Fall 2016--
Spring 2017

Research Exchange at Beihang University

International Division
Beihang University

List of Research Projects

Notes: The 2016 projects are all in English, 3~6 months long, and based at three Schools

16F01-02: School of Energy and Power Engineering
16F03-05: School of Automation Science and Electrical Engineering
16F06-09: School of Instrumentation and Opto-electronics Engineering

Applicants should contact their prospective supervisors by sending their CV and motivation letter while copying international@buaa.edu.cn.

For detailed application procedures and assistance, please visit:
http://id.buaa.edu.cn/lxbh/jhxx/Exchange_Studies_at_Beihang_University.htm

16F01 - Tip leakage flow in high pressure turbines

Supervisor

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School

School of Energy and Power Engineering

SPECIALIZATION

My research focuses on the aerodynamic design technology of advanced high loaded turbine, unsteady flow mechanism of turbomachinery, advanced CFD methods and multidisciplinary coupling study. Specifically, our research interests are mainly centered on four topics:

(1) Boundary layer transition

(2) Tip leakage flow mechanism and leakage loss control

(3) Flow/thermal/solid coupling mechanism and numerical method

PROJECT DESCRIPTION

Tip leakage flow is inevitable in turbomachinery, especially in high pressure turbines. It is very important to control the tip leakage loss for improvement of turbine efficiency. The purpose of this project is to develop some effective methods for suppressing tip leakage loss, such as 3D blade tip structure design, blade tip cooling holes design and low-dimensional model development for predicting tip leakage flow and loss. Theoretical analysis, CFD and experiment methods will be used in this study.

STUDENT ROLES

The students should learn about the flow physics of tip leakage flow firstly. Then they will summarize the studies on the influence law of cooling hole geometrical/aerodynamic parameters on tip leakage loss, and do some studies on blade tip cooling hole arrangements and optimization.

REQUIRED SKILLS

Students interested in this project should have a basic knowledge in fluid mechanics, CFD and some professional software such as CFX, TECPLOT. The students are also required with a strong work ethic.

16F02 - Multi-scale Modeling for Surface Treatment Process

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School

School of Energy and Power Engineering

SPECIALIZATION

My research focuses on the experimental study and multi-scale modeling of strength, fatigue and damage tolerance for Aeroengine components. Specifically, my research interests are mainly centered on three topics:

(1)Finite element modeling and experimental investigation of the residual stress induced by the processes of shot-peening/laser shock peening and welding.

(2)Combined fatigue mechanism and established experimental systems including plain specimens, component-like specimens and actual components: such as combined high-low cycle fatigue test for turbine blade-disc attachment, thermal mechanical fatigue (TMF) for turbine blade, etc.

(3)Probabilistic design and uncertainty quantification (UQ): Consider the uncertainties involving material, load and geometry so as to quantify the failure risk or structural reliability using probabilistic method or QMU.

PROJECT DESCRIPTION

The residual stress of aerospace components will be induced by surface treatment process to improve the fatigue life and crack growth resistance. The key issue is to simulate the surface treatment process by finite-element method and to investigate how the residual stress affects mechanics performance and components' life.

My research will apply finite-element modeling to address plasticity induced residual stress during surface treatment process

and life prediction for the metal components. Additionally, the aim of my research is to optimize the surface treatment process by controlling the process parameters.

STUDENT ROLES

The student will be actively engaged in working on surface treatment process such as peening topics in a multi-disciplinary environment, and will receive significant training on materials characterization, stress analysis and life prediction. Specifically, the candidate will learn how to use this surface treatment process to improve the components' lifetime and further to optimize the surface process and how to perform finite element modeling, experimental methodology and microscopic characterizations, including scanning electron (SEM), transmission electron microscopy (TEM), X-ray diffraction (XRD) analysis, etc.

REQUIRED SKILLS

Solid mechanics, materials engineering, and/or finite element simulation.

Students interested in this project should have a basic knowledge in materials engineering and solid mechanics. Students in aerospace engineering usually have the necessary background. The project requires a strong interest in finite element simulation such as Abaqus, Ansys software.

16F03 - Event-triggered control, cooperative control of multi-agent systems

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School

School of Automation Science and Electrical Engineering

SPECIALIZATION

Prof. Hao’ s main research area is focusing on the ongoing topics:

Distributed cooperative control of networked multi-agent systems

Model-based event-triggered control of networked control systems

Consensus control of multi-agent systems by event-triggered control methods

PROJECT DESCRIPTION

Cooperation control of multi-agent systems has gained much attention due to its broad applications. The advancements are that a group of networked autonomous agents can perform tasks more efficiently than a single agent or can accomplish tasks not executable by a single one. Moreover, networked multi-agent systems have advantages like increasing tolerance to possible agent fault, providing flexibility to the task execution or taking advantage of distributed sensing and actuation.

To coordinate with other agents in a network, each agent needs to share information with its neighbors so that all can agree on common goal of interest, e.g. the value of some measurement in a sensor network, the heading of a UAV formation, or the target position of robotic team. To reduce communication and computing resource in the resource limited systems, event-triggered control strategy will be used. Because of the interdisciplinary nature of the field, the study of distributed cooperative control problem and event-triggered control problem of networked multi-agent systems have attracted increasing

attention from researchers in various fields of physics, mathematics, automatics, engineering, and biology.

The objective of this project is to develop new distributed control algorithms and new event-triggered control algorithms for networked multi-agent systems, according to different cooperative tasks or different performance tasks, and improve the effective of networked multi-agent systems both from the viewpoint of stability and performance in accomplishing certain tasks and in the robustness and reliability of the system.

STUDENT ROLES

The aim of this project is to develop new distributed control algorithms and event-triggered control algorithms to successfully use cooperation control problem of multi-agent systems. The prospective student will gain experience across different disciplines including control theory, control engineering and related disciplines. Students with good degrees in control engineering, mathematics, and physics are encouraged to apply. If you are interested in this project, and are unsure about whether you have the right background, please contact me.

REQUIRED SKILLS

Prospective candidates with background in Automatics, Mathematics, Control Theory, Control Engineering, Physics and related disciplines, with good academic performance records in their undergraduate/postgraduate studies, are encouraged and invited to apply for and get involved in an appropriate project.

16F04 - Robotics and Actuation Technology

Supervisor

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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 candidatures 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.

16F05 - Brain Decoding Models for neurodegenerative disease aided diagnosis and classification

Supervisor

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School

School of Automation Science and Electrical Engineering

SPECIALIZATION

Dr. Li’ s main research area is focusing on the ongoing topics:

(1)System identification and modeling for complex nonlinear processes: NARMAX methodology and applications;

(2)Nonlinear and nonstationary signal processing: intelligent computation and data mining, parameter estimation and model optimization, sparse representation etc.

(3)Signal processing and data modeling: Neurophysiology and neuroimaging data modeling and analysis with applications in clinical and medical diagnosis and prognosis; EEG, fMRI/MEG and ECG data processing, modeling and analysis; brain computer interface etc.

(4)Image processing and machine learning: novel methodologies developments of image registration and segmentation algorithms, multivariate pattern classification algorithm to control engineering, bioengineering, neuroscience, systems/ synthetic biology, navigation etc.

PROJECT DESCRIPTION

Brain-related diseases such as epilepsy, (mild cognitive impairment) MCI or AD and mental disorders, normally cause suffering and place a huge toll on the health care systems of the world. To find better medical diagnosis and treatments, neuroinformaticians are developing the infrastructure and tools needed to integrate many levels of data and link symptoms to the underlying disease causes. Neruoinformatics, which applies computational tools and approaches that are essential for

understanding the brain, integrates information across all levels and scales of neuroscience to help interpret the brain and treat disease. It encompasses the computational tools and signal processing techniques for data acquisition, tuning the computational mathematical model, feature extraction and classifier training analysis, visualization, modeling and simulation. Signal processing techniques are commonly used for feature extraction in medical diagnosis, cognitive neuroscience and many other application fields. The main purpose of signal processing is to reveal underlying information on specific problems in these applications. To make a meaningful interface at the group level, developing generic brain decoding models that work well across different subjects is crucial. However, because of the structural and functional differences of the brain across subjects together with the inherent variability of the brain measurements due to, for example, changes in environmental variables, a certain degree of difference is expected between the brain signals of different subjects for different neurodegenerative diseases.

STUDENT ROLES

The aim of this project is developing new adaptive and machine learning algorithms to successfully decode brain signals across subjects from different neurodegenerative diseases. The prospective student will gain experience across different disciplines including engineering, computer science, signal processing, machine learning and neuro-computation. Students with good degrees in engineering, computer science, mathematics, physics and neuroscience are encouraged to apply. If you are interested in this project, and are unsure about whether you have the right background, please get in touch.

REQUIRED SKILLS

Prospective candidates with background in Engineering, Computer Science, Mathematics, Biomedical and Bioengineering, Physics and related disciplines, with good academic performance records in their undergraduate/postgraduate studies, are encouraged and invited to apply for and get involved in an appropriate project.

16F06 - Measurement scheme experiment for atomic Magnetic Microscopy

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School

School of Instrumentation and Opto-electronics Engineering

SPECIALIZATION

My research interests include:

(1)High precision atomic spin sensors,

(2)Atomic Magnetic Microscopy,

(3)Microfabrication and devices,

(4)New sports based on MEMS sensors

PROJECT DESCRIPTION

Atomic magnetic microscopy is attracting in that it has the potential to obtain better spatial resolution and magnetic sensitivity simultaneously than the other methods such as scanning SQUID microscopy, NV-diamond microscopy. However, the diffusion of the gas atoms limit the spatial resolution of atomic magnetic microscopy currently.

Our research will apply short pulse atomic spin polarization technology and microelectromechanical system (MEMS) technology to solve the problem. The proposed research project is an initial step and an individual experiment for the atomic magnetic microscopy conception.

The successful candidate will setup a short pulse experiment based on our design and equipment.

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 and atomic experiments. Specifically,

the candidate will learn how to optimize the optical pumping system and how to analyze the experimental data theoretically, etc.

REQUIRED SKILLS

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

16F07 - Fiber laser based on Er-doped photonic crystal fiber

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School

School of Instrumentation and Opto-electronics Engineering

SPECIALIZATION

My research focuses on fiber laser, fiber optic sensors

PROJECT DESCRIPTION

Fiber lasers are innovative laser technologies. Narrow linewidth fibre lasers have important applications in optical communications, sensing, and imaging and broadband fiber lasers are the key part of many fiber sensors, such fiber optic gyroscope and fiber grating, etc.. Our research will develop high performance fiber source, including narrow linewidth fiber laser and broadband fiber source, with innovative photonic crystal Er-doped fiber The successful candidate will develop fiber laser and measure and investigate the characteristic of fiber laser.

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 fiber and fiber laser. Specifically, the candidate will learn how to use fusion splicer and other instruments to assembly a fiber laser and use optical spectrum analyzer and other instruments to measure and investigate the characteristic of fiber laser, etc.

REQUIRED SKILLS

Optics, and/or Physics, and/or Electronics .
Students interested in this project should have a basic knowledge in optics and laser, at least at the second year level, physics or optics usually have the necessary background. The project requires a strong work ethic and interest in learning a
range of instrumentation.

16F08 - Satellite-Based Radio Occultation for Atmospheric Sounding, Weather Forecasting and Climate Monitoring

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School

School of Instrumentation 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 modeling.

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.

PROJECT DESCRIPTION

This project aims to develop algorithms and methodologies to integrate the observations to/from Global Navigation Satellite Systems (GNSS) and Low Earth Orbiting (LEO) satellites 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 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 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 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.

16F09 - Robust Signal Quality Monitoring and Threat Mitigation for the Next Generation Global Navigation Satellite Systems

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School

School of Instrumentation 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 modeling.

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.

PROJECT DESCRIPTION

The modernization of the US GPS, the revival of the Russian GLONASS and the advent of the European Galileo system will lead to the next generation Global Navigation Satellite Systems. Many safety-critical applications that utilize the GNSS, such as aircraft navigation, require a high quality satellite signal. Three major threats to GNSS signal quality are satellite signal anomaly, radio frequency interference and multipath. To mitigate these threats, a

novel signal processing technique based on software defined radio approach and multiantenna and multicorrelator techniques is proposed, which will then lead to the design of a GNSS signal threat mitigation receiver. The aim of this project is to develop a robust signal quality monitoring (SQM) and signal threat mitigation (STM) solution for the next generation GNSS.

STUDENT ROLES

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

-To investigate GNSS satellite signal anomaly and develop a novel GNSS signal quality monitoring method;

-To study GNSS radio frequency interference (RFI), and develop a novel RFI detection, location and suppression technique for the next generation GNSS; and/or

-To investigate and develop new GNSS multipath mitigation approaches for the next generation GNSS signals.

REQUIRED SKILLS

1. Basic knowledge and experience in both theoretical and practical aspects of GNSS receiver, signal processing;

2. Sound experience in software development skills using Matlab and/or C/C++