the online image processing with feedback control will be applied in the system.

REQUIRED SKILLS

Mechanics/simulation/programming.

Students interested in this project should have a basic knowledge in mechanics, at least at the second year level. Students in mechanical department, electronic engineering usually have the necessary background. The project requires a strong work ethic and interest in learning a range of instrumentation.

18F13 - Key technology of magnetic-grating-like hydraulic cylinder integrated displacement sensor

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School

School of Mechanical Engineering & Automation

SPECIALIZATION

My research interests are mainly centered on the following topics:

(1) Hydraulic servo system and equipment.

(2) Aerospace electrically actuators (EHA, EMA).

(3) Industrial robots design and control

PROJECT DESCRIPTION

According to the fact that the existing displacement sensor could not effectively achieve the requirement of new type hydraulic actuators such as EHA and single rod symmetrical cylinder for high reliability, high security, high power-weight ratio and high accuracy. A high magnetic-grating-like hydraulic cylinder was proposed based on the unique detection and hydraulic cylinder.

Our research will apply electromagnetism and signal processing to address the above challenges. Initially, due to the difficulty of quantitative analysis, a mathematical model of magnetic-grating-like hydraulic cylinder should be established. Second, in order to improve the accuracy of the sensor, present an optimum structure solution theory of the magnetic-grating-like hydraulic cylinder piston rod and the permanent magnet object via the study of magnetic lines modulation. Third, analyze the influences on the magnetic-grating-like hydraulic cylinder displacement sensor accuracy of the different piston rod shapes and the relative position between the permanent magnet object and the sensitive element. Finally, through the established special harmonic signal subdivision accuracy evaluation function, acquire a design method of the hydraulic cylinder.

The successful candidate will develop a high precision Magnetic-grating-like hydraulic cylinder.

STUDENT ROLES

The student will be actively engaged in working on cutting-edge topics in a multi-disciplinary environment, and will receive significant training on mechanical-electrical integration and hydraulic components. Specifically, the candidate will learn how to use some professional tools such as Ansoft Maxwell to analysis the Changing magnetic field. Besides, basic knowledge of mechanical design is required.

REQUIRED SKILLS

Electromagnetism and Signal Processing

Students interested in this project should have a basic knowledge in Electromagnetism and Signal Processing, Strong work ethic and interest are required in this project.

18F14 - Anti-crash aircraft design

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School

School of Mechanical Engineering & Automation

SPECIALIZATION

One of my research directions is the anti-crash aircraft design, aiming to reduce the death rate in air-crash.

This research mainly consists of three aspects.

(1) the design of anti- falling structure for aircraft

(2) the selection of the material and the analysis of elasticity, plasticity and impact resistance

(3) the feasibility analysis of anti-falling aircraft (economic cost, space volume, safety performance, etc.)

PROJECT DESCRIPTION

Although the safety of the aircraft is relative higher than many other vehicles, but in the event of an accident, the survival rate is very low concerning the current anti-crash technology.

In order to solve this problem, it is of practical significance to design the anti-crash aircraft.

STUDENT ROLES

Students should have a background in science and engineering (such as mechanical design, or equipment design, or materials science, or industrial design, etc.). They need to learn about aircraft structure and material properties for this project. Students will participate in the design of anti-crash aircraft to improve the safety of the aircraft by analyzing structure.

REQUIRED SKILLS

Students who are interested in this project should have a background in science and engineering, skills of 3D modeling, MATLAB and other software is in need. Students also need to have strong enthusiasm.

18F15 - Noise reduction design in aircraft cabin

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School

School of Mechanical Engineering & Automation

SPECIALIZATION

One of my research directions is the design of methods aiming to reduce aircraft cabin noise in aircraft cabin.

This topic mainly analyzes the influence of engine noise and air conditioning noise on the cabin, consisting of three aspects.

(1) analysis of the effects of vibration performance of aircraft skin and rib plate on transmission performance

(2) the design of air conditioning pipe muffler

(3) analysis of the sound absorption performance of the interior trim panel and carpet

PROJECT DESCRIPTION

Aircraft engine noise affects the comfort and safety of passengers in the cabin, also having some influences on the aircraft equipment. This project studies the noise spectrum characteristics of aircraft engine, the influence of engine on the fuselage vibration, analysis of the vibration performance of the outer skin of the aircraft, the sound absorption and sound insulation between the outer skin and the interior trim, and the design of the substitute.

This project also involves analysis of the influence of air conditioning noise on the cabin, design of air conditioning pipe muffler, analysis of the sound absorption performance of the interior trim panel, carpet, etc.

STUDENT ROLES

Students need to learn to understand the structure of aircraft and aircraft material properties, through structural analysis, involved in the design of a better sound insulation properties of the structure or material, reduce cabin noise, improve the cabin comfort and security.

REQUIRED SKILLS

Students interested in this program should have a mechanical design, or physics or other aspects of knowledge background, and some basic knowledge of 3D modelling design, MATLAB or other software. Students also need to have a strong work ethic and work passion.

18F16 - The control of coastal desert

Supervisor

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School

School of Mechanical Engineering & Automation

SPECIALIZATION

One of my research directions is the control of coastal desert, mainly for the coastal areas of the desert proposed governance programs, such as Saudi Arabia and Dubai desert.

Mainly consisting of four aspects:

(1) analysis of the natural condition in the desert coastal area, latitude and altitude, the main wind direction, ocean currents and temperature, humidity in the coastal area of mountain hills and plain geographical analysis, underground soil analysis, the local coastal microbial survival condition

(2) the design of desert water diversion

(3) protection of desert microorganisms

(4) desert soil and water conservation design

PROJECT DESCRIPTION

The desert is part of nature in some areas deserts have lost their ecological balance. How to control the process of desert and desertification is very important. In this project, the desert of the coastal areas as the object of governance, put forward feasible solutions, such as Saudi Arabia, Dubai desert control.

The first step to study the desert of the coastal areas natural conditions is analysis, such as longitude, altitude, direction, direction, main currents, temperature and humidity in the mountain hills of coaster area and geographical analysis, underground soil analysis, the local coastal microbial survival status; the second step is analysis of the survival conditions of the desert environment design for microorganisms, microbial growth, desert soil and water conservation design ; the third step is the desert water diversion design , putting forward the feasible scheme for desert greening.

STUDENT ROLES

Students who are interested in this project should have a background in science and engineering. Students need to learn the knowledge of geography, desert and ocean knowledge, and have the ability of analysis of the ecological environment and microbial growth conditions. In this project, students will participate method of desert control design, as focusing on microorganism, to propose a suitable auxiliary structure of microbial growth, to promote microbial breeding, promote the growth of plant, and to put forward a feasible design scheme for desert area green.

REQUIRED SKILLS

Students who are interested in this project should have the sense of environmental protection and strong working passion, good analytical skills and ability to communicate, and some skills of the 3D design software design and the ability to use MATLAB software. Students also need to have a strong work ethic.

18F17 - Island water development

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School

School of Mechanical Engineering & Automation

SPECIALIZATION

One of my research directions is the design of island water, which is based on the problem of island water use. Mainly consisting of four aspects:

(1) analysis of island geographical position, the current trend, perennial wind etc.

(2) the rock and soil properties of the hills in the island (the present situation of the rock capillary, the angle of the rock surface slope, etc.)

(3) analysis of microorganisms and vegetation on islands

(4) the design of water diversion and storage

PROJECT DESCRIPTION

For islands that lack fresh water, how do we use seawater to obtain fresh water?

This project is to study the water permeability of the rock and soil and the natural condition of the capillary. Based on the principle of siphon and capillary, this project aims to design to provide water resources and water storage for the residents on the island. Design seepage line, the use of sea island mountain natural water absorption performance and the wave of waves to boost the role of the island to provide water resources and water storage, for the residents on the island.

In addition, this project will assess the feasibility and methods for searching for fresh water below the seabed by finding specific structure such as whirl and current under island, reef and the others.

STUDENT ROLES

Students need to have a background in science and engineering, and need to learn about the geography, ocean and other aspects of knowledge, to participate in the design.

REQUIRED SKILLS

Students who are interested in this project should have strong creative passion, and need to show your problem analysis and problem solving ability and team work spirit. It is also needed to have skills of 3D design software and MATLAB, etc.

(Best, you can swim.)

18F18 - Floating island design

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School

School of Mechanical Engineering & Automation

SPECIALIZATION

One of my research is the design of the floating island, the redesign of the new home is mainly aimed at the island of the world is about to disappear or sink. Mainly consisting of four aspects:

(1) the overall design of the floating island;

(2) selection of floating island material;

(3) analysis of the strength of the floating island;

(4) the relationship between floating islands and marine ecology.

PROJECT DESCRIPTION

With the change of world ocean climate, sea level is gradually increasing. As a result some islands are about to disappear or sink. Islands such as Malta, for the survival of mankind, need to design a new home for the people of these islands - floating island.

The new concept of floating island can also be used as a tourist industry, or a support for marine aquaculture. Mainly consisting of four aspects:

(1) The overall design of the floating island;

(2) Feasibility analysis;

(3) The selection and strength analysis of floating island material;

(4) The analysis of the relationship between the floating island and marine ecology, and the life age of the floating island.

STUDENT ROLES

Students need to have a background in science and engineering, and need to learn about geography, marine, ship and other aspects of knowledge, to participate in the floating island design.

REQUIRED SKILLS

Students who are interested in this project should have strong creative passion to participate in design. You need to demonstrate your analytical and problem solving skills, team work spirit, some 3D design software skills and presentation skills, and the skills of MATLAB, etc.

18F19 - Reconstruction of rural ecological environment

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School of Mechanical Engineering & Automation

SPECIALIZATION

One of my research directions is the re-construction of urban and rural ecological environment. Delivering such a project is mainly because young people in urban and rural areas are willing to work and live in big cities, which enlarges the population of big cities. On the contrary, the rural population is gradually decreasing, which leads to the lack of maintenance of agricultural land in part of the rural areas, even desertification of some farmland.

The purpose of this project is to re-design and re-construct rural villages and towns, to rebuild our homes by the restoration of ecological balance, attracting city dwellers to the countryside, even just for a short time.

PROJECT DESCRIPTION

This project consists of the following 9 parts:

(1) re-design of rural towns

(2) specific romantic, beautiful, practical rural ecological hut (courtyard) design

(3) happy farm house (farm stay) and customer source re-planning and design

(4) exploration of the design, operation and maintenance of rural tourism (travel inn)

(5) children from urban to rural life experience planning (planting, breeding, restoring green space, etc.)

(6) plan for city people self-driving, summer cooling, haze escaping, and the allocation for the required labor of rural ecological recovery

(7) according to chronological division, design reconstruction for rural villages and towns.

The reproduction and display of human habitation and life style on the scale of ten thousand years. These can be used as a historical education base, film and television venues etc.

(8) assessment of ecological restoration in rural areas

(9) research for the regional and global resource utilization and the distribution of rights and interests of waste gas emissions.

STUDENT ROLES

Students need to have a romantic sense, with a poetic passion to participate in design of a beautiful and practical ecological hut (courtyard) for rural China.

REQUIRED SKILLS

Students who are interested in this project should have strong and creative passion and good command of written and spoken English.

Hope to demonstrate your analytical and problem solving skills, team work spirit, skills of the 3D modeling design software or painting expression ability to show your design.

We are waiting for you!

18F20 - Online distribution of airline tickets

Supervisor

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School

School of Economics and Management

SPECIALIZATION

Dr. TIAN is a full professor of Transportation Economics and head of the Department of Behavioral and Operations Management at Beihang University. He received his BSc and PhD degrees in Management Science from Beihang University. His research interests include travel behavior, transportation network modeling and optimization, and logistics. He has published more than 20 papers in peer-reviewed journals, such as Transportation Research Part B/C/E, Transportmetrica, Operations Research Letters.

PROJECT DESCRIPTION

In today’ s digital world, airlines typically distribute tickets both via their own websites and through Online Travel Agency (OTA) platforms such as Expedia and Travelocity. Although associated with higher distribution costs, selling tickets through the platforms offers airlines exposure to a broader consumer base, and potentially higher sales than selling tickets solely through their own websites.

Our research discusses the behavior of airlines and OTA platforms for airline tickets selling. Particularly, how do airlines make decision between the single-channel approach and the multi-channel approach? What strategy will OTA platform make to achieve the greatest profit? Is there any possible for airlines and OTA platform to collaborate to make promotion or get the extra benefit?

The common processes and methods we do such researches are formulating economic models, numerical modeling and doing simulations and so on

STUDENT ROLES

The student will be actively engaged in working on cutting-edge topics in a multi-disciplinary environment, and will receive significant training on air transport management, economics and

mathematics. Specifically, the candidate will get familiar with the latest development of today' s airline market with regard to competition and collaboration of major air-ticket roles, learn how to describe an economic phenomenon using certain models with a better commend of economic and mathematic knowledge, be sensitive to data and get promotion in statistic analyzing and simulation practicing, etc.

REQUIRED SKILLS

Economics and Management, Mathematics and Statistics, Transportation, etc.

Students interested in this project should have a basic knowledge in economics and mathematics. Students in economics and management, mathematics and transportation usually have the necessary background. The project requires a strong work ethic and interest in learning new things in relevant fields.

18F21 - Sharing vehicle demand guiding and price strategy

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SPECIALIZATION

Dr. TIAN is a full professor of Transportation Economics and head of the Department of Behavioral and Operations Management at Beihang University. He received his BSc and PhD degrees in Management Science from Beihang University. His research interests include travel behavior, transportation network modeling and optimization, and logistics. He has published more than 20 papers in peer-reviewed journals, such as Transportation Research Part B/C/E, Transportmetrica, Operations Research Letters.

PROJECT DESCRIPTION

Sharing vehicle has becoming an increasingly international hot issue with its significance in both environmentally friendly stuff and solving the last one mile problem. Many professors have made great progress in this field, which has pave us the way for further exploring. Regardless of the past achievements in traditional sharing system in demand prediction, vehicle distribution, sharing network design, etc., new prospect has to be faced with the new concept of free-float sharing system.

Our research will focus on the deep relationship between price and demand guiding, and to build a reasonable model to describe their cause and effect. We tend to use statistic instruments like regression and simulation in dealing with existing data coming from those free-floating sharing system company to verify the feasibility of our project. Then initial model can be designed under some hypothesis. Those parameters will be rectified under practical consideration. With this idea, we try to explore a new way of solving the confliction between demand and supply, that is, price strategy. In this way, we can roll the sharing system under free-floating perspective more fluent.

STUDENT ROLES

The student will be actively engaged in working on cutting-edge topics in free-floating sharing system, and will receive significant training on micro- economics, transportation, statistics, etc. Specifically, the candidate will have an integrated comprehension on sharing vehicle system and can form characteristic findings based on personal academic interest.

REQUIRED SKILLS

Economics and Management, Mathematics and Statistics, Transportation, etc.

Students interested in this project should have a basic knowledge in economics and mathematics. Students in economics and management, mathematics and transportation usually have the necessary background. The project requires a strong work ethic and interest in learning new things in relevant fields.

18F22 - Research on NYC Citi Bike system

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SPECIALIZATION

Dr. TIAN is a full professor of Transportation Economics and head of the Department of Behavioral and Operations Management at Beihang University. He received his BSc and PhD degrees in Management Science from Beihang University. His research interests include travel behavior, transportation network modeling and optimization, and logistics. He has published more than 20 papers in peer-reviewed journals, such as Transportation Research Part B/C/E, Transportmetrica, Operations Research Letters.

PROJECT DESCRIPTION

Citi Bike presents a quick alternative to walking, taking a cab, or waiting for a crosstown bus. This bike sharing system offer an environment-friendly solution for the first-and-last mile connection and help bridge the gap between existing transportation modes such as subways and bus systems. And City Bike provides the raw data of history trip.

Our research will apply statistical knowledge and mathematical algorithm to analyze the data. And we want to study the bike rebalancing problem and the bike usage by different types of consumers.

STUDENT ROLES

The student will be actively engaged in working on data processing. Specifically, the candidate will learn how to programming and data mining.

REQUIRED SKILLS

Inorganic chemistry, and/or electrochemistry.

Students interested in this project should have a basic knowledge in urban transportation. The project requires a strong work ethic and interest in learning a range of transportation.

18F23 - Dynamic pricing for reservation-based parking system

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SPECIALIZATION

Dr. TIAN is a full professor of Transportation Economics and head of the Department of Behavioral and Operations Management at Beihang University. He received his BSc and PhD degrees in Management Science from Beihang University. His research interests include travel behavior, transportation network modeling and optimization, and logistics. He has published more than 20 papers in peer-reviewed journals, such as Transportation Research Part B/C/E, Transportmetrica, Operations Research Letters.

PROJECT DESCRIPTION

With the population of urban vehicle, parking resources are becoming scarcer and scarcer. Additionally, the lack of parking information, unreasonable parking charging and uncertain parking demand aggravates parking problems. With the advent of the Internet era as well as the improvement of urban smart level, parking reservation has become one of the most effective ways to solve parking problems.

Our research proposes a dynamic pricing model allowing travelers reserving parking spaces through their personal smart equipment in advance. The parking system is operated by a private owner and her/his objective is to maximize the expected revenue. The revenue management method is adopted in setting the dynamic pricing policy of the reservation-based parking problem when trip demand is price sensitive and stochastic. Numerical experiments will be given to show that our optimal policy could save much cruising cost relative to traditional fixed price, which results in significant reduction in adverse socioeconomic externalities such as traffic jams and environmental pollution.

STUDENT ROLES

Firstly, the student will review literatures about revenue management and parking reservation. Secondly, the student will build a mathematical model to realize dynamic pricing for parking reservation. Thirdly, Numerical experiments will be designed to show the effectiveness of optimal policy. Finally, the student will analyze the contributions that our research makes to parking policy.

REQUIRED SKILLS

Microeconomics, mathematical modeling and programming ability (Matlab/C).

Students interested in this project should have a basic knowledge in mathematical modeling (Advanced Mathematics, Linear Algebra are necessary). Because of the necessary of numerical experiments, students have better to master programming ability, such as Matlab, C, C++ and so on. The project requires a strong work ethic.

18F24 - The market equilibrium and social welfare in taxi market with E-hailing applications

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SPECIALIZATION

Dr. TIAN is a full professor of Transportation Economics and head of the Department of Behavioral and Operations Management at Beihang University. He received his BSc and PhD degrees in Management Science from Beihang University. His research interests include travel behavior, transportation network modeling and optimization, and logistics. He has published more than 20 papers in peer-reviewed journals, such as Transportation Research Part B/C/E, Transportmetrica, Operations Research Letters.

PROJECT DESCRIPTION

In recent years, the taxi industry has been developed rapidly and taxi market with E-hailing applications has received considerable attention in the field of urban transportation. The emergence and popularity of e-hailing applications offers a new way for taxi drivers and passengers to communicate on line, which not only changes the behaviors of passengers and reduce the idle rate of taxi ,but also brings the cost of information for taxis and passengers.

Referring to the classic circular city model and combining with the characteristics of new way to taking taxis and the cost of information, we formulate the model of taxi market with e-hailing applications, which describes the behavior of passengers waiting for idle taxis and idle taxis cruising for un-served passengers. We provide an algorithm to simulate the model and obtained the stochastic steady-state results. Based on the results of simulations, we analyze the distributions of taxi utilization rate and passengers waiting time with or without using the e-hailing application, the queue of passengers and idle taxis and the gap time between two orders of the taxis. At the same time, we will find the equilibrium solutions to the model and focus on the properties of the

equilibrium solutions and social welfare, which varies with the changes of model parameters, such as the information quality, time value, subside for taxis or passengers and so on.

The findings will extend our knowledge of e-hailing applications, help to cognize the pros and cons of e-hailing applications objectively and offer the reference for decision making.

STUDENT ROLES

The student will be actively engaged in working on cutting-edge topics in a multi-disciplinary environment and will receive significant training on transport economics research, transportation planning and managements and transportation system modeling and analysis, especially user equilibriums and social optima in traffic systems. Specifically, the candidate will learn how to formulate the urban traffic model, solve the traffic model through mathematical method and computer application software and further to analyze the properties of a certain traffic model.

REQUIRED SKILLS

Transportation, and/or Economics, and/or Managements.

Students interested in this project should have a basic knowledge in operational research or mathematical programming, microeconomics and transportation planning and managements. Students in transportation, economics or managements usually have the necessary background. The project requires a strong work ethic and interest in transportation research.

18F25 - Cellular automaton model for traffic flow

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School of Economics and Management

SPECIALIZATION

Dr. TIAN is a full professor of Transportation Economics and head of the Department of Behavioral and Operations Management at Beihang University. He received his BSc and PhD degrees in Management Science from Beihang University. His research interests include travel behavior, transportation network modeling and optimization, and logistics. He has published more than 20 papers in peer-reviewed journals, such as Transportation Research Part B/C/E, Transportmetrica, Operations Research Letters.

PROJECT DESCRIPTION

Cellular automata (CA) were historically proposed in the 1940s (Neumann, 1948) and popularized in the 1980s (Wolfram, 1983) to accurately reproduce macroscopic behavior of a complex system using minimal microscopic descriptions. And it has been frequently applied in various fields, including traffic flow modeling. Several notable traffic CA (TCA) models were developed for reproducing CF & LC behaviors, such as single-cell models, multi-cell models and so on.

Our project is to research on different kinds of TCA models holding different hypothesis and to find out the linkage between different TCA rules and macroscopic traffic flow characteristics.

STUDENT ROLES

The student will be engaged in working on topics about TCA models in a multi-disciplinary environment, and will receive significant training on operations research, travel behavior analysis, and math. Specifically, the candidate will not only have a good command of the TCA models, but also learn how to use cellular automata to reproduce macroscopic behavior of a complex system in various other fields using minimal microscopic descriptions.

REQUIRED SKILLS

Students interested in this project should have a basic knowledge in microeconomics and have basic programming ability.

18F26 - Sustainable Supply Chain Management and Research

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School of Economics and Management

SPECIALIZATION

My research focuses on supply chain management, inventory and logistics management, production safety management, emergency management and heuristics optimization. Currently, my research interests are mainly centered on the following topics:

(1) Sustainable Supply Chain Management: Green Supply Chain, Remanufacturing Supply Chain, Recycling Channel, Asymmetric Information.

(2) Safety Production Investment Analysis and Safety Production Supervision Mechanism Design.

PROJECT DESCRIPTION

There is a growing need for integrating environmentally sound choices into supply-chain management research and practice. Remanufacturing generally refers to the process in which used products are renovated professionally and upgraded, and their qualities are equal to or superior to their original qualities. Remanufacturing protects the environment by recycling resources and decreasing the use of new materials. The application and promotion of remanufacturing is of salient value. However, there are still many challenges confronted manufacturers when applying remanufacturing, such as uncertainty of consumers' preference for remanufactured product, unstable recycle rate for used product, cannibalization problem, and so on. By considering consumer segments and competition among supply chain players, we would explore the production strategy, pricing strategy, recycling strategy in a closed-loop supply chain, we would also investigate the potential roles of remanufacturing: cost saving device, compliance with legal requirements, or marketing tool.

The primary goal of this project is to provide manufacturers with guidelines for remanufacturing decisions.

STUDENT ROLES

Sustainable supply chain management is a cutting-edge topic in current supply chain operating practices. The student will be actively engaged in working on using different research methods like behavioral experiments, empirical model analysis, data-driven research and analytical model analysis to explore the production strategy, recycling strategy, pricing strategy, and distribution strategy, etc.

REQUIRED SKILLS

Applicants with backgrounds of operations management, supply chain management, mathematics, or computer science are welcomed. This project provides students with advanced knowledge on how to identify, resolve and manage complex operations problems. At the same time, it requires a strong work ethic and interest in learning a range of problem solving methodology and associated tools.

18F27 - Solving natural language processing tasks via deep learning techniques

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School

School of Computer Science and Engineering

SPECIALIZATION

My research focuses on the machine learning, data mining and information retrieval. Specifically, my research team are mainly centered on the following topics:

(1) The theory and algorithms of deep learning

(2) Natural language processing

(3) Human Computer collaborative computing

(4) Social network analysis

PROJECT DESCRIPTION

Machine learning algorithms are widely used in the Natural Language Processing tasks, such as Parsing, Named Entity Recognition (NER), Relation Classification, and Sentiment Analysis. These existing approaches highly dependent on human designed representations and features. Recently, with the development of deep learning, researchers are able to discover features and representations automatically. The algorithms, such as RNN, LSTM and Sequence2Sequence model outperforms the traditional machine learning algorithm on the NLP tasks in a large margin.

STUDENT ROLES

The goal of this project is to grasp the skills of utilizing Deep Learning models to build deep learning based models to solve real-life problems. In this project, students will learn the basic ideas and models of deep learning and the deep learning developing frameworks (Torch, Theano or TensorFlow). The distributed representation model for vector representations for phrases and sentences will be studied and be implemented. Several traditional NLP tasks, NER, sentiment analysis and

sentence completion, will be studied and these tasks are required to be implemented by deep learning models.

REQUIRED SKILLS

Basic machine learning knowledge, programming language (Python)

18F28 - Magnetic reconnection in space plasmas

Supervisor

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School

School of Space and Environment

SPECIALIZATION

My research fields include the fundamental space plasma processes (e.g., turbulence, magnetic reconnection, wave-particle interaction) and the space weather (e.g., substorms, radiation belts, Solar wind—Magnetosphere—Ionosphere coupling). Particularly, I devote myself to understanding how the energy is transferred from solar wind to magnetosphere through magnetic reconnection, how it is carried by the earthward-propagating dipolarization fronts during substorms, and how it is injected into the radiation belts and ring-current region. My scientific achievements are primarily based on analysis of the spacecraft data, including the data from MMS, Cluster, THEMIS etc. Also, I develop a technique to reconstruct the magnetic field topology in space, which is very useful for the study of magnetic reconnection.

PROJECT DESCRIPTION

Magnetic reconnection is a fundamental plasma process converting magnetic energy into particles' kinetic and thermal energy, and has been widely accepted as a mechanism responsible for many explosive phenomena in the universe such as solar flares, coronal mass ejection, Gamma-ray bursts, substorms, and the disruptions in fusion experiments. Typically, a large amount of energetic electrons are observed when reconnection occurs. These electrons can excite hard X-ray emissions in the solar corona, and provide seed population for the radiation belts in the Earth' s magnetosphere. So far, exactly how these energetic electrons are produced is still unclear. A few models, including adiabatic and non-adiabatic, have been proposed in previous studies, but they failed to explain the amount of the energetic population. To fully understand the electron acceleration process, the measurement of three-dimensional (3D) electric field is necessary. In previous studies, however, such measurement is unavailable. The MMS mission, which was launched in March 2015, includes a 15-meter probe along the spin axis, so it measured the 3D electric field. In

this project, we will use the MMS measurements to study energetic electron acceleration during magnetic reconnection. By analyzing the MMS data, we expect to better and fully understand the acceleration mechanism, and provide clear evidence for the acceleration process during reconnection.

STUDENT ROLES

The student will be actively engaged in analyzing spacecraft data, learning the FOTE technique and using the technique to reconstruct magnetic field topology, interpreting the spacecraft data, discussing with other members in the team, and writing scientific articles.

REQUIRED SKILLS

Space Physics, Plasma Physics, and/or Physics

Students interested in this project should have a basic knowledge in space physics or plasma physics, and some basic skill in programming.

18F29 - Design, experiment and modeling of electromagnetic thrusters

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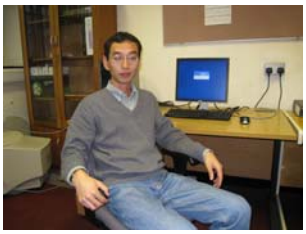
School

School of Space and Environment



SPECIALIZATION

My research focuses on the Advanced Propulsion and Space Systems, like the electric propulsion, micro-propulsion, plasma sails, spacecraft-environment interactions, spacecraft reliability engineering, etc. Specifically, our current research interests are mainly centered on four topics:

(1). Design and manufacturing electric thruster prototypes, e.g. Magnetoplasmadynamic Thruster (MPDT), Pulsed Plasma Thruster (PPT), Hall Effect Thruster (HET), and Ion Thruster.

(2). Experimental investigation of electric thrusters using the vacuum facility as well as relevant measurement systems, e.g. small mass flow measurement system, micro-thrust stand, various diagnostics tools, etc.

(3). Modeling and numerical simulation on physical processes within electric thrusters by a fully kinetic Particle-in-cell (PIC) method, or Magnetohydrodynamic (MHD) method.

(4). Performance tests of cold gas micro thrusters, like Propane Propellant Micro Thruster, and Liquid Ammonia Micro Thruster.

PROJECT DESCRIPTION

Electric Propulsion (EP) nowadays has demonstrated rapid evolutions in concept and technology therefore possesses even more advantage to move satellites and spacecraft in space. The systems cover a broad range of sizes and performances, among which some are commercially available whereas some are still laboratory prototypes under development.

Our research will apply both experimental and numerical approaches to explore the propulsive performance of an electromagnetic thruster, e.g. self-designed HET or MPDT. The

proposed research project is to program the test system for thruster prototypes and to get performance data, analyzing power efficiency, propellant utilization, and etc. For parametric study it is encouraged to build the numerical model of thruster and to implement simulations. Detailed processes and parameter relations should be explicated by using our modified 2D full-PIC/MHD codes. Thereafter we will foresee an improved performance by adjusting magnetic circuit.

STUDENT ROLES

The student will be actively engaged in working with others to receive significant training on electric propulsion system design and experimental measurements using our vacuum facility. Specifically, the candidate will learn how to use the power system, micro-thrust stand, mass flow control and measurement system, etc.

By characterizing the operation performance of electromagnetic prototypes through a numerical way, the successful candidate will learn and understand better the knowledge of plasma propulsion and may further propose an optimized design of magnetic circuit for electromagnetic thrusters.

Also, the candidate will accumulate skills of operating professional software during the procedure of data acquisition and post-processing.

REQUIRED SKILLS

Students interested in this project should have a basic knowledge in plasma physics, classical mechanics, and electromagnetism.

Students in Aerospace Engineering, and/or related physics major usually have the necessary background. Particularly, the applicant is expected to have interest in programming languages like C++, Fortran, and learning a range of instrumentation.

18F30 - Terrestrial ionosphere-magnetosphere coupling

Supervisor

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School of Space and Environment

SPECIALIZATION

Prof. Yiqun Yu' s main research interest is on the solar wind – magnetosphere - ionosphere coupling and inner magnetospheric dynamics. She has extensive experience in conducting MHD simulations using the Space Weather Modeling Framework (SWMF) developed at University of Michigan to investigate solar wind-magnetosphere interactions and magnetosphere-ionosphere coupling. She is also experienced in studying the ring current dynamics and investigating microphysics within the magnetosphere, such as wave-particle interactions, and magnetic reconnection.

PROJECT DESCRIPTION

Solar wind-magnetosphere interaction plays an important role in transferring solar wind energy into the magnetosphere system and is the primary driver for various dynamics within it. This project aims to understand how the magnetosphere responds to changes in the solar wind and interplanetary conditions, including how the interplanetary magnetic field By component penetrates into the magnetotail region and how the tail flows are impacted.

STUDENT ROLES

The student will learn to conduct simulations with high-performance computers and analyze simulation results through Tecplot software.

REQUIRED SKILLS

Linux, IDL/Python/Matlab/Fortran/Tecplot

18F31 - Design of novel zeolites for biomass conversion

Supervisor

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School

School of Space and Environment

SPECIALIZATION

My research focuses on the design of multi-functional Nanostructured Materials for Clean, Renewable Energy technologies. Specifically, our research interests are mainly centered on four topics:

(1) Nanomaterials and Nanotechnology: Synthesis, Characterization, and Properties of Carbon nanotubes (CNTs), N-doped CNTs, Graphene, N-doped graphene, Metal and Metal oxide nanostructures, and Nanocomposites from particles to wires, tubes, and films.

(2) Clean Energy Conversion and Storage: Proton Exchange Membrane Fuel Cells (PEMFC), Lithium Battery, Solar Cells, and Hydrogen Storage.

(3) Fundamental electrochemistry & chemistry of surfaces and interfaces.

(4) Structure-property relationships of nanostructured materials.

PROJECT DESCRIPTION

Biomass is the only current sustainable source of organic carbon, and biofuels---fuels derived from plant biomass---are the only current sustainable source of liquid fuels. Fast pyrolysis is one useful method to transform biomass into liquid products. However, the fast pyrolysis oil has the major drawback of instability caused by high oxygen content and acidity, thereby rendering it unsuitable for incorporation into existing petroleum based infrastructure. Incorporation of zeolite catalysts into the pyrolysis reaction is an effective way to reduce the reactive oxygenated compounds into aromatics and increase the C/O ratio. However, although 238 zeolite frameworks are available, zeolite-catalyzed processes use only about 10 different framework types. Up to now,

the ZSM-5 catalyst is the most effective catalyst at producing aromatic hydrocarbons from the oxygen-rich vapors. Therefore, the synthesis of novel zeolite catalysts has become an area of great interest.

Zeolites can be synthesized under a wide range of different conditions, giving rise to different crystal sizes, morphologies, and elemental compositions. This flexibility allows for an effort to study some of the factors affecting the aromatic yield from biomass pyrolysis in detail to develop a better understanding of biomass catalytic fast pyrolysis and to create a better zeolite based pyrolysis catalyst. Our research will focus on the application of novel zeolites in the catalytic pyrolysis of lignocellulosic biomass. The proposed research project is to fabricate new zeolite for this purpose.

STUDENT ROLES

The student will be actively engaged in working on cutting-edge topics in a multi-disciplinary environment, and will receive significant training on the synthesis, characterization, and catalytic properties of zeolites. Specifically, the candidate will learn how to use this green chemistry technology to synthesize novel zeolites and further to control their morphology and how to perform microscopic characterizations, including scanning electron (SEM), X-ray diffraction (XRD), Gas Chromatography-Mass Spectrometer (GC-MS) analysis, etc.

REQUIRED SKILLS

Inorganic chemistry, and/or environment.

Students interested in this project should have a basic knowledge in chemistry, at least at the second year level (general chemistry, introductory thermodynamics and some laboratory work are typical at this stage). Students in chemistry or environmental science usually have the necessary background. The project requires a strong work ethic and interest in learning a range of instrumentation.

18F32 - Reliability-Based Optimal Design Method of Porous Material Structure Considering Manufacturing Instability

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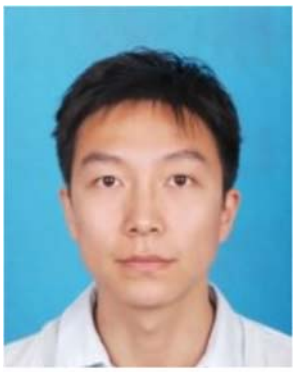

SPECIALIZATION

My research focuses on Structural Analysis, Optimization and Control. Specifically, our research interests are mainly centered on four topics:

(1) Topology optimization: Reliability-based topology optimization, Multi-material topology optimization, Multiscale topology optimization;

(2) Structural Reliability-based Optimization: Structural reliability analysis and optimization design under uncertainty, Uncertainty quantification (UQ) analysis;

(3) Inverse problems in mechanics;

(4) Noise prediction and active vibration control.

PROJECT DESCRIPTION

With the continuous improvements of additive manufacturing technologies, the porous materials are widely used in developing processes of the major military/civilian equipment and products. However, subjected to the limitation of the preparation instability, the uncertainty effects existing in meso-mechanical models of porous materials (such as the geometric deviation in basic components and the property dispersion in substrate materials) are inevitable and extremely affect the performances of macroscopic structures, which the mismatch between the design expectation and the actual service status and even serious safety risks must be confronted. In view of this, the meso-scale uncertainties derived from preparation instability will be taken as the research start in this project. Under the objective circumstances of poor information and insufficient data, a method of non-probabilistic reliability-based design optimization of

porous material structures with consideration of procedure constraint is developed by combination of integrated design theory, non-probabilistic set theory, and structural reliability theory. This project will focus on the main problems, including the construction of uncertain meso-mechanical models and the deduction of macro properties, analysis of the bi-level non-probabilistic stiffness reliability, concurrent optimization of both meso-shape and macro-topology as well as the reliability verification techniques, etc., which aims at conquering the following three key scientific issues, namely, the reasonable description of the preparation instability, the accurate prediction of scale-span structural response bounds, and the efficiency and validity of the concurrent optimization. The achievements of this project can provide theoretical support for the current multiscale design theories, and may also play a significant promoting effect on the integrated design and manufacturing processes of high performance material structures.

STUDENT ROLES

The student will be actively engaged in working on cutting-edge topics in reliability-based topology optimization and integrated optimization of cross scale structure. Specifically, the candidate will learn how to use the non-probabilistic method to analyze the uncertain mechanical properties of porosity structures considering the manufacturing instability, and how to construct an integrated reliability-based optimization method for cross scale structures of mesoscopic shape and macroscopic topology.

REQUIRED SKILLS

Solid mechanics or Engineering mechanics

Students interested in this project should have a basic knowledge in mechanics and aircraft design, at least at the third-year level (theoretical mechanics, material mechanics, elastic mechanics, aircraft design and some laboratory work are typical at this stage). Students in Solid mechanics, Engineering mechanics or aircraft design usually have the necessary background. The project

requires a strong work ethic and interest in learning a range of instrumentation.

18F33 - Cooperative Control Technology for UAVs Formation Flight

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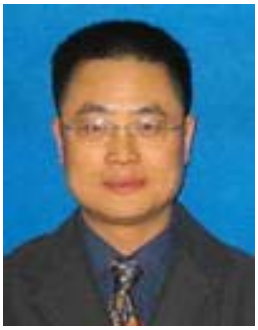

SPECIALIZATION

My research focuses on the fight mechanics, that is, dynamics and control of aircraft. Specifically, our research interests are mainly centered on three topics:

Controllability design, flight control design and flying quality evaluation for flying wing aircraft.

• Digital virtual flight test for civil aircraft .

• Flying quality evaluation based on flight task for combat aircraft.

• Flight dynamic modeling and adaptive flight control for morphing aircraft.

PROJECT DESCRIPTION

It is well known that unmanned aerial vehicle (UAV) is more and more widely applied in military and civil areas. In order to using better of UAV, we could utilize multi UAVs cooperative formation.

The multi UAVs cooperative formation control technology in the mainly contains the following key techniques: data fusion technology, sensing technology, task allocation technology, path planning technology and formation control technology. Our research will focus on the choise of control strategy and the optimization of formation control technology. The successful formation control technology will make the UAVs take the formation flight and the distance difference limited by 10%. This project will increase the usage of UAVs and improve the operational capability of UAVs.

STUDENT ROLES

The student will be actively engaged in working on control technology in a multi-disciplinary environment, and will receive

significant training on control strategy and control method. Specifically, the candidate will learn how to use this control technology to make the UAVs take the formation flight.

REQUIRED SKILLS

Students interested in this project should have a basic knowledge in UAVs and control method, at least at the third year level. Students in Aeronautics and Astronautics or Automatic Control usually have the necessary background. The project requires a strong work ethic and interest in learning a range of software.

18F34 - Intelligent UCAV Air Combat

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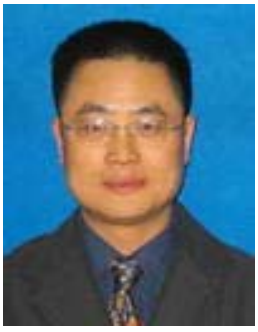

SPECIALIZATION

My research focuses on the fight mechanics, that is, dynamics and control of aircraft. Specifically, our research interests are mainly centered on three topics:

Controllability design, flight control design and flying quality evaluation for flying wing aircraft.

• Digital virtual flight test for civil aircraft .

• Flying quality evaluation based on flight task for combat aircraft.

• Flight dynamic modeling and adaptive flight control for morphing aircraft.

PROJECT DESCRIPTION

Currently, fighter aircraft are being developed with new, highly agile flight characteristics. However, manned testing requires trial-and-error tactics development by highly trained pilots, and the cost of comprehensive tactical analysis is prohibitive. Therefore, to fully evaluate the performance of the fighter during air combat, the on-line simulation of air combat is developed.

The project will apply the artificial intelligent method to the air combat simulation. The proposed research project is to analyze the dynamics of 1-on-1 dogfight and develop a novel methodology to simulate the air combat based on soft computing methods such as genetic algorithm, neural networks and fuzzy logic or their combinations.

After the methodology developing, the simulation will be conducted on the MATLAB/SIMULINK platform. After a series of training, the methodology can solve the decision-making problem by itself during the on-line simulation with uncertain situations.

STUDENT ROLES

The student will be actively engaged in working on the dynamic analysis of dogfight and the methodology developing after the literature review. Specifically, the candidate will learn the modeling of air combat environment and the assessment of the enemy threat and then further to develop the strategy under the uncertain situation including the enemy fighters, the enemy SAMs, etc.

REQUIRED SKILLS

Aeronautic Engineering

Students interested in this project should have a basic knowledge in fight dynamics of aircraft, at least at the third year level. The basic skill of MATLAB or SIMULINK is necessary. The project requires a strong work ethic and interest in modeling the aircraft and coding the methodology.

18F35 - Nonlinear Time-Varying System Stability

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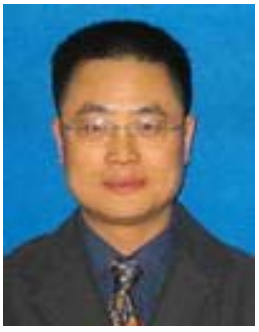

SPECIALIZATION

My research focuses on the fight mechanics, that is, dynamics and control of aircraft. Specifically, our research interests are mainly centered on three topics:

Controllability design, flight control design and flying quality evaluation for flying wing aircraft.

• Digital virtual flight test for civil aircraft .

• Flying quality evaluation based on flight task for combat aircraft.

• Flight dynamic modeling and adaptive flight control for morphing aircraft.

PROJECT DESCRIPTION

For a morphing aircraft, in addition to fixed planform stability, we are also interested in the transient stage of flight during which the aircraft changes shape. The particular question that we want to address is how the speed of transition of transition affects stability. This issue can be abstracted into the stability analysis of a complicated nonlinear time-varying multi-rigid-body system. Therefore, a quantitative analysis method of nonlinear time-varying system stability is urgently needed developing.

The CCEBC (Complementary-Cluster Energy-Barrier Criterion) theory, recently developed for transient stability assessments of power systems, is rigorous and quantitative. It has been widely used in power system engineering projects at home and abroad. Our research is to apply the CCEBC to multi-rigid-body systems to study their dynamics stability under large disturbances, and the stability margins of disturbed trajectories which is a quantitative stability analysis.

The successful candidate will develop a multi-particle-spring system dynamics model on the MATLAB/Simulink platform. By

online simulation, the stability under large disturbances, the evaluation of disturbance-clearing-time accuracy and the unstable domain in parameter space can be calculated based on the CCEBC theory.

STUDENT ROLES

The student will be actively engaged in working on stability topics based on a multi-rigid-body system, and will receive significant training on modeling dynamics models, characterization, and coding methodology. Specifically, the candidate will learn how to use CCEBC theory to quantitative analysis the stability of a multi-particle-spring system, and further to study how the unstable mode varies with the disturbance clearing time and the parameters of dynamics system.

REQUIRED SKILLS

Nonlinear dynamics, and stability analysis.

Students interested in this project should have a basic knowledge in nonlinear multi-rigid-body dynamics and system stability, at least at the third year level. The basic skill of MATLAB/Simulink is necessary. The project requires a strong work interest in modeling nonlinear dynamics, learning CCEBC theory and coding methodology.

18F36 - Uncertain Multidisciplinary Numerical Computation and Optimization Theory and Method of Complex Engineering Systems and its Applications

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School

Institute of Solid Mechanics, School of aeronautic science and engineering

SPECIALIZATION

My research focuses on Computational Solid Mechanics, Aero-elasticity Mechanics, Random Vibration, Structural Reliability and Optimization Design, Durability and Damage Tolerance Design, Non-linear Problems in Mechanics, Intelligent Material Structure and Composites Mechanics. Specifically, our research interests are mainly centered on three topics:

(1) Non-probabilistic set-envelope theory of test-based performance quantification for aircraft structures;

(2) Non-probabilistic set-evolution theory of response boundary law for aircraft structures;

(3) Non-probabilistic set-interference theory of reliability assessment for aircraft structures.

PROJECT DESCRIPTION

Considering that more advanced numerical calculation and optimization technology is needed in the analysis and design of modern complex engineering systems, as the development and supplement of deterministic multidisciplinary analysis, the technique of numerical calculation and optimization theory based on multidisciplinary uncertainty is gradually becoming a hotspot and difficulty in the world powers. In view of the great demand to the country, the sophisticated aerospace vehicle structures will be regarded as the main objects of the research in this project. Furthermore, by virtue of the mutual integration of interdisciplinary studies, included by the fields of structure, material, aerodynamics, mathematics, software, experimental technique, the multidisciplinary numerical calculation and

optimization design technologies, which serve the aircraft structures , will be established and developed. Thus, some issues will be investigated, which included by uncertainty/error quantification and computational analytic techniques involved in the procedure of the computational analysis, optimization design or experimental verification subjected to the aircraft structures; the study on advanced algorithms for dealing with the problems of multidisciplinary uncertainty-based optimization as well as verification and validation techniques with reference to the numerical computational and optimization models; construction of the software platform for the realization of uncertainty numerical calculation and optimization in practical aircraft engineering. Through this project, we are committed to transform the theoretical value of the above uncertainty numerical calculation and optimization design into the economic, social and even military values. The research can be treated as the theory basis and technology foundation for the analysis and design of the complex engineering systems on one hand, and further contribute to the development of the model-oriented numerical analysis and optimization design platform.

STUDENT ROLES

The student will be actively engaged in working on advanced algorithms for dealing with the problems of multidisciplinary uncertainty-based optimization as well as verification and validation techniques with reference to the numerical computational and optimization models; Specifically, the candidate will learn how to use the non-probabilistic method to propagate uncertainties through multidisciplinary analysis and optimization model.

REQUIRED SKILLS

Solid mechanics or Engineering mechanics

Students interested in this project should have a basic knowledge in mechanics and aircraft design, at least at the third year level (theoretical mechanics, material mechanics, elastic mechanics, aircraft design and some laboratory work are typical at this stage).

Students in Solid mechanics, Engineering mechanics or aircraft design usually have the necessary background. The project requires a strong work ethic and interest in learning a range of instrumentation.

18F37 - Cyber security of Intelligent connected vehicle

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School

School of Transportation Science and Engineering

SPECIALIZATION

My research focuses on the following topics:

(1) Cyber security of Intelligent connected vehicle

(2) Vehicle operating condition monitoring and safety early warning

(3) Road coordination and safety control

(4) Regional Traffic Control

PROJECT DESCRIPTION

With the continuous advancement of automobile intelligence and network linking, intelligent vehicle cyber security incidents frequently appear, the life and property safety of users are threatened, information security protection has become an important factor that relates to the rapid development of intelligent vehicle.

In order to address the above challenges, we need to analysis Intrusion detection methods and make up prevention systems by designing our own safe T-box.

STUDENT ROLES

Students will learn the forefront of China's automotive cyber security technology, have the opportunity to participate in related fields meetings. Can independently choose the direction of interest in the field of cyber security research, including: intrusion detection and prevention methods, risk assessment, vehicle-to-vehicle virus transmission research, T-box development. The current laboratory has 4 PhD students, 6 master students, they are willing to help you learn together.

REQUIRED SKILLS

Students interested in this project should have a background in science and engineering, Because of the necessary of computer experiments, students have better to master programming ability, such as python, C++ and so on. If you are familiar with deep learning methods, you will be able to help us a lot. The project requires a strong work ethic and interest in learning a range of instrumentation.

18F38 - New concept ice protection system for aero-engine

Supervisor

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School

School of Transportation Science and Engineering

SPECIALIZATION

My research focuses on the airworthiness design and certification for the aero-engine and related parts. Specifically, our research interests are mainly centered on three topics:

1) Airworthiness related problems for aero-engine icing;

2) Ice protection system design and certification;

3) Computational Fluid dynamics for engine icing;

PROJECT DESCRIPTION

Ice protection system (IPS) is very important for the engine to work under icing environment. This project aims to design a new concept ice protection system for aero-engine to decrease the consumption the energy.

An advanced CFD model will be developed to simulate the hot gas flow accounting for the interactions between main stream and anti-ice hot gas film. The model will be validated from a reference. From the simulation, an understanding of the complex flow physics at engine inlet will identify opportunities to use passive geometry features to interact with the inlet flow at different operating condition, allowing a cost effective means of temperature control over the anti-ice surface. From the knowledge gained, a new ice protection system using hot air film will be designed and evaluated using the CFD simulation. It will be optimized through numerical modelling and simulation.

STUDENT ROLES

Design, Modeling and CFD analysis for the new IPS for aero-engine

REQUIRED SKILLS

Undergraduate degree in Mechanical Engineering, Aerospace Engineering or equivalent academic discipline

Some knowledge in Fluid Mechanics or Aerodynamics, Thermodynamics and Maths.

Good communication skills; the candidate will be expected to develop good quality technical papers for publication in journals and presentation at peer-reviewed conferences.

Desirable: Previous experience of 3D CAD modelling and CFD.

18F39 - Assessment of Post-Disaster Re-Entry Scenarios in Megaregions: A Pilot Study

Supervisor

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School

School of Transportation Science and Engineering

SPECIALIZATION

My research focuses on the modeling and analysis of megaregion evacuation, policy analysis for evacuation events, and traffic control under the environment of connected vehicles. Specifically, our research interests are mainly centered on three topics:

(1) Modeling and analysis of evacuation events: the development of simulation models for evacuation events, the optimization of evacuation strategies for emergencies.

(2) Data mining for historical evacuation traffic data.

(3) Traffic control modeling and optimization, especially for traffic control optimization under the environment of connected vehicles.

PROJECT DESCRIPTION

Planning for post-evacuation re-entries procedures is essential to ensure the safety of returning evacuees and the effectiveness of recovery/restoration processes. After an evacuation, potential hazardous conditions may pose a risk to evacuees returning to their homes, businesses, or properties. For example, downed electrical lines, gas line leaks, collapsed bridges, flooded roads, landslides, washed-out roads, etc. may be evidenced as a consequence of a disaster and create a hazardous environment. These conditions may also challenge the recovery process as it requires special machinery and more personnel. Post-evacuation re-entry in some cases may also be challenged by the large number of evacuees that may be returning from distant communities across multiple regions or states. As such, the transportation system could be significantly stressed due to high demand over short periods of time. Although post-evacuation reentry can be more challenging and complex than evacuations, it

was evidenced in the literature that re-entry research is limited and in most cases there is a lack of formal planning. Therefore, this project seeks to assess various post-disaster re-entry scenarios that could be used to support transportation agencies in the development of traffic management plans as they assist emergency management and law enforcement agencies during post-evacuation re-entry efforts. The scenarios to be assessed in this project could be related to re-entry procedures, demand/response rates, network accessibility, etc.

STUDENT ROLES

The student will be actively engaged in building simulation models for evacuation events, and will receive significant training on modeling technology for large scale evacuation events. Specifically, the candidate will learn how to use simulation software to build simulation models for large scale areas such as regions or megaregions. Further, the candidate will learn how to build mathematical models to optimize the performance of evacuations, such as decreasing evacuation clearance time or increasing total number of evacuees in a certain time range.

REQUIRED SKILLS

Traffic Engineering, and/or Computer Science, and/or Industrial Engineering.

Students interested in this project should have a basic knowledge in Traffic Engineering, at least at the second year level (general chemistry, introductory thermodynamics and some laboratory work are typical at this stage). Students in civil engineering, traffic or industrial engineering usually have the necessary background. The project requires a strong work ethic and interest in learning a range of modeling and analysis.

18F40 - Experimental nuclear reaction, nuclear technology and medical physics

Supervisor

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School

School of Physics and Nuclear Energy Engineering

SPECIALIZATION

My research focuses on the design of multi-functional Nanostructured Materials for Clean, Renewable Energy technologies. Specifically, our research interests are mainly centered on four topics:

(1) Nanomaterials and Nanotechnology: Synthesis, Characterization, and Properties of Carbon nanotubes (CNTs), N-doped CNTs, Graphene, N-doped graphene, Metal and Metal oxide nanostructures, and Nanocomposites from particles to wires, tubes, and films.

(2) Clean Energy Conversion and Storage: Proton Exchange Membrane Fuel Cells (PEMFC), Lithium Battery, Solar Cells, and Hydrogen Storage.

(3) Fundamental electrochemistry & chemistry of surfaces and interfaces.

(4) Structure-property relationships of nanostructured materials.

PROJECT DESCRIPTION

Fusion reaction induced by weakly bound nuclei is one of hot topic in the world. We use direct nuclear reactions such as elastic scattering, breakup and fusion to explore the reaction mechanisms. First, unstable nuclei which are from stable line are explored by elastic scattering and breakup. The angular distribution of elastic scattering is measured, then optical model are used to obtain the interaction parameters and the reaction cross section, and continuum-discretized-coupled channel (CDCC) are used to study the breakup, in comparison with that of stable nuclei, the nuclear reaction mechanism and nuclear structure can be studied. Secondly, the reaction dynamics of fusion process induced by weakly stable nuclei is studied by gamma spectroscopy in

coincidence with light charged particles. The complete fusion (CF), incomplete fusion (ICF) and transfer processes can be distinguished. Whether the suppression of CF cross sections depends on the target charge number above Coulomb barrier can be studied. At present a method is found to distinguish ICF and transfer processes for the first time. It is valuable to deeply explore, a experiment will be performed in Italy. The successful candidate will take part in the data analysis and obtain the experimental results.

The detector technology, nuclear electronics and automatic control are developed for experimental nuclear physics, nuclear technology and medical physics. The ionization chamber is made to measure the intensity of proton beam, the simulation software needs to be developed to simulate the parameters of chamber. The finger-type chamber is developed to measure the radiology in radiation oncology. X/γ radiation meter and weak current amplifier are planned to develop the nuclear electronics including the amplifier circuit, high voltage and single chip as well as control program. The successful candidate will take part in hardware/software design and training plan for medical physics in hospital.

on zero-dimensional (0D) nanoparticles. It is well accepted that the catalytic properties of catalysts could be greatly enhanced by modulating their morphologies.

STUDENT ROLES

The student will be actively engaged in working on cutting-edge topics in nuclear reactions and nuclear technology, and will receive significant training on nuclear detectors, physics analysis, design circuit, compile control program. Specifically, the candidate will learn how to use physics and nuclear technology to obtain the physics results, make detectors and design the circuit as well as software. And further to test the detector by source, observe the signal by oscilloscope, test the current by multimeter and compile the program to control the single chip, etc.

REQUIRED SKILLS

Physics, Analogous/Digital circuit, Automatic control.

Students interested in this project should have a basic knowledge in physics, at least at the second year level (general physics and some laboratory work are typical at this stage). Students in physics or control engineering usually have the necessary background. The project requires a strong work ethic and interest in learning physics, electronics and automatic control.

18F41 - Preparation of Tungsten and Its Irradiation in Deuterium / Helium

Supervisor

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School

School of Physics and Nuclear Energy Engineering

SPECIALIZATION

My research focuses on the design of tungsten materials, and research of its irradiation in Deuterium/Helium to simulate tokamak. Our research interests are mainly centered on four topics:

(1)Preparation of tungsten material: Preparation of Tungsten Thin Films by Magnetron Sputtering, Powder metallurgy technology to prepare tungsten alloy, Hollow cathode preparation of tungsten dust.

(2)Deuterium / Helium Irradiation: Deuterium / Helium irradiation to simulate working conditions in tokamak.

(3)Fusion: Tokamak, First wall material, Tungsten, Irradiation.

PROJECT DESCRIPTION

Nuclear fusion is recognized as one of the main ways to effectively solve the future energy and environmental problems in human society. The fusion reactor material problem is one of the key engineering problems in the commercialization of fusion. Among them, the fusion plasma and the first wall interaction (Plasma Wall Interaction, PWI) is generally considered to be one of the key issues to achieve controlled nuclear fusion. W has the advantages of high melting point, low sputtering rate and high thermal conductivity and is considered as the most likely PFM to be fully used in the future tokamak fusion reactor. However, tungsten itself has low temperature brittleness, high toughness and brittle transition temperature. These kinds of problems have prompted the urgency of developing new tungsten materials.

Although helium is insoluble in the matrix material, it is easily trapped in defects in the material to synthesize helium-vacancy complexes. The formation of microscopic helium bubbles at higher concentrations or at higher temperatures leads to the degradation

of the macroscopic properties of the material. After years of work, people have a certain understanding of the behavior and impact of deuterium / helium, but the results are still fragmented and many problems have not been completely solved.

This study provides a reference for the design, preparation and application of PF as a nuclear fusion tokamak device.

STUDENT ROLES

The student will actively work in the direction of the first wall of the nuclear fusion and will accept magnetron sputtering coating and hollow cathode preparation of dust. Specifically, candidates will learn how to make tungsten thin films, tungsten-based alloys, and further control their morphology and how to characterize them, including scanning electron microscopy (SEM) and transmission electron microscopy (TEM). High-resolution transmission electron microscopy (HRTEM) imaging, X-ray diffraction (XRD) analysis.

REQUIRED SKILLS

Students interested in the project should have at least the second year of physical basics (material knowledge, basic physics, and some lab work are typical at this stage). Material, physical students usually have the necessary background. The project requires a strong work ethic and interest in learning a range of instruments.

18F42 - The utilization of the near space: legal challenges and way forward

Supervisor

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Associate Professor Fabio Tronchetti

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School

Institute of Aviation Law and Standard & Institute of Space Law and Strategy, School of Law

SPECIALIZATION

Our research focuses on the legal issues related to sub-orbital flights. Specifically, our research interests are mainly centered on four topics:

(1) Law applicable to sub-orbital flights (air law/space law/both).

(2) Comparative analysis of relevant domestic legislation.

(3) Research on the issues of liability for damage and safety/security management.

(4) Proposal for models and practices for the regulation and management of sub-orbital flights.

PROJECT DESCRIPTION

Not only sub-orbital flights combine elements of air flights and space flights but also take place, for their large part, in the blurred area between airspace and outer space. For these reasons, the legal regime applicable to them remains questionable and somewhat confusing. Indeed, while international law does not directly address sub-orbital journeys, domestically certain States have passed laws to regulate them that are, however, only relevant to domestic subjects. The lack of a harmonized and clear legal framework discourages investors, slow down innovation, affects business plans, and poses safety/security threats.

Our research aims at addressing these challenges by suggesting a model for domestic regulation of sub-orbital flights and by recommending a series of steps to be taken to harmonize the matter at international level.

The research will be organized in four steps:

1 Identification of applicable law;

2 Comparative analysis of relevant domestic legislation

3 Legal analysis and regulation of selected issues (safety, liability, status of passengers)

4 Formulation of models and recommended practices

The successful candidate will contribute to each step of the research project and will be actively engaged in research and writing tasks.

STUDENT ROLES

The student will be actively engaged in working on cutting-edge topics in a multi-disciplinary environment, and will receive significant training on legal research, analysis and writing. Specifically, the candidate will learn how to use legal techniques to address innovative issues related to the utilization of the near space and to propose legal solutions that take into account the interests of the industry, regulators and users.

REQUIRED SKILLS

International law

Students interested in this project should have a good knowledge of international law, international politics, possibly, some basic knowledge of aviation law and/or space law. An additional asset would be a basic understanding of international law of the sea' s issues. Students of international economic law can also participate in this project provided that they have a basic knowledge of international law. The project requires good English skills and a strong work ethic.

18F43 - Legal regulation of sub-orbital flights: a multi-level approach

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School

Institute of Aviation Law and Standard & Institute of Space Law and Strategy, School of Law

SPECIALIZATION

Our research focuses on the legal issues related to the long-term utilization of the near space. Specifically, our research interests are mainly centered on four topics:

(1) Legal status of the near space.

(2) Comparative analysis of international and domestic laws/regulations and standards applicable to the near space.

(3) Analogy with existing international law regimes.

(4) Proposal for a new legal categorization of the near space to favor its long-term commercial utilization.

PROJECT DESCRIPTION

The utilization of the near space represents the new frontier of aerospace activities. While in the past operations were concentrated in the portion of the airspace below the altitude of 20km (65,616 feet), or in outer space above the 100 km mark (328,083 feet), technological advancements are rapidly enabling the possibility to place high-altitude platforms and vehicles in the area comprised between 20 and 100 km of altitude, the so-called 'near-space', to provide communication, navigation, sensing, internet, and other services. Near space plans are envisioned to be significantly profitable and highly beneficial to users. However, in order to become commercially viable, near space activities must solve a significant challenge: the uncertain legal status of the near space. Such an uncertainty acts as a discouraging factors on innovators and investors, creates unpredictability on the rules applicable to near space operations and poses safety/security concerns.

Our research aims at addressing these challenges by proposing a new categorization of the near space that promotes its broad accessibility and commercial utilization while respecting fundamental States' interests.

The research will be based on four pillars: 1) utilization of international law precedents and theories of law to the maximum extent; 2) achieving a balance between the interests of the industry, regulators and users; 3) promoting an use of the near space that is consistent with sovereignty, security and safety considerations; 4) adopting a legal approach that matches technological advancements and economic dynamics.

The successful candidate will contribute to each step of the research project and will be actively engaged in research and writing tasks.

STUDENT ROLES

The student will be actively engaged in working on cutting-edge topics in a multi-disciplinary environment, and will receive significant training on legal research, analysis and writing. Specifically, the candidate will learn how to use legal techniques to address innovative issues related to the utilization of the near space and to propose legal solutions that take into account the interests of the industry, regulators and users.

The student will also receive first-hand training on law-making and negotiating techniques.

REQUIRED SKILLS

International law

Students interested in this project should have a good knowledge of international law and/or international politics, and, possibly, some basic knowledge of aviation law and/or space law. An additional asset would be a basic understanding of international law of the sea' s issues. Students of international economic law can also participate in this project provided that they have a basic knowledge of international law. The project requires good English skills and a strong work ethic.

18F44 - Machine Learning Applied to GNSS Observation Data Analysis

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School

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SPECIALIZATION

My research focuses on Spacecraft Navigation and related theories and applications, including GNSS Navigation, Gravity Gradient based Navigation, Dynamic System Estimation, and Signal Processing. Specifically, our research interests are mainly centered on three topics:

(1) GNSS theory and applications: Precise Point Positioning, Attitude Determination, Precise Orbit Determination, Multi-GNSS technology, Integer Ambiguity Resolution, GNSS Data Quality Control and Pattern Analysis

(2) Gravity Gradiometer based Spacecraft Navigation: Gravity Gradiometry, Gravity Filed Modelling, Gravity Gradient Matching

(3) Advanced Signal Processing: Intelligent Optimization Algorithms, Machine Learning, Information Fusion

PROJECT DESCRIPTION

The Global Navigation Satellite System (GNSS) has been widely used in the past decades. Its application ranges from navigation, geodetic surveying, and remote sensing. The GNSS performance definitely relies on its data quality. Take GNSS precise point positioning for example. Centimeter precision is achieved only when on multipath interference, outliers, or carrier phase cycle slips exist in the observation data.

Our research will apply machine learning theory to GNSS observation data analysis, in order to find whether anomaly phenomenon exist. This will be quite useful for stand alone, non-aided GNSS applications. Actually, the GNSS code pseudorange data will be investigated in this project for single point positioning. Data training samples will be provided to distinguish channels containing larger modelling or observation errors.

STUDENT ROLES

The student will be actively engaged in working on cutting-edge topics in a multi-disciplinary environment, and will receive significant training on GNSS navigation and machine learning. Specifically, the candidate will learn how to use the popular supervised machine learning theory to GNSS data pattern analysis. Theoretical formulation, numerical simulations and experiments would be conducted to fulfill the research task.

REQUIRED SKILLS

Students interested in this project should have a basic knowledge in calculus and matrix theory, at least at the second year level (engineering, applied mathematics, and some laboratory work are typical at this stage). The project requires a strong work ethic and interest in learning a range of information theory.

18F45 - Atmospheric Sounding with Ground-based and Satellite-borne GNSS Meteorology

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School

School of Instrumentation Science and Opto-electronics Engineering

SPECIALIZATION

The research is conducted in the context of next generation satellite navigation and remote sensing systems, to support a wider range of applications.

The SNARS Group is committed to becoming a serious player in the global space science community, conducting world-class and cutting-edge research, education and innovation activities. It is currently working towards developing new methods, new algorithms and frontier technologies for satellite positioning, navigation, and timing, space situation awareness, space weather and climate change modelling.

The SNARS Group's strength lies in its internationalized team of researchers from a multitude of different research backgrounds including, satellite positioning and navigation, Global Navigation Satellite System (GNSS) meteorology, atmospheric science, space physics, geodesy and surveying. Each staff member brings with them a plentitude of research skills and fundamental knowledge that contributes of the scientific and technological prowess of the group. Further information can be found from http://shi.buaa.edu.cn/fwu

PROJECT DESCRIPTION

This project aims to develop algorithms and methodologies to integrate the observations from both ground-based and space-borne GNSS with advanced meteorological observations for weather and climate studies. This project will investigate an innovative approach for global profiling of temperature, pressure and humidity from Earth's surface to the stratosphere by employing a satellite-based radio occultation technique. This technique is promising as it is able to map the detailed refractivity profile and the structure of Earth's atmosphere inexpensively with

a fine vertical resolution and high spatio-temporal sampling density. The outcome of the project will be a GNSS-based atmospheric profiling system that can be used for data assimilation in weather forecasting and climate research. This system will provide a better understanding of climate change and global warming since the system should be able to monitor climatic variations and trends at different vertical levels for different seasons.

STUDENT ROLES

The students will be involved in one of the following research activities:

- To investigate an integration algorithm for the space-borne and ground-based GNSS meteorology in order to determine the four-dimensional water vapour distribution field;
- To develop and demonstrate an active atmospheric sounding method for data assimilation into climate variability/change research and validation/improvement of atmospheric models;
- To investigate an optimal methodology for atmospheric information retrieval;
- To establish a comprehensive but effective integration architecture for the determination of calibration-free atmospheric profiles with high resolution, high reliability and high precision;
- To support advancement in Numerical Weather Prediction (NWP) by conducting, analysing and validating meteorological data obtained from existing space missions; and

To assess and improve present water vapour attenuation models.

REQUIRED SKILLS

1. Basic knowledge and experience in both theoretical and practical aspects of GNSS, meteorology, and/or geodesy;

2. Sound experience in software development skills using Fortran, IDL, Matlab and/or C/C++, under Linux environment in particular.