ROYAL INSTITUTE OF TECHNOLOGY

KTH-CSC Programme Entry 2021 positions for late application

Content

Full PhD student:(48 months)

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.

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.

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

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.

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).

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.

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.

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.

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.