ROYAL INSTITUTE OF TECHNOLOGY

Positions available at

KTH Royal Institute of Technology

for entry academic year 2021

for Chinese Scholarship Council (CSC) appilcants

Content

Full PhD student:(48 months)

Ventilation performance in Indoor Environment (Reg. No. 2101)

Type of position Full PhD student: (48 months)		**Main supervisor** Sasan Sadrizadeh
KTH School ABE		**Co-supervisor(s)**
KTH Department Department of Civil and Architectural Engineering		**Main email contact** ssad@kth.se

Specific subject area(s)

Fluid Mechanics, Indoor Air Quality and Health, Laboratory Measurement

Title of project

Ventilation performance in hospital environment

Number of available positions

1

Earliest start date

01 January, 2021

Latest start date

01 Semptember, 2021

Short description of the project

KTH, School of Architecture and Built Environment is looking for a doctoral student to research the area of Fluid and Climate Technology. The doctoral student in the Fluid and Climate Technology specialization will be focusing on the airborne spread of infectious agents in the hospital environment. The purpose of this research is to evaluate and develop solutions for airborne pollutant removal and control in the hospital environment. Considering the recent COVID-19 outbreak, we want to develop a COVID Secure environment in hospital operating and isolation rooms.

Qualifications

You are expected to have a Master degree in Technology, or a similar degree, which includes courses in the topics of fluid dynamics and mass/heat transfer, aerosol technology, chemistry, measurement technologies. Experience and interest in basic measurement technology and CFD (Computational Fluid Dynamics) simulation and numerical methods is essential. You are expected to have good knowledge and experience in laboratory works and measurement technologies that enable you to measure airflow filed (velocity and temperature) as well as particle and tracer gases. In addition, you should be able to conduct CFD simulations using the commercially available code ANSYS Package.

For PhD studies to be successful, it is necessary to have a high degree of motivation for scientific research, well developed analytical capacity, ability to work independently, good communication abilities and the social ability to work in a team. Good language skills in English both writing and speaking are also expected.

Chemistry (Reg. No. 2102)

Type of position Full PhD student: (48 months)		**Main supervisor** Assistant Prof. Markus Kärkäs
KTH School CBH		**Co-supervisor(s)** Peter Dinér
KTH Department Department of Chemistry		**Main email contact** karkas@kth.se

Specific subject area(s)
Organic chemistry
Title of project
New Light on Chemical Synthesis
Number of available positions
1
Earliest start date
May 2021
Short description of the project
The use of visible light photoredox catalysis for promoting single-electron transfer processes enables formerly inaccessible or challenging reaction manifolds to be explored under exceptionally mild reaction conditions. The overall objective of this research project is to extend the present limits of current state-of-the-art functionalization technologies by integrating new approaches to generate and utilize nitrogen-centered radical intermediates in coupled processes as well as cooperative catalytic systems for assembling nitrogen-containing motifs. One key feature of the strategies is the exploitation of feedstock chemicals, such as carboxylic acids, alcohols and olefins, as handles for controlled radical generation and subsequent bond formation. A combination of methodology development with mechanistically guided studies will provide a framework for expediting nontraditional bond constructions and expanding the synthetic repertoire. The research project will provide opportunities for dramatically simplifying synthetic chemistry and will streamline access to, for example, valuable pharmacophores and biologically relevant targets within fundamental and applied research.

Medical image analysis (Reg. No. 2103)

Type of position Full PhD student: (48 months)		**Main supervisor** Örjan Semdby
KTH School CBH		**Co-supervisor(s)** Chunliang Wang
KTH Department Departement of Biomedical Engineering and Health Systems		**Main email contact** orsme@kth.se

Specific subject area(s)

Artificial Intelligence for Medical image analysis

Title of project

Deep learning based image analysis method for studying cardiovascular diseases

Number of available positions

1

Earliest start date

August 2021

Short description of the project

Cardiovascular disease is the leading cause of death worldwide. Several large medical imaging studies have aimed at studying the risk factors, severity and prognosis of cardiovascular diseases using 3D imaging modalities such as CT, MRI, and ultrasound, which include the Swedish CArdioPulmonary bioImage Study (SCAPIS). While the early efforts and financial support have been focusing on the study design and imaging acquisition, it has become more and more evident that there is a lack of automated or semi-automated image analysis tool to perform quantitative analysis of the image data to allow researchers to better understand the disease pattern. Our research group is actively involved in developing advanced deep-learning-based image analysis tools to data-mine the big medical image databases and provide the clinicians with automated diagnosis tools. In this project, the PhD candidate will work closely with our clinical partners to develop advanced AI tools for diagnosis and evaluate cardiovascular disease and support big medical image data mining. The PhD candidate is expected to work with both advancing the deep learning theory to improve the accuracy and robustness of deep neural networks and translating the advanced image analysis methods to serve clinical practice. Good understanding of deep neural networks and good communication skills in English are required to apply for this position.

Solid mechanics; Mechanical engineering (Reg. No. 2104)

Type of position Full PhD student: (48 months)		**Main supervisor** Xiaogai Li
KTH School CBH		**Co-supervisor(s)** Peter Halldin; Svein Kleiven
KTH Department Biomedical Engineering and Health Systems (MTH)		**Main email contact** xiaogai@kth.se

Specific subject area(s)

Head injury biomechanics; Finite element modeling; Head protection systems

Title of project

Mechanisms of head and neck injuries towards improved head protection systems

Number of available positions

1

Earliest start date

01 Semptmber, 2021

Short description of the project

Traumatic brain injury (TBIs) is a worldwide problem not only lead to substantial financial burden but also long-lasting consequences for the victims and close relatives. A better understanding of injury mechanisms is a necessary step towards developing novel and effective head protection systems to reduce the risks of brain injuries. Despite extensive research on adults, the injury biomechanics for children are less studied. Today, head protection for children are mostly scaled from adults. But children's heads cannot be taken as scaled small adults head due to nonlinear growth both in material property and geometrical. Further, different ages of children may injure differently. Thus, a better understanding of the age-dependent head injury mechanisms are needed towards developing effective head protection systems (e.g., helmets) specifically for children, further, to optimize for different-ages of children. Besides, with more e-bikes and e-scooters emerging as new commuting tools, there is an urgent need to understand the mechanisms of TBIs in case of falls, as well as to develop targeted head protection systems. This project will be divided into two major parts: 1. Use advanced Human body models (HBMs) and head models of different details of children to study the age-dependent head injury mechanisms; 2. Develop & optimize novel head protection systems for different ages of children, as well as for e-bikers and e-scooters.

The research will be carried out at Division of Neuronic Engineering at KTH in collaboration with MIPS AB – an innovative head protection system company. The Division has a long tradition of performing multidisciplinary researches focusing on developing new and effective technology innovations for head and neck injury prevention as well as clinical treatment using advanced human head models. Since its establishment, several spin-off companies have been founded from the research conducted at the Division, e.g.,

MIPS AB, Impact Neuronic AB, Repair Technologies Sweden AB, Bioservo Technologies. The group also maintains thematically diverse international research collaborations and national industrial partners.

We are seeking a highly motivated and ambitious Ph.D. student for the above-outlined research project. The candidate is expected to have a solid background in solid mechanics. Experience in Finite Element (FE) modeling and computer programming is desirable, but not mandatory. The successful candidate will gain substantial experience in injury biomechanics, finite element modeling, and innovative product design. The candidate will also be given solid technical support and supervision.

Chemical Engineering (Reg. No. 2105)

Type of position Full PhD student: (48 months)		**Main supervisor** Zeynep Cetecioglu Gurol
KTH School CBH		**Co-supervisor(s)** Kerstin Forsberg
KTH Department Chemical Engineering		**Main email contact** zeynepcg@kth.se

Specific subject area(s)
Environmental Biotechnology
Title of project
Bioengineering Approach for Baltic Sea
Number of available positions
1
Earliest start date
March, 2021
Short description of the project
The Baltic Sea is a semi closed and brackish sea that is bordered by nine countries (Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russia and Sweden). The major environmental problem in the Baltic Sea is eutrophication due to excessive nitrogen and phosphorus loading. Although nutrient inputs have been reduced in the last decades by strict actions of the countries, the eutrophication problem is still ongoing. Hypoxic bottom water results in release of phosphorus from sediment to the water column promoting the "vicious circle" of eutrophication. So, it is urgent to find solutions for the remediation of the Baltic Sea and to prevent internal release of phosphorus. Furthermore, phosphorus was announced as a critical raw material in 2014 by the European Commission; recovery of phosphorus should also be integrated into remediation of the Baltic Sea to promote the circular phosphorus economy in the region.
This project aims to propose a sustainable solution to reduce the effects of eutrophication of the Baltic Sea and to recover phosphorus using bioengineering approaches. The objectives of the project consist of:
1- Deep water and sediment characterization of the Baltic Sea,
2- Optimization of operational and environmental conditions of the bioengineering approach by short term screening experiments,
3- Long term operation of bioreactors for testing system applicability,
4- Evaluation of phosphorus recovery options,
5- Proposing a feasible and sustainable pilot scale operation.

Biotechnology (Reg. No. 2106)

Type of position Full PhD student: (48 months)		**Main supervisor** Torbjörn Gräslund
KTH School CBH		**Co-supervisor(s)**
KTH Department Protein science		**Main email contact** torbjorn@kth.se

Specific subject area(s)

Protein engineering and design

Title of project

Affibody molecules for medical applications

Number of available positions

1

Earliest start date

1 September, 2021

Short description of the project

Affibody molecules are folded and small engineered affinity protein domains, which can be generated to interact specifically with desired targets with high affinity. During recent years our group has focused on development of affibody molecules for cancer diagnostics and therapy as well affibody molecules to enhance the efficacy of biological drugs. Two key high-impact publications describe some of our efforts:

Altai M. et al. J Control Release. 2018 Aug 30;288:84-95.

Seijsing J. et al. Proc Natl Acad Sci U S A. 2014 Dec 2;111(48):17110-5.

We now aim to take the therapy applications to the next level where we will:

1. Engineer new drug conjugates based on affibody molecules and investigate their properties in vitro and in animal models of cancer.
2. Select affibody molecules to novel targets for application in oncology, immunity and inflammation.

The student will work with design and engineering of proteins for medical applications. More specifically the student will learn phage-display based selection from combinatorial libraries, rational design of proteins, protein production and purification, protein analysis using a number of state-of-the-art techniques. In collaboration with other groups in Sweden and internationally as well as small biotech companies, studies of the function of the designed proteins in animals will be conducted.

Security and privacy (Reg. No. 2108)

Type of position Full PhD student: (48 months)		**Main supervisor** Panagiotis Papadimitratos
KTH School EECS		**Co-supervisor(s)**
KTH Department Computer Science		**Main email contact** papadim@kth.se

Specific subject area(s)

Network security; wireless and mobile security; privacy enhancing technologies; location privacy; computer security; IoT security; ML security and privacy

Title of project

Networked systems security and privacy

Number of available positions

3

Earliest start date

May 1, 2021

Latest start date

September 1, 2021

Short description of the project

We are looking for highly motivated individuals to pursue a PhD in security and privacy. The position involves activities leading to original research and results in peer-reviewed publications. The research topics can relate with any of the areas the Networked Systems Security (NSS) group works on. NSS designs and builds trustworthy networked systems. Our research agenda covers a gamut of security and privacy problems a number of our results got significant attention by the research community.

Candidates with experimental/systems or theoretical profiles and research interests in any aspect of security and privacy are welcome to apply.

Applicants must hold or be about to receive an MSc degree in computer science, electrical engineering, computer engineering, information and communication technologies, or a related area. Furthermore, the applicant must have:

- Strong academic credentials, written and spoken English proficiency, communication and team-work skills.
- Interest in several of the following: design, analysis, verification, implementation, or empirical evaluation of secure networked systems.
- Background in several of the following: computer security, mobile computing, networking, Internet security, wireless communications, distributed algorithms and systems, programming languages, performance analysis, operating systems, simulation techniques and tools, software engineering, system and network programming, applied cryptography, privacy preserving or enhancing technologies, optimization, information theory.
- Preparation and readiness to contribute to our research agenda and to work in an internationally oriented group.

Electromagnetic Engineering (Reg. No. 2109)

Type of position Full PhD student: (48 months)		**Main supervisor** Oscar Quevedo-Teruel
KTH School EECS		**Co-supervisor(s)**
KTH Department Division for Electromagnetic Engineering		**Main email contact** oscarqt@kth.se

Specific subject area(s)
Antennas, microwave technology, active components
Title of project
Active lens antennas for communication systems
Number of available positions
1
Earliest start date
September 2021
Latest start date
October 2021
Short description of the project
The main goal of this project is to investigate the concept of lenses for generating highly efficient antenna for wireless communication systems.
Therefore, to produce high efficient systems, fully-metallic lens antenna solutions will be investigated.
These antennas will be integrated with active components to produce an active lens antenna.

Electrical Engineering (Reg. No. 2112)

Type of position Full PhD student: (48 months)		**Main supervisor** Xiongfei Wang
KTH School EECS		**Co-supervisor(s)** Lennart Harnefors
KTH Department Division of Electric Power and Energy Systems		**Main email contact** xiongfei@kth.se

Specific subject area(s)
Power Electronics
Title of project
Resilient Control of Multi-Converter Systems under Severe Disturbances
Number of available positions
1
Earliest start date
1 July 2021
Latest start date
31 December 2021
Short description of the project
Voltage-source converters (VSCs) have been widely adopted in renewable power generation, transport electrification, and variable speed drives. Multi-VSC systems are increasingly found in modern energy conversion systems. To stably operate multi-VSC systems, continuous research efforts have been made on the small-signal modeling and control of VSCs. However, the nonlinear dynamics of multi-VSC systems under large disturbances still remain open issues. The dramatic de-loading of multi-VSC systems under severe grid faults has been reported in the Hornsea offshore wind farm, UK, in 2019. This PhD project thus intends to develop analytical modeling tools for characterizing nonlinear dynamics of multi-VSC systems, and explore resilient control methods for stabilizing the system under severe disturbances and physical constraints in both dc- and ac-sides. The developed analysis tools and control solutions will be validated with hardware experiments. The project is hosted by the Division of Electric Power and Energy Systems at the School of Electrical Engineering and Computer Science, and it is in collaboration with ABB Corporate Research, Västerås, Sweden, and Aalto University, Finland.

Electrical Engineering (Reg. No. 2113)

Type of position Full PhD student: (48 months)		**Main supervisor** Xiongfei Wang
KTH School EECS		**Co-supervisor(s)**
KTH Department Division of Electric Power and Energy Systems		**Main email contact** xiongfei@kth.se

Specific subject area(s)
Power Electronics and Power Systems
Title of project
Dynamic Model Reduction for Large-Scale Power-Electronic-Based Power Systems
Number of available positions
1
Earliest start date
1 July 2021
Latest start date
1 December 2021
Short description of the project
Power electronics is becoming a foundational technology for modernizing electric power grids. Power-electronic-based power systems (PEPS), which can efficiently and flexibly manage electricity among power-electronic-interfaced sources and loads, are being envisioned in the near future. The highly nonlinear and fast control dynamics of power electronic converters are radically changing power grid dynamics. Dynamic interactions among power converters and with the power grid tend to introduce oscillations in a wide timescale, which challenge the dynamic analysis of PEPS. This PhD project intends to develop modeling and stability analysis methods for large-scale PEPS under small and large disturbances. Both grid-following and grid-forming control modes of power converters will be considered in the PEPS. Dynamic model reduction techniques for small-signal and transient stability analysis of large-scale PEPS will be developed. During the project, the student has the opportunity to collaborate with international academic and industry partners. The project is hosted by the Division of Electric Power and Energy Systems at the School of Electrical Engineering and Computer Science.

Machine Design (Reg. No. 2114)

Type of position Full PhD student: (48 months)		**Main supervisor** Sergei Glavatskih
KTH School ITM		**Co-supervisor(s)** Thomas Norrby
KTH Department Machine Design		**Main email contact** segla@kth.se

Specific subject area(s)
Machine Design
Title of project
Lubrication technologies designed for e-drives
Number of available positions
1
Earliest start date
1 August, 2021
Short description of the project
The research project aims at the development of new lubrication technologies to enhance e-mobility. The demands on lubricants for increased energy efficiency and sustainability in “green” electric machinery are escalating. The goal of the project is to understand lubrication mechanisms of novel lubricant formulations to control friction and decrease wear in e-drives. The technology will also bring additional functionality such as electric conductivity.
Lubricated contacts in gears and bearings will be modelled and studied by using our research test rigs. A range of equipment will be used to analyse surfaces worn in the tests and lubricant properties. The research is part of a multidisciplinary project that links synthesis, simulations, physical chemistry, tribology and e-machine design. The project is carried out in a close collaboration with industry.

Mechatronics and Embedded Control Systems (Reg. No. 2115)

Type of position Full PhD student: (48 months)		**Main supervisor** Lei Feng
KTH School ITM		**Co-supervisor(s)** Jinzhi Lu
KTH Department Machine Design		**Main email contact** lfeng@kth.se

Specific subject area(s)

Model-based System Engineering; Cyber-Physical Systems; Architecture Design; Simulations

Title of project

Model-Based System Engineering for Architectural Design and Simulation of Cyber-Physical Systems

Number of available positions

1

Earliest start date

1 September, 2021

Latest start date

1 December, 2021

Short description of the project

Model-based Systems Engineering (MBSE) is an emerging technique in the area of systems engineering which is expected to become a next generation approach for supporting complex Cyber-Physical System (CPS) development. Currently, fundamental tenets of systems engineering are supported by a model-based approach to minimize risks and to avoid design changes in late development stages. The models are used to formalize, analyze, design, optimize and verify system development and artifacts helping developers to integrate engineering development across domains. Though model based development is well established in specific domains such as software, mechanical systems, electrical systems its role in integrated development from system architecture is still a big challenge for current industry.

The project will explore both systems engineering and model-based technologies to support complex CPS development. In the first area, we expect to provide an integrated modeling framework to support architecture modeling with unified semantics. This framework aims to develop meta-models which are used to construct architecture models through one unified textual and semantic language specification. Concrete syntax and abstract syntax will be designed in order to satisfy the meta-model and model development. We want to develop a web-based modeling environment based on the design language specification including language parse, code generator, meta-modeling environment and modeling environment. The modeling environment will be one open source tool which collaborate with one Chinese IT company Z.K. Fengchao, Beijing

Institute of Technology and Shanghai Jiaotong University.
In the second area, we want to adopt the modeling language integrated with simulation techniques, such as hybrid automaton simulation, hybrid ODE and SMT in order to support system analysis of CPS verification. The semantics for formalizing these features in the modeling language should be developed. Related compiler for these simulation solvers will be developed for the open source modeling environment. More complex scenarios to integrate these simulation techniques are considered when developing semantics and the modeling environment. The final target is to promote the analysis capabilities of the developed language for complex CPS verification.
The new modeling language, simulation methods and the related modeling environment will be tested on the aerospace case from China National MBSE alliance and several autonomous driving system case developed by KTH student projects.

Energy Technology (Reg. No. 2116)

Type of position Full PhD student: (48 months)		**Main supervisor** Björn Laumert
KTH School ITM		**Co-supervisor(s)** wujun@kth.se
KTH Department Department of Energy Technology		**Main email contact** bjorn.laumert@energy.kth.se

Specific subject area(s)

Solar energy

Title of project

Novel thermochemical looping for concentrating solar power application

Number of available positions

1

Earliest start date

1 April, 2021

Latest start date

1 October, 2021

Short description of the project

High-temperature thermal energy storage is becoming more and more important as a key component in concentrating solar power (CSP) systems and as an economically viable large-scale energy storage solution. In commercial CSP plant, molten salts are still the major thermal energy solutions. However, due to the thermal stability and corrosion problems at high temperature, the working temperature of the existing large-scale thermal storage system is still locating in the temperature range of 500-600 °C. Furthermore, all these thermal storage systems are sensible thermal storage system, so the power densities are relatively low. Thermochemical looping technology is an attractive way in store thermal energy efficiently with high power density. It has a great potential in playing an important role in the future thermal energy storage market. This project aims to develop a novel thermochemical looping system for CSP application. The temperature range is around 500 °C, which is suitable for both linear-focusing CSP system and waste heat recovery from steel industrial.

Energy Technology (Reg. No. 2117)

Type of position Full PhD student: (48 months)		**Main supervisor** Björn Palm
KTH School ITM		**Co-supervisor(s)** Justin NW Chiu; Saman Nimali Gunasekara
KTH Department Energy Technology		**Main email contact** bjorn.palm@energy.kth.se

Specific subject area(s)

Smart Distributed Energy System, Energy Storage

Title of project

Thermal Energy Storage Integration in Smart Distributed Energy Systems

Number of available positions

1

Earliest start date

1 March, 2021

Short description of the project

For a transition towards a low carbon society with higher share of intermittent renewable energy sources integration, smart overall system control with energy storage is imperative. In this project the PhD candidate will develop and test thermal energy storage materials for heating applications in the range of 60°C to 200°C. The focus of the project will be on control optimization of distributed systems with the integration of storage systems. Machine learning and big data training for optimized control model establishment will be performed. In addition, the PhD candidate will yield business scenarios analysis.

This project will have potential district heating industrial involvement.

Energy Storage Research Team at Energy Technology, KTH can be found via the link below.
https://www.energy.kth.se/heat-and-power-technology/ekv-researchgroups/thermal-energy-stora

Energy Technology (Reg. No. 2118)

Type of position Full PhD student: (48 months)		**Main supervisor** Viktoria Martin
KTH School ITM		**Co-supervisor(s)** Justin Chiu and Saman Gunasekara
KTH Department Energy Technology		**Main email contact** viktoria.martin@energy.kth.se

Specific subject area(s)
Energy Recovery, Storage and Utilization
Title of project
Food Industry Waste Heat Recovery and Utilization
Number of available positions
1
Earliest start date
1 March, 2021
Short description of the project
Energy efficiency increase and utilization reduction are embedded in UN Sustainable Development Goal (SDG) 7 to ensure access to affordable, reliable, sustainable and modern energy for all. In industrial sector, 40% of the total energy used goes to waste. In this PhD project, the student will focus on recovery and reutilization of waste heat from the food industry by means of thermal energy storage. The candidate will perform storage material development and testing in the range of 100 °C to 300 °C. Energy audit and evaluation will also be conducted during the course of the project including industrial thermal process flow heat recovery modelling, thermal energy storage integration and business case analysis for distributed heat storage and transportation.
Energy Storage Research Team at Energy Technology, KTH can be found via the link below: https://www.energy.kth.se/heat-and-power-technology/ekv-researchgroups/thermal-energy-stora

Applied Physics (Reg. No. 2119)

Type of position Full PhD student: (48 months)		**Main supervisor** Prof Jerker Widengren
KTH School SCI		**Co-supervisor(s)** Dr Haichun Liu
KTH Department Applied Physics		**Main email contact** jwideng@kth.se

Specific subject area(s)

Nanophotonics, biophotonics

Title of project

Dye-sensitization study of lanthanide photon upconversion nanoparticles using transient state spectroscopy

Number of available positions

1

Earliest start date

1 May, 2021

Short description of the project

Lanthanide-doped light up-conversion nanoparticles (UCNPs) can emit shorter-wavelength near-infrared (NIR), visible and even UV light upon excitation of non-coherent low-intensity NIR light. As unique spectrum upconverters, UCNPs are attracting substantial attention in diverse areas, including bioimaging, biosensing, nanothemometry, drug delivery, photodynamic therapy, and optogenetics. Despite advances recently made in UCNP nanochemistry, the low brightness of upconversion luminescence still restricts the practical applications of UCNPs.

Dye sensitization, employing organic dyes as antennas, is an efficient strategy to enhance the brightness of UCNPs by lifting the photon harvesting capacity of these nanoparticles. It has been shown that proper dye decoration can lead to an up-conversion luminescence enhancement by a few orders of magnitude. Currently however, dye sensitization can only work efficiently in organic solvents, and it remains challenging to produce efficient water-soluble dye-sensitized UCNPs, which prevents their applications in biomedical areas.

Recent studies show that triplet states in the dye antennas can play an important role in the sensitization of UCNPs. Considering that triplet states are very sensitive to the environment, a thorough investigation on such transient states of dye molecules interacting with UCNPs can potentially unravel the mystery of the failure of dye sensitization in aqueous media.

In the past decade, a unique spectroscopic technique, transient state (TRAST) spectroscopy, has been well developed in our group to quantify the dye fluorescence dynamics in a simple manner. In TRAST, the average fluorescence intensity in response to a modulated excitation is monitored. By systematically varying the modulation parameters, the transient state kinetics of the dyes can be mapped out.

In this project, we will try to provide a detailed understanding surrounding the dye-UCNP interactions using TRAST spectroscopy and present design rules for dye-sensitized UCNPs that work in water solutions, enabling performances relevant for biophotonics.

Light Microscopy, Biophysics (Reg. No. 2120)

Type of position Full PhD student: (48 months)		**Main supervisor** Ilaria Testa
KTH School SCI		**Co-supervisor(s)** Ilaria Testa
KTH Department Applied Physics		**Main email contact** testa@kth.se

Specific subject area(s)

Super resolution microscopy, single molecules, neuronal imaging

Title of project

3D optical nanoscopy in functioning neurons

Number of available positions

1

Earliest start date

January 2021

Latest start date

June 2021

Short description of the project

A new 3D super resolution microscope to visualize small cellular machineries in actions

Keywords: 3D super-resolution fluorescence microscopy, switchable proteins, live super resolution, Volumetric Imaging.

Lens-based microscopy was unable to discern fluorescently labeled features closer than 200 nm for decades, until the recent breaking of the diffraction resolution barrier by sequentially switching the fluorescence capability of adjacent features on and off quickly made nanoscale imaging routine. Reported nanoscopy variants switch these features either in a target manner with intense laser beams, or molecule by molecule followed by computation in a stochastic fashion. In the Testa laboratory we showed that emergent RESOLFT fluorescence nanoscopy enables fast and continuous imaging of living cells and tissues in super resolved detail by producing raw data images using only ultralow levels of light.

In recent years, the development of parallelized STED (Stimulated Emission Depletion Microscopy, Nobel Chemistry 2014)/RESOLFT (Reversible Saturable/Switchable Optical Fluorescence Transition) super resolution microscopy techniques have shown impressive results combining diffraction unlimited lateral spatial resolution (< 70 nm) with increasingly fast acquisition speeds (~ 1-30Hz) and optical sectioning. However, the diffraction-unlimited resolution improvement in these systems are often limited to the lateral dimension.

In this project, the candidate will focus on the development of a novel illumination patterns for 3-dimensional isotropic diffraction unlimited microscopy. The illumination will be made compatible with STED and RESOLFT optical nanoscopy. While maintaining

the rapid recording speed of a parallelized imaging system, the new 3D microscope will allow to resolved fine spatial details inside living cells. Much like in the original RESOLFT-MoNaLISA set-up [1] the system is based on controlling the spatial distribution of ON-OFF states in a sample labelled with reversibly switchable fluorescent proteins (RSFPs) [2]. Using RSFPs, recently developed and studies in our laboratory, as labels we will achieve high resolution imaging at minimal light doses. Thus making the new 3D technology very suitable for live cell imaging. The candidate will work together in a team of bio-physicist and optical engineer to design the new illumination patterns and to make it compatible with RSFPs switching. The planned interference pattern will be modulated in all three spatial dimensions and it will be used to switch in an OFF, dark states the majority of RSFP. this will allow to confine the emission spots in all the three spatial dimensions to sub-diffraction sized. The extended frequency content in the emission pattern manifests itself as isotropic diffraction unlimited resolution in the final images.

The spatial modulation in all three dimensions is made possible by the incoherent superposition of several independent illumination patterns, each pattern highly modulated in one spatial direction. Proper co-alignment of these patterns results in sharply confined zero intensity volumes that, together with saturation of the fluorophore OFF-state, can create sub-diffraction sized emission volumes. Quantification and reassignment of the emitted photons from these volumes allows for reconstruction of the final isotropic super resolution images. The candidate therefore will be trained as an expert and inventor in super resolution microcopy. She/he will acquire unique hands-on experience in setting-up a microscopy platform all the way from the design of a new optical scheme to its application within the neuroscience. Selected proteins in the packed synaptic environment will be resolved with the new 3D ability and quantified with unprecedented level of details.

In this work we will make possible to record 3D stacks across time of moving organelles and cytoskeleton in living human cells with spatial details < 60 nm in all the three dimensions, paving the way for new questions in bio-imaging studies.

[1] Masullo L A, Boden A, Pennacchietti F, Coceano G, Ratz M and Testa I 2018 Enhanced photon collection enables four dimensional fluorescence nanoscopy of living systems Nature communications 9

[2] Pennacchietti F, Serebrovskaya E O, Faro A R, Shemyakina, II, Bozhanova N G, Kotlobay A A, Gurskaya N G, Boden A, Dreier J, Chudakov D M, Lukyanov K A, Verkhusha V V, Mishin A S and Testa I 2018 Fast reversibly photoswitching red fluorescent proteins for live-cell RESOLFT nanoscopy Nature methods 15 601-4

Physics (Reg. No. 2121)

Type of position Full PhD student: (48 months)		**Main supervisor** Prof Oscar Tjernberg
KTH School SCI		**Co-supervisor(s)** Prof. Jonas Weissenrieder
KTH Department Applied Physics		**Main email contact** oscar@kth.se

Specific subject area(s)
Materials Physics
Title of project
Ultra fast dynamics in high temperature superconductors
Number of available positions
1
Earliest start date
September 2021
Short description of the project
In the position you are expected to conduct experimental research at the unit of Material and Nano Physics. Central to the research project is the study of phenomena and processes that occur at extremely short time periods, down to the femtosecond time scale (10^-15 s). In your research, you will be part of a strong research group studying ultrafast transient states. Your research will be focused on uncovering the mechanism(s) underlying high temperature superconductivity by using time and angle resolved photoemission spectroscopy (trARPES). You will have access to a recently commissioned instrument for high repetition rate ARPES covering a photon energy range up to 32 eV. This novel instrument will provide information on dynamic electronic processes that previously was unfeasible to study experimentally. The PhD project will be conducted in close collaboration with researchers (Postdocs and other PhD:s) studying similar material systems with ultrafast electron microscopy (UEM) in order to obtain dynamic structural information. When results from UEM and trARPES are merged we may formulate a complete picture of the dynamics in quantum materials like high temperature superconductors.

Physics (Reg. No. 2122)

Type of position Full PhD student: (48 months)		**Main supervisor** Prof Jonas Weissenrieder
KTH School SCI		**Co-supervisor(s)** Prof. Oscar Tjernberg
KTH Department Applied Physics		**Main email contact** jonas@kth.se

Specific subject area(s)
Materials Physics
Title of project
Ultrafast dynamics in quantum matter
Number of available positions
1
Earliest start date
September 2021
Short description of the project
In the position you are expected to conduct experimental research at the unit of Material and Nano Physics. Central to the research project is the study of phenomena and processes that occur at extremely short time periods, down to the femtosecond time scale (10^-15 s). In your research, you will be part of a strong research group studying ultrafast transient states and phase transitions of quantum materials as well as ultrafast dynamics in magnetic systems. Your research will be focused on a newly commissioned and for Sweden unique instrument for ultrafast electron diffraction and microscopy, an ultrafast electron microscope (UEM). The instrument is based on modified technology from the fields of transmission electron microscopy and femtosecond pulsed lasers. When merged these fields enables development of a microscope that can track the position of atoms with a time resolution of a few hundred femtoseconds, facilitating the recording of "movies" that follows the motion of atoms within a material through a change in state. This new microscope will thus provide information on dynamic structural and magnetic processes that previously was not feasible to study experimentally. The PhD project will be conducted in close collaboration with researchers (Postdocs and other PhD:s) studying similar material systems with time and angle resolved photoemission (trARPES) in order to obtain electronic band structure information. When results from UEM and trARPES are merged we may formulate a comprehensive picture of the dynamics in quantum materials. Your research will include nonlinear optics, transmission electron microscopy, electron diffraction, and electron energy loss spectroscopy.

Biophysics (Reg. No. 2123)

Type of position Full PhD student: (48 months)		**Main supervisor** Lucie Delemotte
KTH School SCI		**Co-supervisor(s)**
KTH Department Applied Physics		**Main email contact** lucied@kth.se

Specific subject area(s)

Computational biophysics - Molecular Dynamics Simulations

Title of project

Conformational cycle of a heart ion channel using MD simulations

Number of available positions

1

Earliest start date

1 August, 2021

Short description of the project

KCNQ family K+ channels (KCNQ1-5) are crucial for heart, nerve, epithelium and ear function. The KCNQ1 channel, in particular, is involved in cardiac cell function and loss-of-function mutations are associated with Long QT syndrome (LQTS), which can cause sudden cardiac arrest, responsible for tens of thousand of deaths worldwide every year. KCNQ1 channels require phosphatidylinositol 4,5-bisphosphate (PIP2) for voltage dependent activation, and coupling between their voltage-sensing and pore domains is facilitated by calmodulin. Furthermore, their function is regulated by auxiliary subunits KCNE1-3.

CryoEM structures of KCNQ1 have been obtained at atomistic resolution in two separate states. However, the pathway of interconversion between these two states, the structure of the other states involved in the conformational cycle, the relative stability of the various conformational states and how those are modulated by the environment remain to be elucidated. This project proposes to use MD simulations, including adaptive enhanced sampling strategies to address these issues. Having access to the details of the conformational ensemble will allow to design novel targeted modulation strategies, with applications in the treatment of cardiac arrhythmias.

The project is part of an ongoing collaboration with the experimental team of Jianmin Cui, from Washington University in Saint Louis, USA. A continued, tight communication between the KTH and the WashU teams will be crucial for a successful outcome of the project.

Candidates should have a vibrant interest for ion channel biophysics and physiology, and should be trained in molecular modeling, molecular dynamics simulations and data analysis. Experience with enhanced sampling and structural bioinformatics is not required but will be considered a plus. A strong interest for experimental biophysics is necessary to enable communication with the experimental partner.

Engineering Mechanics (Reg. No. 2124)

Type of position Full PhD student: (48 months)		**Main supervisor** Sebastian Stichel
KTH School SCI		**Co-supervisor(s)** Zhendong Liu
KTH Department Engineering Mechanics		**Main email contact** stichel@kth.se

Specific subject area(s)

Rail Vehicle Technology

Title of project

Modelling and simulation of rail vehicle braking system

Number of available positions

1

Earliest start date

November 2021

Short description of the project

The braking system is one of the most important sub-systems for rail vehicles, which directly determines the vehicle performance and ensures operational safety. The braking performance is related to brake type, brake material, structure, energy dissipation, working condition and climate. To improve braking performance and reduce maintenance cost, new system designs and advanced materials have been introduced to the braking system. It is necessary to study the braking systems against different working conditions and climates to inspect their performance and to keep system reliability. This research work involves modelling and simulation of the control system, thermo-mechanical behaviour and material wear in different working conditions and climates, e.g. large variation of temperature, humidity, salinity, sand, winter climate with ice and snow.

Visiting PhD student: (6 - 12 months)

Civil and Eviromental Engineering (Reg. No. 2125)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Andrea Nascetti
KTH School ABE		**Co-supervisor(s)**
KTH Department Urban Planning and Environment - Division		**Main email contact** nascetti@kth.se

Specific subject area(s)
Geoinformatics; Photogrammetry; Deep Learning
Title of project
TACK - Tunnel Automatic CracK Monitoring using Deep Learning
Number of available positions
1
Earliest start date
1 March, 2021
Short description of the project
Rock tunnels in Sweden are normally supported with a thin layer of fibre reinforced shotcrete in combination with rock bolts. Cracks in the shotcrete could lead to a failure of the support system and their existence and width should, therefore, be noted during the inspections of tunnels that are routinely performed. In the latest years, this work has been performed by in-situ surveys that are expensive and time-consuming. Recently, several studies highlight the potential of semi-automatic methods where a mobile mapping equipment (usually mounted on a vehicle) is used to capture the scene and to reconstruct the 3D model of a tunnel using a set of geomatics sensors (i.e., visible and infrared cameras, laser scanning, IMU). This digital representation of the tunnel is subsequently analyzed manually by visual inspection with the aim of seeking the crack and mark its extent. It is clear that, due to a large amount of collected data, these methods are inefficient and affected by human errors.
The aim of this research and development project is to investigate and develop a new technique to detect cracks on tunnel lining and bridges using a hybrid approach of deep learning and photogrammetry. With this technique, cracks will be automatically detected and measured from the imagery acquired using customized mobile mapping systems which leads to a highly efficient monitoring that can increase the overall safety of infrastructures.

Pavement engineering (Reg. No. 2126)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Associate Professor, Denis Jelagin
KTH School ABE		**Co-supervisor(s)** Manfred N. Partl
KTH Department Civil and Architectural Engineering		**Main email contact** jelagin@kth.se

Specific subject area(s)
Pavement materials, tyre-pavement interaction
Title of project
Durability and functional performance of ultra thin pavement overlays
Number of available positions
1
Earliest start date
1 April, 2021
Short description of the project

Ultra thin overlays are an effective maintenance treatment for restoring or upgrading pavement surface properties. In this project the guest doctoral student will work on modeling the relationship between the overlays design and their functional performance, in terms of providing optimal tire-road interaction and durability. The goal is to develop and validate a tire-road interaction model allowing to quantify the effect of pavements surface parameters and aggregate morphologies on the tire-road friction, rolling resistance and other safety relevant issues. The second objective is to evaluate experimentally durability of several existing and novel overlay materials.

Building Energy Simulation (Reg. No. 2127)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Sasan Sadrizadeh
KTH School ABE		**Co-supervisor(s)**
KTH Department Department of Civil and Architectural Engineering		**Main email contact** ssad@kth.se

Specific subject area(s)

Control strategies in building energy management, energy storage, energy recovery, innovative HVAC systems, LCC/LCA calculations

Title of project

Energy simulation/optimization in Build Environment

Number of available positions

2

Earliest start date

1 January, 2021

Latest start date

1 December, 2021

Short description of the project

Visiting PhD student to KTH Royal Institute of Technology, School of Architecture and Built Environment

KTH Royal Institute of Technology in Stockholm has grown to become one of Europe's leading technical and engineering universities, as well as a key centre of intellectual talent and innovation. We are Sweden's largest technical research and learning institution and home to students, researchers and faculty from around the world. Our research and education covers a wide area including natural sciences and all branches of engineering, as well as in architecture, industrial management, urban planning, history and philosophy.

Job description

KTH, School of Architecture and the Built Environment is looking for a visiting PhD student to conduct research in the area of Fluid and Climate Technology. The researcher in the Fluid and Climate Technology specialization will be focusing on the building energy simulation. The purpose of this research is to evaluate energy consumption in buildings and develop solutions for energy and heating/cooling load management. Control strategies in building energy management, energy storage, energy recovery, innovative HVAC systems, and LCC/LCA calculations are among the solutions in the conducted research.

Qualifications

You are expected to register as PhD student in China with knowledge in the topics of heat and mass transfer, building HVAC systems, thermodynamics, and building energy

simulation/measurement. Experience in using any related software for building energy simulation such as IDA ICE, TRNSYS, EnergyPlus is expected.
To achieve a great outcome from this research visit, it is necessary to have a high degree of motivation for scientific research, well developed analytical capacity, ability to work independently, good communication abilities, and the social ability to work in a team.
Good language skills in English both writing and speaking are also expected. Your ability to formulate and draft research articles would be a merit.

Management models for combined renewable energy systems (Reg. No. 2128)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Anders Wörman
KTH School ABE		**Co-supervisor(s)** Joakim Riml
KTH Department Department of Sustainable Development, Environmental Science and Engineering (SEED)		**Main email contact** worman@kth.se

Specific subject area(s)

Implementation of climate forecasts and spate-temporal coordination objectives in production optimisation models

Title of project

Climate impact on renewable energy systems

Number of available positions

1

Earliest start date

1 January, 2021

Short description of the project

Renewable energy systems, such as combined wind-, solar- and hydropower, are sensitive to climate fluctuations. Handling of such fluctuations requires sufficient energy storage capacity and electric transfer capacity as well as new appropriate management incentives that consider both future climate events and appropriate technical-societal objectives. Management incentives can consider regional coordination of energy production and demand in order to account for the spatio-temporal variation and cross-covariance in the availability of different energy sources, which thereby introduces "virtual" benefits in terms of reduced energy storage demand. Such coordination will improve the economy of the energy production and secure energy storage also in periods with regionally low energy availability. This project regards improvements of power production management models by expressing the objective function on a form that considers the before-mentioned spatio-temporal coordination with account taken to climate fluctuations and, especially, rare climate events. These advancements are incorporated in optimisation routines using dynamic programming supported by long-term climate forecasting. Examples are taken from large watersheds with large combined energy production systems.

Medical Image Analysis (Reg. No. 2129)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Chunliang Wang
KTH School CBH		**Co-supervisor(s)**
KTH Department Department of Biomedical Engineering and Health Systems		**Main email contact** chunwan@kth.se

Specific subject area(s)
Artificial Intelligence for Medical image analysis
Title of project
Image-based COVID-19 severity quantification and prognosis prediction using AI
Number of available positions
1
Earliest start date
August 2021
Short description of the project
Chest computed tomography (CT) is as an important tool for the diagnosis of virus pneumonitis including COVID-19, especially for assessing the severity of the disease. As clinicians are stressed by the large number of decisions they have to make during the outbreak, it is important to present the severity of a case in a quantitative manner that is easier to comprehend and facilitate clinical decision making. Ideally it would be even better if a projection of the disease prognosis could be made to predict the likelihood of a patient that will end up in a critical situation, so the healthcare workers could plan ahead and start more aggressive treatment earlier. However, so far there are no such quantitative tools available for COVID-19. Current clinical practice largely relies on the radiologists or the clinicians themselves to access the severity visually, which is both subjective and time-consuming. In this project, we propose to develop an automated and quantitative severity assessment and prognosis prediction system for COVID-19 using chest CT with the help of AI technology. More specifically, we aim to:
1) Develop a deep-learning based image analysis tool to automatically identify and quantify different types of pathological findings in chest CT scans.
2) Correlate the image metrics with clinical findings (such as oxygen saturation and other physiological measurements) using machine learning models, to identify the most important imaging biomarkers for disease characterization and develop a grading system that best reflects the patient's residual lung function
3) Leverage time series of chest CT scans acquired at different stage of the disease to build a predictive model to predict the near future prognosis of the disease using radiomics

Chemistry and Biology (Reg. No. 2130)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Yaoquan Tu
KTH School CBH		**Co-supervisor(s)**
KTH Department Department of Theoretical Chemistry and Biology		**Main email contact** yaoquan@kth.se

Specific subject area(s)
Theoretical Chemistry and Biology
Title of project
Theoretical studies of protein corona formation on nanozeolite
Number of available positions
1
Earliest start date
1 September, 2021
Short description of the project
Protein corona has been widely used in biomedicine, bio-catalysis, and biosensors. Plenty of materials and modification methods have been used to improve its properties for applications in industry or medicine. Previous studies have shown that nanozeolite has a special selectivity on protein residues when protein corona formed on its surface and the activity of the protein on the zeolite can vary with the ions in solution. In this project, molecular simulation methods will be used to study the mechanism of protein corona formation on zeolite and the effects of ions on the activities of the proteins.

Evolutionary genetics and genomics (Reg. No. 2131)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Peter Savolainen
KTH School CBH		**Co-supervisor(s)** Pelin Sahlen
KTH Department Dept of Gene technology		**Main email contact** savo@kth.se

Specific subject area(s)

Origin and evolution of the domestic dog: Phylogeographic and selection analysis

Title of project

Evolution of the domestic dog: identification of selected genes and geographic origin

Number of available positions

2

Earliest start date

1 June, 2021

Short description of the project

This project is based on a long-established collaboration between Sweden and China, with the research groups of Professor Ya-ping Zhang and Professor Guo-Dong Wang at Kunming Institute of Zoology, Chinese Academy of Sciences. In a number of prominent papers we have previously, based on large-scale genetics and genomics, indicated South China as the probable region of dog origins, and identified genes under selection in the first phase of dog evolution, affecting e.g. digestion and behaviour.

We have now increased sampling in South China and Southeast Asia, for refined phylogeographic analyses. We analyse all types of genetic markers: nuclear genomes as well as mitochondrial, Y-chromosomal and X-chromosomal DNA. Furthermore, previous studies of selection have been based on genome sequencing, which can identify only roughly 50% of genes affected by selection, since most mutations are situated in regulating regions far from the affected genes. We will now identify these regulatory sequences under selection in the domestication, by mapping of promoters and enhancers and of their interactions.

Because of the broad aims of this study, students with different backgrounds are welcome to apply; molecular biology, bioinformatics or phylogeographic analysis.

Data procession, model reduction (Reg. No. 2132)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Christophe Duwig
KTH School CBH		**Co-supervisor(s)**
KTH Department Department of Chemical Engineering		**Main email contact** duwig@kth.se

Specific subject area(s)

Combustion analysis, image procession, AI, model reduction

Title of project

Analysis of Combustion data and reduced order modelling

Number of available positions

1

Earliest start date

1 March, 2021

Latest start date

31 October, 2021

Short description of the project

Recent progresses in combustion simulations have enabled scientists to capture accurately finite rate reactions, mixing and flame propagation in turbulent flows. It results a considerable amount of data that has not yet been explored fully. In addition, the detailed kinetics and DNS models are still too massive for daily use in engineering. There is there for a need for developing automated procedure to analyze combustion data and to devise reduced models (ROM).

This projects focuses on using the data produced at KTH while simulating swirling flames with relatively detailed chemistry and/or turbulent droplets evaporation. The work consists in writing analysis script using python AI and data processing libraries for uncovering underlying mechanisms, pattern and behaviors. Secondly, the script would be extended to derive ROM.

The project suits a PhD-student with engineering or data processing background. Experience of AI & machine learning (with tensor flow) and expertise in Python are needed. Additional experience of analyzing combustion images/data is a strong merit.

Biomedical Engineering (Reg. No. 2133)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Dmitry Grishenkov
KTH School CBH		**Co-supervisor(s)**
KTH Department Biomedical Engineering and Health Systems		**Main email contact** dmitryg@kth.se

Specific subject area(s)

Acoustics, Ultrasound, Chemical Engineering

Title of project

Cellulose microcapsules for ultrasound visualisation and controlled drug delivery

Number of available positions

1

Earliest start date

1 September, 2021

Latest start date

1 December, 2021

Short description of the project

A continuous development of new therapeutic agents has made novel drugs available for a variety of diseases. However, a wide spectrum of active molecules alone does not guarantee optimal therapic effect as other relevant factors, such as bioavailability and release mechanism, come into play. The “drug” has rather become a “complex” whose therapeutic efficacy is obtained with the collaborative action of a compound and a delivery system.

The current project introduces a new class of microdevices providing integrated diagnostic and therapeutic applications, i.e., theranostics using microbubble-based ultrasound contrast agent loaded with therapeutic compound.

Acoustic droplet vaporization (ADV) is the physical process of superheated liquid changing the phase into gas using ultrasound. ADV can convert microcapsules with a liquid core into gas core microbubbles (MBs) and they would act as the ultrasonic contrast agents (UCAs). ADV has broad potentials in medical applications, such as targeted drug delivery, ultrasound imaging, thermal therapy and histotripsy, because of its ability for localised noninvasive energy deposition.

The aim of this project is to further improve existing and develop new contrast pulse sequences for diagnostic and therapy using the preclinical ultrasound imaging platform Verasonics Research System® (Verasonics Inc., Kirkland WA, USA) and the PFC-core capsules based on cellulose nanofibers (CNF) following acoustic droplet evaporation.

Chemistry and Biology (Reg. No. 2134)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Yaoquan Tu
KTH School CBH		**Co-supervisor(s)**
KTH Department Theoretical Chemistry and Biology		**Main email contact** yaoquan@kth.se

Specific subject area(s)

Theoretical Chemistry and Biology

Title of project

Molecular recognition in protein-ligand binding for ligand/drug optimization and design

Number of available positions

2

Earliest start date

1 September, 2021

Short description of the project

The knowledge of protein-ligand interactions and the role of water molecules in protein-ligand binding is essential for understanding many biological processes and for structure-based drug design. With the development of computer technologies, theoretical modelling has become an increasing powerful tool in the study of protein-ligand binding. In this project, we will use theoretical modelling to study molecular recognition in protein-ligand binding. In particular, we will use thermodynamic signatures to identify the characteristics of protein-ligand binding and the inhomogeneous solvent model to study the role of water molecules in some important drug targets with the aim to design/optimize ligands/drugs, such as through replacing unfavorable water molecules with new ligand groups complementary to the protein surface.

Analytical chemistry (Reg. No. 2135)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Åsa Emmer
KTH School CBH		**Co-supervisor(s)**
KTH Department Chemistry		**Main email contact** aae@kth.se

Specific subject area(s)

Miniaturized sample handling, enrichment and analysis of glycosylated proteins and peptides from biosamples, including microfluidics, separation science and mass spectrometry

Title of project

Microscale enrichment and analysis of glycosylated proteins and peptides

Number of available positions

2

Earliest start date

1 May, 2021

Short description of the project

Analysis of biosamples is generally challenging due to both lack of sample and low analyte concentrations. Difficulties in detecting important but scarce biogenic molecules, or substances with bioactivity, are therefore common obstacles both in clinical diagnostics and biomedical research, such as in the search for biomarkers for different diseases. A majority of these types of substances are potent at very low concentrations, and pretreatment and detection procedures providing extremely high sensitivity and specificity are therefore needed.

Proteins are among the most important biomolecules in the human body, with innumerous functions, and enormously diverse characteristics. Many proteins undergo structural changes after translation from the genes, e.g. phosphorylation and glycosylation, profoundly affecting their functionalities. For example, glycosylation, is widely associated with malfunctions and diseases, such as immunodeficiency, neurological diseases, and cancers. Thus, glycoproteins are important potential biomarkers. In addition, the interest for this kind of proteins has grown tremendously with the introduction of therapeutical antibody biopharmaceuticals. The safety and efficacy of these drugs are directly derived from the glycan structures. Nevertheless, the study of glycoproteins is difficult because of among other things the complicated molecule structure, and the often low concentrations in complex biological samples. Hence, the use of enrichment procedures for isolation and purification of glycoproteins is essential to make determination and characterization by e.g. mass spectrometry possible. The analytes of interest are often disguised by the presence of highly abundant proteins like albumin present in blood and other human samples. Combining targeted sample

preparation, including e.g. fractionation/preconcentration, with high performance separation could significantly improve the chance of sorting out selected components. Regarding glycosylated proteins and peptides specifically, hydrophilic, functionalized materials directed towards the glycan moieties are needed for enrichment. Moreover, pretreatment, separation and characterization procedures and setups must be adapted to the small sample volumes available, and general sustainability considerations.

The utilization of miniaturized systems including microfluidics has increased continuously in bioanalysis. This is very well motivated by the limited availability of many biological samples. Using microfluidics, microliter or even nanoliter volumes of liquids can be manipulated and analyzed. Furthermore, using micromanufacturing the geometric size and shape of microchannels, microvessels and other utilities can be freely chosen. Thus, the system can be adapted to suit both sample pretreatments and direct analysis of a variety of samples originating from human tissue, body fluids, or other living organisms or bioreactors.

Downscaling of bioanalytical processes has several advantages besides compatibility with small sample volumes. These include fast and efficient mass transport and mass exchange due to the short distances involved. This in turn can accelerate and improve biological and chemical reactions/interactions as well as analytical separations. Otherwise lengthy procedures can be accomplished in minutes or even seconds in miniaturized devices. The infinitesimal volume scale also decreases the problems associated with the use of rare, expensive or hazardous chemicals or solvents, while minimizing the environmental impact. This taken together offers possibilities for development of novel systems, techniques and methods for application in a wide variety of areas.

The proposed project includes developments of new strategies, principles, materials and devices for enrichment, separation and detection of glycosylated molecules utilizing micro systems. Within these systems several units with different functions could be included. Miniaturized sample preconcentration, separation using chromatography or electromigration, and detection/identification by MS or MSMS are examples of such operations.

Of special interest will be the studies of glycoproteins and glycopeptides involved in outbreak of different diseases or other processes in the body, and for use as biomarkers for specific diseases or syndromes.

In the group of analytical chemistry, we have long experience of miniaturization, sample preparation, separation and mass spectrometry. To our disposal we have micro robotic systems, chromatography instrumentation, capillary electrophoresis equipment, different mass spectrometry systems etc.

Polymer Technology (Reg. No. 2136)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Minna Hakkarainen
KTH School CBH		**Co-supervisor(s)** Karin Odelius
KTH Department Fibre and Polymer Technology		**Main email contact** minna@kth.se

Specific subject area(s)
Biobased circular materials
Title of project
Biobased recyclable thermosets
Number of available positions
1 or 2
Earliest start date
1 September, 2021
Short description of the project
There is an increasing awareness of the problems connected to our current production, use and recovery of plastic materials. Thermosets is a material group for which the end-of-life handling is especially challenging. These network structures are commonly intended for high demand applications and are not re-shapeable upon heating, contrary to the more commonly used thermoplastics. This project aims to tackle several of these issues to move towards more sustainable plastic production, use and end-of-life handling. First, approaches for using renewable resources and applying the principles of green chemistry in the synthesis of thermosets will be elucidated. The chemical structure of the renewable building-blocks will be carefully chosen to ensure that the material property demands and lifespan of the material set for the specific application are met. The thermoset will also need to be designed to enable thermoset recycling after use. Secondly, benign recycling conditions will be elucidated for the thermoset to ensure full material recovery and to enable new material synthesis of the created building-blocks. Recyclable thermosets from renewable resources with the desired structure-property relationship will contribute to circular bioeconomy.

Chemistry (Reg. No. 2137)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Assistant Prof. Markus Kärkäs
KTH School CBH		**Co-supervisor(s)** Associate Prof. Peter Dinér
KTH Department Department of Chemistry		**Main email contact** karkas@kth.se

Specific subject area(s)
Organic chemistry
Title of project
Controlling Catalysis with Visible Light
Number of available positions
1
Earliest start date
May 2021
Short description of the project
Nitrogen-containing compounds are important motifs and have a widespread presence in natural products, pharmaceuticals, agrochemicals as well as in material science. Recent advances in the field of visible light photoredox catalysis have established this field as an enabling catalytic platform for the mild and selective generation of nitrogen-centered radicals. The proposed research focuses on the development of methodologies for formation of nitrogen-centered radicals and their utilization in carbon–hydrogen (C–H) functionalization and cascade reactions by radical relay processes. The proposed research project aims to deliver key advances in free-radical reaction manifolds and a crucial framework for utilizing nitrogen-centered radicals for productive bond formation in complex settings.

Multi-phase flows, heat and mass transfer, simulation, vapour-liquid equilibrium, Carbon Capture Technologies (Reg. No. 2138)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Christophe Duwig
KTH School CBH		**Co-supervisor(s)**
KTH Department Department of Chemical Engineering		**Main email contact** duwig@kth.se

Specific subject area(s)
Detailed modelling of CO2 absoption, transport and reaction in a single droplet
Title of project
Detailed modeling of CO2 capture by an insolated droplet
Number of available positions
1
Earliest start date
1 April, 2021
Latest start date
31 October, 2021
Short description of the project
Carbon Capture and Sequestration (CCS) is a promising technique for limiting CO2 emissions and even producing negative emissions when combined with biomass combustion. The process consists in removing CO2 from the exhaust gas prior to release in the atmosphere. Among different technical solutions, the absorption of CO2 in a working fluid (amine solution) is one of the dominant option.
At present, the cost for CCS is estimated to be at least $30/ton CO2 - up to $100/ ton CO2 in some cases. In order to accelerate the deployment of CCS units, research and innovation are needed to lower this cost. To that end, we wish to establish a detailed modeling framework to test virtually ideas and innovations. The first step is to create a detailed model for CO2 transport, absorption and reaction.
The work will start from our in-house solver (set of Matlab routines) that is capable of resolving transport and vapour/liquid equilibrium (VLE) for a single droplet in a quiescent environment. The first task will be to research, select and include an appropriate VLE model and transport properties for CCS.
The second task will be to extend the code for simulating chemical reactions in the liquid phase. The third task will be to perform single droplet simulations in order to explore the complete design space and identify the limiting steps and associated regimes depending on the droplet size, gas concentration, operating pressure and temperature and CO2 concentrating in the liquid droplet.
The project is suited for a PhD-student with strong knowledge in thermodynamics, simulation and transport phenomena, e.g. energy, chemical or combustion engineering.

Pollutant formation and removal (Reg. No. 2139)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Christophe Duwig
KTH School CBH		**Co-supervisor(s)**
KTH Department Department of Chemical Engineering		**Main email contact** duwig@kth.se

Specific subject area(s)

reacting flow, aerosol modelling, uncertainty quantification

Title of project

Modelling of aerosol formation - Uncertainty Quantification of a detailed model

Number of available positions

1

Earliest start date

1 April, 2021

Latest start date

1 October, 2021

Short description of the project

Pollutant emissions due to marine transport are significantly impacting life on land and at sea. While MARPOL regulations are entering a new phase, the retrofit of existing fleet is challenging and one need a new generation of technical solutions for capturing efficiently NOx and SOx.

We study a novel process for converting NOx and SOx into ammonium nitrate and sulfate - hence capturing gaseous pollutant into solid particles for further removal. To that end, we collaborate with the Swedish Meteorological Institute and have extended an atmospheric aerosol growth model for application to exhaust gas conditions. The behavior of the new model is not yet fully understood and we need to quantify the sensitivity to the model constants and inherent uncertainty.

The present project consists of performing a complete Uncertainty Quantification using our in-house aerosol growth model and detect the dominant sources of uncertainty as well as the response of the model to fluctuation (variability) in the operating conditions.

The project is suited for a PhD-student with background in chemical, combustion or energy science/ engineering with specialization in simulations and computing. Having previously worked with uncertainty quantification is a merit.

Theoretical Chemistry and Physics (Reg. No. 2140)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Victor Kimberg
KTH School CBH		**Co-supervisor(s)**
KTH Department Theoretical Chemistry and Biology		**Main email contact** kimberg@kth.se

Specific subject area(s)

X-ray spectroscopy for XFEL applications

Title of project

Non-linear pump-probe x-ray spectroscopy of structure and dynamics

Number of available positions

2

Earliest start date

1 April, 2021

Short description of the project

The invention of X-ray free-electron laser (XFEL) with ultra-short pulses of high intensity has opened the way to transfer nonlinear spectroscopy from the optical to the X-ray regime, allowing to explore rich new physical processes and applications. The present project aims to meet the exciting opportunities and challenges through the development of new models and theory to predict and understand the deep new phenomena which will be unraveled by coming nonlinear pump-probe spectroscopy based on XFELs. Understanding and modeling nuclear dynamics effects in complex quantum systems is one of the major challenges of modern condensed matter physics. The present project is aimed to perform quantum-classical simulations for description the nuclear dynamics in the isolated molecules and molecular ensembles under strong XFEL pulse excitation. X-ray absorption spectroscopy (XAS) [1] and Resonant Inelastic X-ray Scattering (RIXS) [2] techniques were recently successfully applied by our theoretical group and our experimental collaborators for the study of structure and dynamics in liquid water. In the present project, the stimulated X-ray emission and stimulated resonant inelastic X-ray scattering in liquids and solutions will be explored theoretically and proposed for experimental verification, based on our previous development [3-4]. The project is motivated by that the full potential of XFELs for the new applications for study of disordered systems is yet to be discovered. There is a strong request for realistic numerical modeling and method development from the whole community of strong field X-ray physics. The applicant (guest doctoral student or visiting researcher) will join a team which includes researchers with strong expertise in different theoretical approaches required for studying X-ray nonlinearity. Our group also have long term collaboration with the experimental groups working at modern XFEL facilities (MAX IV, European XFEL, etc), where our theoretical findings can be confirmed and push forward new developments in

the field of linear and nonlinear X-ray science.

[1] J. Niskanen, et al., Proc Natl Acad Sci USA 116, 4058-4063 (2019).
[2] V. Vaz da Cruz, et al., Nature Communication 10, 1013 (2019).
[3] V. Kimberg, et al., Faraday Discuss. 194, 305–324 (2016).
[4] V. Kimberg and N. Rohringer, Struct. Dyn. 3, 034101 (2016).

Image processing, compression (Reg. No. 2141)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Markus Flierl
KTH School EECS		**Co-supervisor(s)**
KTH Department Intelligent Systems		**Main email contact** mflierl@kth.se

Specific subject area(s)

Signal representation, coding, and machine learning

Title of project

Neural Network based Image and Video Coding

Number of available positions

1

Earliest start date

1 August, 2021

Short description of the project

Algorithms for image and video coding are developed and evaluated that take advantage of neural network based signal representations and machine learning. The project is in the context of future image and video coding standards.

Security and privacy (Reg. No. 2142)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Panagiotis Papadimitratos
KTH School EECS		**Co-supervisor(s)**
KTH Department Computer Science		**Main email contact** papadim@kth.se

Specific subject area(s)

Network security; wireless security; mobile security; information theoretic security and privacy; privacy enhancing technologies; location privacy; IoT security; ML security and privacy

Title of project

Networked Systems Security and Privacy

Number of available positions

3

Earliest start date

1 May, 2021

Latest start date

1 September, 2021

Short description of the project

We are looking for highly motivated individuals already pursuing a PhD in security and privacy to join our group for a short-term visit. The position involves activities leading to original research and results in peer-reviewed publications. The research topics can relate with any of the areas the Networked Systems Security (NSS) group works on. We design and build trustworthy networked systems. Our research agenda covers a gamut of security and privacy problems a number of our results got significant attention by the research community.

Candidates with experimental/systems or theoretical profiles and research interests in any aspect of security and privacy are welcome to apply. Applicants must hold an MSc degree in computer science, electrical engineering, computer engineering, information and communication technologies, or a related area, and be already in a PhD program. It is preferable if they are at the late stage of their PhD and their research is aligned with or complements the work at NSS. Furthermore, the applicant must have:

- Strong academic credentials, written and spoken English proficiency, communication and team-work skills.
- Interest in several of the following: design, analysis, verification, implementation, or empirical evaluation of secure networked systems.
- Background in several of the following: computer security, mobile computing, networking, Internet security, wireless communications, distributed algorithms and systems, programming languages, performance analysis, operating systems, simulation

techniques and tools, software engineering, system and network programming, applied cryptography, privacy preserving or enhancing technologies, optimization, information theory, machine learning.

- Preparation and readiness to contribute to our research agenda and to work in an internationally oriented group.

Computer Science (Reg. No. 2143)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Marco Chiesa
KTH School EECS		**Co-supervisor(s)** Marco Chiesa
KTH Department Software Computer Systems		**Main email contact** mchiesa@kth.se

Specific subject area(s)

Computer Networks

Title of project

Towards self-programmable intelligent Internet communication systems

Number of available positions

1

Earliest start date

1 March, 2021

Short description of the project

Communication networks are crucial to human society. The most notable network - the Internet - offers a plethora of services to its users and it is poised to become more pervasive in the near future. Yet, the heterogeneous set of requirements posed by the emerging services stands as a huge challenge for the Internet community for two main reasons: i) Internet networks have been extremely hard to adapt to the emerging use cases for decades and ii) end-to-end Internet connectivity entails forwarding packets across multiple networks that are owned by completely independent organizations with possibly contrasting goals.

The goal of this Ph.D. position is to explore the most recent networking paradigms and to build highly innovative programmable networks that better suit the emerging modern-day requirements for the Internet. A critical aspect of the project is to "learn" what is happening in a network where operators do not have complete visibility, as it is the case in the Internet. This task entails devising inter- and intra-domain solutions that conciliate the needs of the different networking organizations, networking vendors, Internet application services, Cloud datacenters, and beyond. Examples include leveraging the emerging network programming abstractions (e.g., SDN, P4), novel approaches (Machine Learning), and congestion control schemes to improve the performance, security, robustness, and reliability of today’s Internet-wide connectivity.

Information technology and robotics (Reg. No. 2144)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Zhibo Pang
KTH School EECS		**Co-supervisor(s)** Xi Wang
KTH Department Division of Information Science and Engineering		**Main email contact** zhibo@kth.se

Specific subject area(s)

Intersection of robotics system, automatic control, edge computing and wireless communication

Title of project

Intelligent Robots Controlled over High Performance Wireless Networks

Number of available positions

1

Earliest start date

1 June, 2021

Latest start date

1 December, 2021

Short description of the project

Short description of the project: In this project, we will develop a new architecture of future robotics called WiNC-Robot (wireless networked control-based robots) which will be more open, modularized, and softwarized than the state-of-the-art. In the WiNC-Robot, the digital parts (communication, computing, control, intelligence, software applications, etc.) and the mechanical parts (wheels, joints, motors, drives) of the robot will be largely decoupled by offloading as much as possible the low-level control (e.g. drive control) into the PC-based controller. The overall cost could be significantly reduced by using simpler and exchangeable mechanical parts and more open digital parts. The barriers for the developers in digital subjects to enter the robotics area will be completely pushed down. More advanced control and machine intelligence will be developed on the more open, powerful and natively edge-cloud-based controller platform. All these features are essential to accelerate the digital innovations and enable the adoption of robots in service scenarios such as logistics, healthcare, retail, restaurant, agriculture, etc. As a key member of this project, you will contribute to the theoretical modeling, simulation, prototyping and experimental validation of these new ideas. You will get hands-on supervision from world-class researchers in this area and access to world class academic and industrial lab facilities on wireless control and robotics.

Physics (Reg. No. 2145)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Andris Vaivads
KTH School EECS		**Co-supervisor(s)**
KTH Department Electrical Engineering		**Main email contact** vaivads@kth.se

Specific subject area(s)

Space physics

Title of project

Coupling of turbulence and magnetic reconnection in space plasma

Number of available positions

1

Earliest start date

1 May, 2021

Short description of the project

The guest PhD student would address the topic of understanding the turbulent properties of the magnetic reconnection diffusion region. Magnetic reconnection is one of the major energy conversion processes in space, e.g. leading to space plasma heating to hundreds millions of degrees. While simplified models of magnetic reconnection exist, satellite observations show the high complexity of the process where turbulence plays an important role in the plasma dynamics. Only in the last years, with availability of new spacecraft data, it has been possible to experimentally address the different important questions related to the turbulence in magnetic reconnection. The guest PhD student would study in details diffusion regions of magnetic reconnection, regions where reconnection is initiated, using data from the NASA MMS mission.

Electrical Engineering (Reg. No. 2146)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Marley Becerra
KTH School EECS		**Co-supervisor(s)**
KTH Department Electromagnetic Engineering		**Main email contact** marley@kth.se

Specific subject area(s)

High voltage engineering, Engineering plasmas

Title of project

Physics of pre-breakdown in mineral oil/solid dielectric insulating systems

Number of available positions

1

Earliest start date

April 2021

Latest start date

August 2021

Short description of the project

Stable operation of power transformers is essential in power electrical systems. Mineral oil plays a major role in insulation and heat dissipation, and is the main insulating medium inside oil-immersed transformers. Although the dielectric strength of mineral oil has attracted much attention, the failure of insulating systems including solid interfaces also present in transformers is much less understood. Thus, the project is intended to perform computer modeling and laboratory experiments with the objective of developing a simplified, macroscopic model of the development of streamers in a mineral oil/solid insulation system. The laboratory work includes measurements with high speed photography and charge measurements of the streamer development. Modeling requires JAVA programming in a finite element commercial software.

Electrical Engineering (Reg. No. 2147)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Daniel Månsson
KTH School EECS		**Co-supervisor(s)**
KTH Department Division of Electromagnetic Engineering		**Main email contact** manssond@kth.se

Specific subject area(s)

Energy storage, electrochemical batteries

Title of project

Restoration of aged lead-acid batteries aided by electrically fast transients

Number of available positions

1

Earliest start date

April 2021

Short description of the project

Background - need for energy storage

Many places around the globe are very suitable for production of renewable energy using wind- and/or solar power. However, renewable energy is intermittent, not only from expected seasonal and daily variations but also due to more stochastic variations, e.g., from varying cloud coverage and gusts of wind. Therefore, such renewable sources requires some type of energy storage system (ESS) to store surplus power for later times of peak usage.

Energy storage systems - batteries

Lead-acid batteries is the oldest technology (1859, Gaston Planté) for rechargeable batteries (i.e., secondary batteries) but is today often only associated with vehicles and SLI (“starting, lighting, ignition). However, lead-acid batteries have many favorable qualities (e.g., large power-weight ratio, low production cost, a large recyclability of ~98 %) that makes them (still) relatively competitive compared to more modern technologies. This especially in situations where the weight (i.e., energy density) is not a critical factor such as in a large stationary storage for, e.g., renewable energy. The downside of lead-acid batteries, compared to, e.g., Li-ion technology, is the shorter life cycle, the lower energy density and sensitivity to regular deep discharges.

When lead-acid batteries are discharged, amorphous lead sulfate is created (from the lead, lead dioxide and sulfuric acid) and it covers the electrodes. The process is then reversed when the battery is charged again. When the battery goes through many cycles some of the amorphous lead sulfate doesn’t recombine back to the initial components but instead starts to crystallize. The same thing happens when the batteries are stored in a low charge (large DoD) state. The crystalline lead sulfate will build up over time and start to severely affect the capacity and power rating of the battery. This is one large reason for their

disadvantage.
On the market there exist products today that claim to be able to "desulfate" even severely affected batteries, through various charging methods and schemes. However, in the scientific literature the publication material on this is very limited, even though the market possibilities of successful restoration of aged lead-acid batteries could be a huge step towards prolonging their life span and, thus, increase their competitiveness and their ability to assist with the "green transition".
Project description
The purpose of the work proposed here is to investigate the ability to restore (i.e., “desulfate”) lead-acid batteries (with crystalline lead sulfate covering the electrodes) using different electrically fast transients (EFT) in combination with different charging methods. This is done via quantitative experiments on both single lead-acid cells and complete batteries to determine the state of health of the object as well as using numerical simulations tools such as COMSOL.
The student appropriate for this work presumably has, or wants to develop, a deep knowledge in energy storage systems and battery technology (electrochemical storage types). Also the student has an interest to plan, carry out and analyze results of experiments, analytical calculations and numerical simulations.
The project is done at the division of Electromagnetic Engineering at KTH and is in the form of a one year guest doctoral study.

Software Engineering (Reg. No. 2148)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Martin Monperrus
KTH School EECS		**Co-supervisor(s)**
KTH Department TCS		**Main email contact** martin.monperrus@csc.kth.se

Specific subject area(s)
Program analysis - Program Repair
Title of project
Automatic Program Repair
Number of available positions
1
Earliest start date
1 January, 2021
Short description of the project
The project will take place in the research group of Prof Martin Monperrus, department Theoretical Computer Science, ar KTH Royal Institute of Technology
Automatic repair is a new and fascinating research field at the confluence of software engineering and programming languages. Automatic software repair is the process of fixing software bugs automatically. When repair happens at the level of the program code, it is called program repair or patch generation (for instance by changing the conditional expression of an if statement). Repair may also happen at the level of the program state, at runtime, in response to field failures (for instance by changing the value of a variable), this is known as runtime repair or state repair.
The student will contribute to one of the program repair platforms we are developing in the group.

Photonics (Reg. No. 2149)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Max Yan
KTH School SCI		**Co-supervisor(s)**
KTH Department Applied Physics		**Main email contact** maxyan@kth.se

Specific subject area(s)

Si photonics, nanofabrication, optical characterization, optical communication, optical sensing, mid-infrared source

Title of project

Integrated Photonics

Number of available positions

2

Earliest start date

1 September, 2021

Short description of the project

This project aims to develop integrated photonic technologies for sensing and communication based on silicon platform at both conventional telecom and mid-infrared wavelength ranges. The candidate can choose to carry out theoretical and/or experimental investigations during the visiting period. Some sub research areas include: silicon-based subwavelength structure for controlling dispersion, phase, temporal delay, polarization, modal profile etc.; integration of nonlinear materials on silicon for frequency conversion; generation of tailored mid-infrared thermal emission; integrated mid-infrared detection; etc. If necessary, the candidate can be involved in nanofabrication based on our electron-beam lithography system.

Nuclear Energy Engineering (Reg. No. 2150)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Janne Wallenius
KTH School SCI		**Co-supervisor(s)**
KTH Department Physics		**Main email contact** janwal@kth.se

Specific subject area(s)
Nuclear fuel performance
Title of project
Thermomechanical modeling of nuclear fuels in BELLA
Number of available positions
1
Earliest start date
10 January, 2021
Latest start date
1 September, 2021
Short description of the project
BELLA is a tool for safety informed design of lead-cooled reactors, developed by the nuclear engineering division. So far the code is not capable of predicting the evolution of fuel under irradiation. This capability is required in order to correctly assess the integrity of the fuel under transient conditions.
In this project a thermo-mechanical module for simulation of oxide and nitride nuclear fuels will be developed and introduced into the BELLA code. This includes fuel restructuring, evolution of thermal conductivity, gas release and swelling, as function of burn-up.

Vehicle Engineering (Reg. No. 2151)

Type of position Visiting PhD student: (6 - 12 months)		**Main supervisor** Lars Drugge
KTH School SCI		**Co-supervisor(s)**
KTH Department Engineering Mechanics		**Main email contact** larsd@kth.se

Specific subject area(s)

Vehicle Dynamics

Title of project

Vehicle dynamics control of electric vehicles

Number of available positions

1

Earliest start date

June 1, 2021

Short description of the project

The focus of this project is on vehicle dynamics control of electric vehicles (EVs) utilising high-fidelity vehicle models, including tyre-road interaction, transmission systems, actuator responses etc. With more detailed vehicle models control constraints can be provided in a more detailed manner, which can help improve the overall control performance of the system. The influence of model fidelity on vehicle dynamics control can e.g. be studied in the case of preview control of node vehicles in a heterogeneous EV platoon considering a non-ideal communication environment, where for instance normalisation modelling methods can be utilised to characterise the complex vehicle dynamics of the heterogeneous node vehicles.

Visiting scholar: (3 - 12 months)

Environmental Engineering (Reg. No. 2152)

Type of position Visiting scholar: (3 - 12 months)		**Main supervisor** Anders Wörman
KTH School ABE		**Co-supervisor(s)** Luigia Brandimarte
KTH Department Department of Sustainable Development, Environmental Science and Engineering (SEED)		**Main email contact** worman@kth.se

Specific subject area(s)
River-Groundwater hydraulics
Title of project
River-aquifer interaction in regulated rivers
Number of available positions
1
Earliest start date
January 2021
Latest start date
December 2021
Short description of the project
In a hydropower regulated river the river stage fluctuations induce flows into and out of connecting groundwater reservoirs, which can be significant in comparison to the natural river-aquifer interaction and groundwater infiltration. This change of water interaction is important for many environmental problems, such as contaminant transport in rivers and stream ecology, but also for the water resource utilization, such as behavior of drinking wells. Due to the variation of hydrogeological conditions, the interaction between river and groundwater would regularly change the induced water flux, the flow direction and the hydraulic head. The investigation of surface-groundwater exchange directions plays a crucial role to characterize this interactive process.
Scholars around the world have conducted research on the mechanisms of exchange at the surface-subsurface water interface and have proposed several mathematical models in different settings such as the drivers of hyporheic flow and the lateral river-aquifer interaction on longer range. Usually, the hyporheic flow is considered to be a vertical exchange process with little effect on the groundwater table, whereas the latter flow is acknowledged as a wave phenomenon with important effects on the water table. The lateral wave propagation is normally analyzed in a one-dimensional framework.
The main purpose of this project is to develop analytical methods for groundwater flow analysis that represents the process of surface-groundwater exchange in both the vertical

and horizontal directions. This can be done both theoretically, by separating the lateral and horizontal components by the superposition principle of groundwater flow, or by fully couple the flow exchange in a numerical framework. Another purpose would be to apply the model (-s) on the surface-groundwater interaction at a hydropower regulated river, such as along the middle Han River of the Jianghan plain, China, and to assess the exchange budget in the different flow directions. As mentioned, the suggested study the effect of regulation of rivers on the hyporheic zone is important for both environmental problems, stream ecology and water resource management. Particular important research progress would be to distinguish the vertical and horizontal component during surface-groundwater exchange.

Indoor Air Quality and Heath (Reg. No. 2153)

Type of position Visiting scholar: (3 - 12 months)		**Main supervisor** Sasan Sadrizadeh
KTH School ABE		**Co-supervisor(s)** Christophe Duwig
KTH Department Department of Civil and Architectural Engineering		**Main email contact** ssad@kth.se

Specific subject area(s)

Fluid Mechanics, Indoor Air Quality and Health, Laboratory Measurement

Title of project

Covid-secure hospital isolation rooms

Number of available positions

2

Earliest start date

1 January, 2021

Latest start date

1 December, 2021

Short description of the project

KTH, School of Architecture and Built Environment is looking for a doctoral student to research the area of Fluid and Climate Technology. The doctoral student in the Fluid and Climate Technology specialization will be focusing on the airborne spread of infectious agents in the hospital environment. The purpose of this research is to develop a cost-effective, easy to implement solution to the hospital isolation rooms that can increase the isolation capacity of hospitals. This is be done using numerical simulation as well as laboratory measurements.

Qualifications

You are expected to have a PhD degree in Technology or a similar degree, with extensive knowledge in aerosol technology, chemistry, measurement technologies, fluid dynamics and mass/heat transfer. Experience and interest in basic measurement technology and CFD (Computational Fluid Dynamics) simulation and other numerical methods is essential. You are expected to have good knowledge and experience in laboratory works and measurement technologies that enable you to measure airflow filed (velocity and temperature) as well as particle and tracer gases.

For research work to be successful, you need to be goal-oriented and persevering in your work. Your ability in the following points is highly important to us:

• Ability to worth both independently and in a group
• Analyse and work with complex issues
• Communicate in English, both speaking and writing
• Good skills in measurement technology as well as numerical modelling

We have a great emphasis on personal qualities and personal suitability.

Chemistry (Reg. No. 2154)

Type of position Visiting scholar: (3 - 12 months)		**Main supervisor** Assistant Prof. Markus Kärkäs
KTH School CBH		**Co-supervisor(s)** Associate Prof. Peter Dinér
KTH Department Department of Chemistry		**Main email contact** karkas@kth.se

Specific subject area(s)
Organic chemistry
Title of project
Enabling Chemical Synthesis with Visible Light
Number of available positions
1
Earliest start date
May 2021
Short description of the project
The application of visible light to promote chemical reactivity has far-reaching implications in minimizing the environmental impact and for the development of sustainable catalytic platforms. In this regard, visible light photoredox catalysis has proven to be a sustainable and a powerful tool for promoting free-radical chemistry to access chemical reactivity that would otherwise be inaccessible using conventional two-electron processes. The proposed research focuses on the development of methodologies for formation of nitrogen-centered radicals and their utilization in carbon–hydrogen (C–H) functionalization manifolds. The research project aims to deliver key advances in free-radical chemistry and a crucial framework for utilizing nitrogen-centered radicals in coupled processes and cooperative catalytic systems for productive bond formation in complex settings.

Chemical engineering; Energy and Process Engineering (Reg. No. 2155)

Type of position Visiting scholar: (3 - 12 months)		**Main supervisor** Shareq Mohd Nazir
KTH School CBH		**Co-supervisor(s)** Christophe Duwig
KTH Department Department of Chemical Engineering		**Main email contact** smnazir@kth.se

Specific subject area(s)

negative emissions; process modelling and simulation; thermodynamics; reaction engineering

Title of project

Negative emission industrial processes

Number of available positions

1

Earliest start date

1 May 2021

Latest start date

1 August 2021

Short description of the project

Biomass has been identified as the potential carbon neutral source to satisfy both the process chemistry and energy requirements in energy intensive industries like steel and cement. Both these industries are crucial for Sweden's GDP and important in achieving the net zero emissions target by the year 2045. In the Hybrit project, hydrogen is used to decarbonize the steel production process. In cement, electrification of clinker can decarbonize the cement process. However, steel needs a carbonaceous source in the process to obtain the carbon composition in the final product. Cement process emits CO2 from the process due to decomposition of raw material (CaCO3->CaO+CO2) and needs a complete technology and energy systems change if it needs to be electrified. Therefore, biomass can provide a pathway to reduce CO2 emissions from these energy intensive industries. Hence, a process level understanding of utilizing biomass in steel and cement industry is important. This project will focus on understanding the (i) points at which biomass can be introduced in the process (ii) process design changes due to using biomass (iii) efficiency gain/penalty (iv) techno-economic analysis. Integrating CO2 capture process with the biomass based process will result in negative emissions. For specific industry type and the conditions in the industrial process, the techno-economic optimal CO2 capture technology will be identified. The project will also present the overall techno-economic analysis of achieving negative emissions in the steel and cement industry. The tasks in the project will involve (i) literature review of the state-of-the-art (ii) process modelling and simulation (iii) techno-economic analysis. A visiting scholar (postdoc) candidate who has experience or obtained a PhD in energy and process engineering is the

best fit for the project. The tasks can be completed in 12 months.

The results of the project will be helpful to gain industry's attention and their collaboration in future research projects/proposals. Results will be published in high impact journals with gold open access.

Solid Mechanics; Mechanical Engineering (Reg. No. 2156)

Type of position Visiting scholar: (3 - 12 months)		**Main supervisor** Svein Kleiven
KTH School CBH		**Co-supervisor(s)** Xiaogai Li
KTH Department MTH		**Main email contact** sveink@kth.se

Specific subject area(s)

Finite element modeling; Head protection systems; Structural dynamic response.

Title of project

Dynamic response of head protection system in different impact environments

Number of available positions

1

Earliest start date

1 September, 2021

Short description of the project

In this project, novel head protection systems that adapt to different impact environments will be developed and optimized to reduce the risk of traumatic brain injury (TBIs). The research will be focused on the influence of the material performance and structure of the head protection system on the degree of head injury in complex impact environments. The results will provide an optimization method and evaluation basis for the existing head protection systems. The research will be carried out at the Division of Neuronic Engineering at KTH in collaboration with national and international partners.

Evolutionary genetics and genomics (Reg. No. 2157)

Type of position Visiting scholar: (3 - 12 months)		**Main supervisor** Peter Savolainen
KTH School CBH		**Co-supervisor(s)** Pelin Sahlen
KTH Department Dept of Gene technology		**Main email contact** savo@kth.se

Specific subject area(s)

Origin and evolution of the domestic dog: Phylogeographic and selection analysis

Title of project

Evolution of the domestic dog: identification of selected genes and geographic origin

Number of available positions

2

Earliest start date

1 June, 2021

Short description of the project

This project is based on a long-established collaboration between Sweden and China, with the research groups of Professor Ya-ping Zhang and Professor Guo-Dong Wang at Kunming Institute of Zoology, Chinese Academy of Sciences. In a number of prominent papers we have previously, based on large-scale genetics and genomics, indicated South China as the probable region of dog origins, and identified genes under selection in the first phase of dog evolution, affecting e.g. digestion and behaviour.

We have now increased sampling in South China and Southeast Asia, for refined phylogeographic analyses. We analyse all types of genetic markers: nuclear genomes as well as mitochondrial, Y-chromosomal and X-chromosomal DNA. Furthermore, previous studies of selection have been based on genome sequencing, which can identify only roughly 50% of genes affected by selection, since most mutations are situated in regulating regions far from the affected genes. We will now identify these regulatory sequences under selection in the domestication, by mapping of promoters and enhancers and of their interactions.

Because of the broad aims of this study, students with different backgrounds are welcome to apply; molecular biology, bioinformatics or phylogeographic analysis.

Spintronics (Reg. No. 2158)

Type of position Visiting scholar: (3 - 12 months)		**Main supervisor** Gunnar Malm
KTH School EECS		**Co-supervisor(s)** Gunnar Malm
KTH Department Electronics and Embedded Systems		**Main email contact** gunta@kth.se

Specific subject area(s)

Spintronic device physics and large-scale micromagnetic simulations

Title of project

Hardware security primitives based on spintronic microwave oscillators

Number of available positions

1

Earliest start date

15 January, 2021

Latest start date

1 September, 2021

Short description of the project

Hardware security is an important feature of advanced integrated circuits. Two specific areas of interest are physical unclonable functions (PUFs) and true random generators (TRNGs) that are used for unique circuit identification and on-chip cryptographic solutions. Recently several groups have investigated PUFs and TNRGs based on embedded non-volatile MRAM. In this project we will address the use of microwave oscillators so called STOs and SHNOs. These devices are efficient spin wave emitters and the intrinsic thermal noise can be used to generate pseudo-random frequency hopping. We are performing large-scale GPU-accelerated micromagnetic simulations on high performance computing clusters in order to investigate suitable device configurations for hardware security applications. This project will focus on modelling and simulations but the work is done in close collaboration with experimental researchers and we have access to prototype devices for measurement and verification of the modelling results.

Image processing, compression (Reg. No. 2159)

Type of position Visiting scholar: (3 - 12 months)		**Main supervisor** Markus Flierl
KTH School EECS		**Co-supervisor(s)**
KTH Department Intelligent Systems		**Main email contact** mflierl@kth.se

Specific subject area(s)

Learned signal representations, coding, and machine learning

Title of project

Advanced Methods for Image and Video Coding

Number of available positions

1

Earliest start date

1 August, 2021

Short description of the project

The visiting scholar is invited to explore novel signal representations for image and video coding. Prior work on variational autoencoders will be helpful. Learned signal representations, adaptive quantization, and efficient rate-distortion solutions are of interest.

Security and privacy (Reg. No. 2160)

Type of position Visiting scholar: (3 - 12 months)		**Main supervisor** Panagiotis Papadimitratos
KTH School EECS		**Co-supervisor(s)**
KTH Department Computer Science		**Main email contact** papadim@kth.se

Specific subject area(s)

Network security; wireless security; mobile security; information theoretic security and privacy; privacy enhancing technologies; location privacy; IoT security; ML security and privacy

Title of project

Networked Systems Security and Privacy

Number of available positions

4

Earliest start date

1 May, 2021

Latest start date

1 September, 2021

Short description of the project

We are looking for highly motivated individuals for short term positions involving activities leading to original research and results in peer-reviewed publications. The research topics can relate with any of the areas the Networked Systems Security (NSS) group works on. We design and build trustworthy networked systems. Our research agenda covers a gamut of security and privacy problems a number of our results got significant attention by the research community.

Candidates with experimental/systems or theoretical profiles and research interests in any aspect of security and privacy are welcome to apply. Applicants must hold or be about to receive a PhD degree in computer science, electrical engineering, computer engineering, information and communication technologies, or a related area. Furthermore, the applicant must have:

- Strong academic credentials, written and spoken English proficiency, communication and team-work skills.
- Interest in several of the following: design, analysis, verification, implementation, or empirical evaluation of secure networked systems.
- Background in several of the following: computer security, mobile computing, networking, Internet security, wireless communications, distributed algorithms and systems, programming languages, performance analysis, operating systems, simulation techniques and tools, software engineering, system and network programming, applied cryptography, privacy preserving or enhancing technologies, optimisation, information theory, machine learning.
- Preparation and readiness to contribute to our research agenda and to work in an internationally oriented group.

Cyber-physical systems (Reg. No. 2161)

Type of position Visiting scholar: (3 - 12 months)		**Main supervisor** Martin Törngren
KTH School ITM		**Co-supervisor(s)** A co-supervisor will be appointed among PIs involved in TECoSA (www.tecosa.center.kth.se)
KTH Department Machine Design		**Main email contact** martint@kth.se

Specific subject area(s)
robust machine learning, cyber-security, resilience engineering
Title of project
Resilient AI and ML based cyber-physical systems
Number of available positions
2
Earliest start date
December 2020
Short description of the project
Cyber-Physical Systems (CPS) integrate computation, communication and physical processes to form systems with improved and entirely new capabilities. The trends are well manifested by developments in automated vehicles (AVs) and intelligent transportation systems (ITS). As CPS become smarter and collaborating, incorporating AI/ML components and connected to each- other and digitalized infrastructure, this poses a number of new challenges for CPS development and assurance.
First, CPS, are by definition heterogeneous and the addition of AI/ML components will require a proper understanding of their development frameworks and how the corresponding components can be integrated into CPS, including in embedded and edge-based systems.
Secondly, the physical nature of CPS and their capabilities, will typically imply that they are mission critical in some sense; their failures may for example cause vehicles to crash or disrupt important societal services. It is thus essential to properly understand how CPS may fail or behave when subject to security attacks as well as AI/ML components that do not behave as intended.
The proposed research follows two related tracks both related to resilient CPS (note: We use resilience beyond robustness to also indicate capabilities to adapt and change). The first track will investigate in particular ML/DL components and their frameworks for integration into CPS. Robustness and ways of detecting anomalies and operation outside of training data will be investigated. The second track deals with security where attack and attacker models will be studied. Jointly the two tracks will investigate approaches for developing resilient CPS considering both component failures and attacks.

We are looking for visiting scholars with a background in AI/ML and/or cyber-security, with a strong interest in applying these fields in the context of CPS, including for AVs and ITS. The research is intended to primarily be applied in the context of AVs and ITS where our AD-EYE platform (https://www.adeye.se/) will be utilized. The research will be conducted in collaboration within the Mechatronics research team, where the TECoSA center (https://www.tecosa.center.kth.se/) offers an excellent environment for interacting with a variety of academic experts and industrial partners.

Cyber-physical systems (Reg. No. 2162)

Type of position Visiting scholar: (3 - 12 months)		**Main supervisor** Martin Törngren
KTH School ITM		**Co-supervisor(s)** A co-supervisor will be appointed among PIs involved in TECoSA (www.tecosa.center.kth.se)
KTH Department Machine Design		**Main email contact** martint@kth.se

Specific subject area(s)

Fault-tolerant computer control systems

Title of project

Fault-tolerant automated driving and intelligent transportation systems

Number of available positions

2

Earliest start date

December 2020

Short description of the project

As vehicles are becoming autonomous, and a growing smart infrastructure is slowly emerging to support efficient and safe driving, our transportation systems will become dependent on corresponding computing and communication systems (within vehicles, for communication, in the edge and in the cloud). Transportation systems need to be available and safe, and deal with disturbances and a number of problems (from software bugs and hardware failures, to cyber-attacks). Given partial failures and the critical nature of these systems, it is thus essential that they are made fault-tolerant, having the ability to continue operation despite failures, while striking a balance between safety and availability.

The proposed research will explore cost-efficient fault-tolerance at the automated vehicle and connected vehicle level, investigating relevant fault models, different levels of error detection, redundancy and diversity. The research will include evaluation fault-tolerance patterns through fault-injection and analytical methods. Our AD-EYE platform will be utilized for simulation based evaluation and its connection to the ITS testbed that is being developed at the KTH-campus. The visiting scholars will be able to interact with other researchers at KTH and with industry, benefitting from the TECoSA research center (https://www.tecosa.center.kth.se/) and the ICES competence network (www.ices.kth.se).

Vehicle Dynamics (Reg. No. 2163)

Type of position Visiting scholar: (3 - 12 months)		**Main supervisor** Malte Rothhämel
KTH School SCI		**Co-supervisor(s)** Lars Drugge
KTH Department Engineering Mechanics		**Main email contact** malter@kth.se

Specific subject area(s)

Vertical dynamic measurements

Title of project

Child car seat vibration level measurements

Number of available positions

1

Earliest start date

1 March 2021

Short description of the project

Measurement and evaluation of primary vertical (but even lateral and longitudinal) dynamic accelerations and vibration with focus on child transportation. Modes for variation are dynamic properties of the vehicle (tyre pressure, active damper settings) and different road surface qualities. If the project allows, the road surface quality shall be measured, too, and related to the corresponding vibration level.