Research Exchange at Beihang University

Academic Year 2019-2020

International Division
Beihang University

List of Research Projects

Notes: These projects are all in English and based at 9 schools.

19F01-02: School of Materials Science and Engineering
19F03-04: School of Automation Science and Electrical Engineering
19F05: School of Astronautics
19F06-09: School of Mechanical Engineering and Automation
19F10-14: School of Economics and Management
19F15-17: School of Space and Environment
19F18-19: School of Transportation Science and Engineering
19F20: School of Physics and Nuclear Energy Engineering
19F21-22: School of Law
19F23-24: School of Mechanical Engineering and Automation

How to apply:

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

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

19F01 - Transition-Metal-based bifunctional electrocatalysts for overall water splitting

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School

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SPECIALIZATION

My research focuses on the design, preparation and application of nanomaterials for highly efficient energy conversion and storage. Specifically, our research involves the following four topics:

(1) Controlled growth of nanostructures on conductive and semiconductive surfaces

(2) Electrocatalysis: design and preparation of electrocatalysts for overall water splitting and fuel cells.

(3) Solar-to-Chemical energy conversion: photoelectrochemical water splitting

(4) Advanced oxidation technology: nanomaterials for oxidative degradation of organic pollutants.

PROJECT DESCRIPTION

Electrocatalytic water splitting is the most promising approach to hydrogen production. Developing highly efficient noble-metal-free electrocatalysts is the key issue in the field of water electrolysis.

Our project aims at preparing "doped-type" and "interfacial-type" bifunctional electrocatalysts that are composed of first-row Group VIII metal (iron, cobalt, and nickel) compounds to improve the activity toward both the hydrogen evolution reaction (HER) and the oxygen evolution reaction (OER). We will illustrate the effect of the doping and interface-forming processes on the composition, chemical environment and electronic structure of the catalytic active sites, and reveal the structure-function relationship between active sites and HER and OER activity. We will explore the correlative and interacting dependence of HER on OER and vice versa, and develop methods for the collaboratively optimizing both HER and OER activities, and then realize highly-efficient

electrocatalytic overall water splitting. We hope the results of this project can shed light on the development of electrocatalyst systems with novel structure, high energy conversion efficiency and low cost.

STUDENT ROLES

The students will be actively engaged in the research concerning the design, synthesis, and characterization of nanoscaled electrocatalysts grown on conducting substrates for hydrogen evolution reaction (HER) and the oxygen evolution reaction (OER). They will learn the knowledges and skills of how to do research. They will receive trainings of chemical synthesis (including wet solution synthesis, chemical vapor deposition, and electrodeposition), characterization (including XRD, SEM, TEM, and many electrochemical methods), and evaluation of the property of the synthesized electrocatalysts.

REQUIRED SKILLS

Students interested in this project should have a basic knowledge in chemistry, especially inorganic chemistry, physical chemistry and/or electrochemistry. Students in chemistry, physics or chemical engineering usually have the necessary background. The project requires a strong work ethic and interest in learning a range of instrumentation.

19F02 - Study on the Evolution of Aging Microstructure and Properties of Spray Formed AlZnMgCu Aluminum Alloy

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School of Materials Science and Engineering

SPECIALIZATION

My research focuses on the materials of titanium alloy, aluminum alloy, high temperature alloy, special steel, high entropy alloy, and super tough light bionic composite materials. Specifically, our research interests are mainly centered on five topics:

(1) Mechanism and Technology of Material Strengthening and Toughening.

(2) Assessment of Structural Integrity and Safety.

(3) Assessment of Structural Damage Tolerance

(4) Assessment of Residual Strength

(5) Prediction of Service Life

PROJECT DESCRIPTION

AlZnMgCu alloy is a kind of ultrahigh strength aluminium alloy with high zinc content, however, it is easy to cause macrosegregation, microstructure coarsening and hot cracking due to its high zinc content in the traditional casting process. Spray forming technology can solve this problem well, and make the alloy obtain excellent microstructure and properties. However, the corrosion resistance of this alloy is poor, which is prone to corrosion failure in practical use. Therefore, special aging treatment is needed to improve the corrosion resistance without losing the strength of the alloy.

In this study, we are focusing on studying the original structure of spray formed 7034 aluminum alloy, exploring and optimizing the aging process of the alloy, and studying the influence of aging microstructure on the comprehensive properties of the alloy. We

need develop a new heat treatment technology which can optimize the comprehensive properties of the alloy, and provide guidance for the development of the actual treatment process.

The successful candidate will develop a novel double aging treatment technology, and finish the complete evaluation of the mechanical property.

STUDENT ROLES

In this study, spray formed 7034 aluminum alloy will be taken as the research object. The student needs to analyse the microstructure of the alloy after experienced different aging treatment, and explain the reason of excellent properties of the alloy. Double aging process parameters performed at low temperature will be selected through hardness and conductivity testing. The evolution of precipitates in alloys under different aging conditions will be studied by observing the nano-precipitates. Tensile testing, intergranular corrosion testing, exfoliation corrosion testing, stress corrosion cracking testing and intergranular corrosion + tensile testing can be carried out to study the effect of aging conditions on mechanical properties and corrosion resistance of the alloy. Specifically, the candidate will learn 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, etc.

REQUIRED SKILLS

Students interested in this project should have a basic knowledge of metal materials, such as aluminum alloy and steel and so on. The project requires a strong work ethic and interest in learning a range of instrumentation.

19F03 - Hyperspectral data classification

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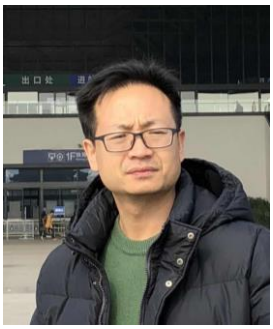

SPECIALIZATION

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

As an emerging technology, hyperspectral imaging provides huge opportunities in both remote sensing and computer vision. The advantage of hyperspectral imaging comes from the high resolution and wide range in the electromagnetic spectral domain which reflects the intrinsic properties of object materials. By combining spatial and spectral information, it is possible to extract more comprehensive and discriminative representation for objects of interest than traditional methods, thus facilitating he basic pattern recognition tasks, such as object detection, recognition, and classification. With advanced imaging technologies gradually available for universities and industry, there is an increased demand to develop new methods which can fully explore the information embedded in hyperspectral images. In this thesis, three spectral-spatial feature extraction methods are developed

for salient object detection, hyperspectral face recognition, and remote sensing image classification.

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 nanomaterials synthesis, characterization, and electrochemistry. Specifically, the candidate will learn how to use this green chemistry technology to synthesize various noble metal (Pt, Au, Ag, etc.) nanostructures 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, etc.

REQUIRED SKILLS

Inorganic chemistry, and/or electrochemistry.

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, physics or chemical engineering usually have the necessary background. The project requires a strong work ethic and interest in learning a range of instrumentation.

19F04 - 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 more candidatures if they are qualified.)

1. Development of intelligent robotic system: This study is mainly on development of parallel or serial robotic system for intelligent manufacturing or assembly. The system will recognize the environment and complete the task automatically for fused signals of video, displacement and force. This is one important direction of intelligent robots in subsequent years. We will also do capsule robot for medical purpose, and UAV such as ornithopters for aerospace applications.

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.

19F05 - Aerodynamic Design of a Twin-Fuselage Aircraft for Space Launch

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Department of Spacecraft Technology
School of Astronautics

SPECIALIZATION

My research interests are in spacecraft conceptual design and multidisciplinary design optimization of aerospace vehicles. Specifically, it includes the following aspects:

1. Design of Expendable Launch Vehicle;

2. New Conceptual Design of a Reusable Space Launch Vehicle;

3. Aerodynamic Design of Aerospace Vehicle;

4. Research on Deep Space Transportation System.

PROJECT DESCRIPTION

The air launch of the space launch vehicle is a novel launch method that is maneuverable and flexible. As a carrier for air launch, the twin-fuselage aircraft has a large load and can be used to carry launch vehicle with greater payload capacity. At present, typical representatives include White Knight No. 2, Stratospheric Launch System, and similar research projects in Russia and France.

This project will carry out aerodynamic configuration design and aerodynamic performance calculation for the twin-fuselage aircraft used for space launch, forming a preliminary feasible aerodynamic configuration for twin-fuselage air launch vehicle.

The research will be based on NASA's open source aircraft design software OpenVSP. By participating in the research work of this project, students will be able to accumulate experiences in aerodynamic design and aerodynamic performance analysis of aircraft.

STUDENT ROLES

Under the guidance of the instructor, students will familiarize

themselves with NASA's open source aircraft design software OpenVSP and the aerodynamic analysis tool VSPAero.

Then use OpenVSP to design the twin-fuselage aircraft, establish a number of shape schemes for analysis, apply VSPAero to calculate the aerodynamic characteristics, analyze and compare, summarize the research results, and write research report and academic paper.

REQUIRED SKILLS

Full of interest and enthusiasm for space exploration, understanding the basic principles of aircraft aerodynamics and space launch, and initial capabilities for 3D geometric modeling.

19F06 - Wire + arc additive manufacturing (WAAM) for large scale aluminum alloy components

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School

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.

19F07 - Flow and fluid-solid interaction in soft porous medium

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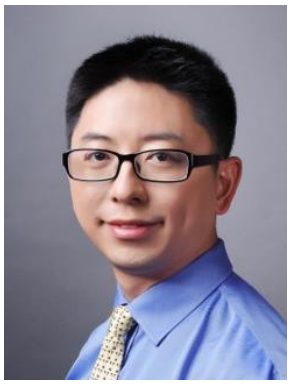
School

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 robotics 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.

19F08 - Adhesion and friction at soft interfaces

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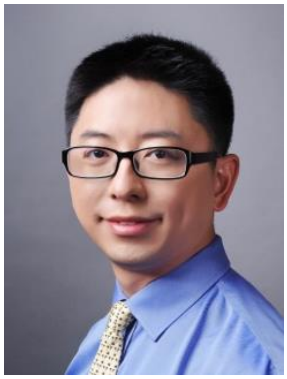

SPECIALIZATION

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 has the necessary background. The project requires a strong interest in learning new concepts and working in a multidisciplinary environment.

19F09 - Design and manufacturing of Capsule Robot with Orientation Controlled by External Magnetic Field

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School

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

Recently, study of microrobot for biomedical usage becomes very popular, such as drug delivery, cell manipulations, and endoscopy. The standard endoscope examination for the gastrointestinal tract is discouraging for lots of patient who commenced or are about to do the procedure, due to the overall perceived size of the gastroscope, which triggers gag reflex and often requiring sedation. Capsule robots were developed to overcome these difficulties with endoscopy as a main purpose, since then capsule robots are progressively improving to include not just the endoscopy system but also other system such as localization system, wireless charging system, wireless data transmission system, in recent years the majority of the researchers focused on improving the performance and quality of captured footage, capsule robots require more innovation to overcome new found

limitations, such as the robot limited by the flow in the digestive system, and other major limitation, some researchers have considered those limitations and began developing legged capsule robots with a sole purpose to hold the capsule in place while the footage is being captured, other researchers seeks answer from magnetic field, most of those solutions remain in preliminary stages and require more development before it is safe for the human testing.

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 how to make the robot in small scale. Specifically, the candidate will learn how to use the electromagnetic system to control the small robot wirelessly, and how the MEMS techniques are used in this field, they can learn image processing, VR, AI, machine learning stuff to use these new technologies in this field etc.

REQUIRED SKILLS

Computer science, Electrical Engineer, and/or Mechanical Engineer

Students interested in this project should have a basic knowledge in Programming, image processing, EE basic knowledge or Mechanics basic knowledge.

19F10 - Online distribution of airline tickets

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School

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Department of
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Management
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.

19F11 - The Efficiency and Fairness of the Assignment of Dedicated Lanes of Airports

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School

Head of the Department of Behavioral and Operations Management 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

Many airports in China are providing female passengers or passengers carrying little baggage with dedicated lanes at the security check points. Such practices are actually providing preferential service for passengers of different service demands. This paper is mainly concerned with the problem that how the airports should assign the dedicated lanes to achieve a better performance of efficiency and fairness under a limited number of security check lanes. By modeling we compared the performances of queueing systems when assigning the dedicated lanes to different kinds of passengers. The expected waiting time curve of the number of dedicated lanes is given and the queueing fairness is quantified by applying SQF in the simulation. The comparison shows that assigning a certain number of dedicated lanes to the passengers with lower service demands is better in terms of fairness and efficiency.

STUDENT ROLES

The student will be engaged in working on topics about Queuing 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 Markov models, but also learn how to use simulation model to

reproduce queuing behavior in various other fields with limited service ability.

REQUIRED SKILLS

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

19F12 - Optimal Control Strategies of Public Transit with Information Provision

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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

Bus bunching is a common phenomenon in public transport system. Many control methods have been proposed to mitigate its negative effects and improve passenger satisfactory. Among these methods, holding control is one of the most effective and common strategies that can be used to regulate bus operation. The holding control approaches can be mainly classified into two groups, namely, schedule-based control and headway-based control. And what' s more, the problem is in focus because of the available information with the rapid development of new technology such as GPS, IC card and the Internet. However, something should be pointed out that these control methods require high manpower and operation cost.

Passengers on transit network are often faced with the problem of choosing between either to board the very crowded arriving bus or to wait a bit longer for the next but less crowded one. Many assignment models are based on the assumption that at a given stop passengers are likely to board the first arriving carrier of a certain subset of the available lines. However, when on-line information on future arrivals of buses are posted at the stop it is unlikely that the above classical assumption holds. Passengers may

choose in this case to board a line that offers the best combination from original to destination considering on-line information such as waiting time and in-vehicle congestion information displayed at the bus stops or in their smart phones. The rapidly evolving wireless communication technology, positioning technology and IC card technology have enabled most transit passengers to access passenger information on their smart phones and other mobile devices whenever and wherever they desire.

STUDENT ROLES

Firstly, the student will review literatures about public transit management and various control strategies. Secondly, the student will build a mathematical model to realize the dynamic process of the bus system. 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 operating the buses.

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.

19F13 - Who is more likely and where is easier to be a passenger in ride-sharing?

Supervisor

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School

Head of the Department of Behavioral and Operations Management 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

The ubiquity of Internet and application of global positioning system (GPS) enabled cell phones provides new opportunities to enable dynamic ride-sharing, where rides are established on very short notice or even en-route. In this paper, the travelers are assumed homogeneous in terms of having the same attitude towards ride-sharing mode. When they confirm their random distributed travel demand, including the OD and time requirements, they firstly announce their request and the platform checks whether they can be picked up by any driver. If failed, they will drive by themselves and become a driver who would like to pick up other passengers en-route. The ride-matching problem is formulated as a set-partitioning problem and a reduction mechanism is proposed to reduce the size of the feasible routes existed in the system. Because the matching problem is NP-hard, we propose a heuristic method to solve the ride-sharing match problem, and compare the results generated by CPLEX for cases with relatively small size. Consequently, several numerical experiments are conducted by using both simulating generated data and the real world taxi request data of Chengdu in China. Several interesting results are found, such as the "passenger ratio" exhibits a decreasing trend as increasing the distance from the

center of region and the lower the mileage of OD trip, the higher "passenger ratio".

STUDENT ROLES

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

REQUIRED SKILLS

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

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

19F14 - The market equilibrium and social welfare in taxi market with E-hailing applications

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Head of the Department of Behavioral and Operations Management 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 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.

19F15 - Design, experiment and modeling of electromagnetic thrusters

Supervisor

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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 magnetic nozzle, 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 instrument, 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).Theoretical Modeling of Acceleration Mechanism of Electromagnetic Propulsion

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, plasma probes, micro-thrust stand, mass flow control and measurement instrument, 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++, and learning a range of instrumentation.

19F16 - Design, experiment and modeling of space electric propulsion 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 magnetic nozzle, 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 instrument, 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).Theoretical Modeling of Acceleration Mechanism of Electromagnetic Propulsion

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, plasma probes, micro-thrust stand, mass flow control and measurement instrument, 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++, and learning a range of instrumentation.

19F17 - 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) Biomass conversion: the application of core-shell hierarchical zeolites/hollow zeolites for the catalytic fast pyrolysis of biomass.

(2) The adsorption of heavy metals from sea water: the application of water stable metal organic frameworks (MOFs) or MOF/GO films for the adsorption of heavy metals from the aqueous solution.

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.

19F18 - New concept ice protection system for aero-engine

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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.

19F19 - 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.

19F20 - 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.

19F21 - The utilization of the near space: legal challenges and way forward

Supervisor

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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 factor 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.

19F22 - 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 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.

19F23 - Physical Vapor Deposition & Ion Implantation

Supervisor

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School

Director, Surface Advanced Coating Lab.
School of Mechanical Engineering & Automation

SPECIALIZATION

Professor Li heads the Surface Advanced Coating and Technology Group. Research projects in these areas are a stimulating mix of fundamental physics and practical applications, in areas which include materials physics, plasma deposition and processing, thin film materials, super hard coatings, lubricating coatings, cross-disciplinary research in the areas of Mechanical Engineering and Materials Engineering. He has published over 200 articles in international refereed journals, 3 book chapters and 11 patents.

Our surface coating and technology focused on four topics:

(1) Plasma Immersion Ion Implantation.

(2) Cathodic Arc Deposition and the Arc Plasma Filter.

(3) Magnetron Spurttering and High-power impulse magnetron sputtering (HiPIMS).

(4) Hybrid surface modification methods, materials, and application.

PROJECT DESCRIPTION

High power pulsed magnetron sputtering (HIPPIMS) is a new method for producing a highly ionised flux of material from a solid target for coating applications. Indications are that it produces a high ionized flux (approaching that of the cathodic arc). The nature of the plasma produced when high power pulses are applied to a sputtering target will underpin commercial application of this source for materials synthesis and is still not understood. In this project high speed optical and electronic diagnostic tools capable of probing the rapidly changing discharge should be developed and deployed. Langmuir probes will be used to investigate the electron temperature. The ultimate aim is to understand the plasma area associated with species in

the plasma to determine their densities and velocities. The transport of particles and species from the target to the substrate.

This project will build up high-tech plasma diagnostic equipment, such as time resolved Langmuir probes, microwave and laser interferometry and tomography, and CIS spectroscopy).

STUDENT ROLES

This research field is very large and rapidly evolving so there is a number of projects available for PhD, Masters and Honours students. Students involved in the work will learn how to design, build and use a range of high tech diagnostic instruments, including high resolution spectrometers, a range of interferometers, electrostatic probes and mass energy analyzers.

REQUIRED SKILLS

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

19F24 - Experimental and Simulation Study of Incremental Sheet Forming

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School

Director, Laboratory of Aerospace Manufacturing Engineering
School of Mechanical Engineering and Automation

SPECIALIZATION

(1) Two-point incremental sheet forming

(2) Double-sided incremental sheet forming

(3) Robot assisted incremental sheet forming

(4) FE simulation of incremental sheet forming

(5) Mechanical properties and microstructure of formed parts

PROJECT DESCRIPTION

Incremental sheet forming (ISF) is a novel sheet forming process. In ISF, the forming tool imposes a localized material deformation by directly contacting with the blank and the desired part is formed by the accumulation of these localized deformations. ISF has received widespread study due to its advantages of economy and flexibility in small batch sheet metal parts. However, to widen the application in the industrial field, ISF have to overcome the forming quality problem, such as surface quality, geometric error and thickness distribution.

Our research will investigate the cause of forming quality problem in ISF. Based on machines developed by us, the forming problem of parts in aerospace field will be investigated through experiment and finite element simulation.

STUDENT ROLES

The student will be actively engaged in working on cutting-edge topics in incremental sheet forming, and will receive significant training on FE simulation, ISF experiment and material characterization. Specifically, the candidate will learn how to

manufacture parts by ISF and establish FE model in ABAQUS or PAM-STAMP, learn how to test the material mechanical property and perform microscopic characterizations.

REQUIRED SKILLS

Mechanical engineering, Manufacturing engineering.

Students interested in this project should have a basic knowledge in mechanical engineering; at least at the second year level (strength of materials should be studied). Students in mechanical engineering usually have the necessary background.