University of Stavanger
Department of Electrical Engineering and Computer Science

The University of Stavanger (UiS) has about 12,000 students and 1,600 employees. We are the only Norwegian member of the European Consortium of Innovative Universities. The university has high ambitions. We will be a driving force in the development of knowledge in the region, and an international research university with an emphasis on innovation. Together with our staff and students, we will challenge the well-known and explore the unknown.

Department of Electrical Engineering and Computer Science is part of the Faculty of Science and Technology. The department carries out research within data, electricity and electronics, and offers bachelor programs in electrical- and computer engineering, master programs in computer science and cybernetics/signal processing, and a PhD program in information technology. The master program in computer science is an international program and is taught in english. There are currently 40 employees, including research fellows and postdocs, and 520 students at the departement.

Research fellow in Computer Science, Signal Processing or Cybernetics

The University of Stavanger invites applications for a doctorate scholarship in Computer Science, Signal Processing, or Cybernetics at Faculty of Science and Technology, Department of Electrical Engineering and Computer Science.

This is a trainee position that will mainly give promising researchers an opportunity for professional development leading to a doctoral degree.

The research fellow will be appointed for three years with only research duties or four years with research and 25 % compulsory duties. This will be clarified in the recruitment process. The position is vacant from 01.07.2018.

It is possible to apply on up to three of the following projects:

1. The control systems behind biomolecular sensing and their connection to systems for adaptation.
2. Deep network representations for scalable graph mining
3. Modeling and simulation of antimicrobial resistance in microbial communities
4. Orchestration and control in software-defined 5G radio access and core networks
5. Biomedical timelines - development of a data analysis framework
6. Image analysis on computer tomographic (CT) perfusion images of acute stroke patients - Prediction of final stroke volume
7. Conversational AI for information access and retrieval
8. Predictive analytics for smart watches (Heart rate and biomarkers)

Please mark in your application which projects you wish to work on and your order of preference. For further information regarding required qualifications and each project, please see below.

The position is funded by Norwegian Ministry of Education and Research.

Applicants must have a strong academic background with a five-year master degree, preferably recently, or possess corresponding qualifications which could provide a basis for successfully completing a doctorate. Both the grade for the master’s thesis and the weight average grade of the master’s degree must individually be equivalent to or better than a B grade.

Applicants will be evaluated based on their potential for research in the field, as well as that person’s individual prerequisites for research education.

The appointee must be able to work independently and as a member of a team, be creative and innovative.

The research fellow must have a good command of both oral and written English.

This fellowship position is important for obtaining a scientific position at a University.

The doctorate will mainly be carried out at the University of Stavanger, apart from a period of study abroad at a recognized and relevant center of research.

The research fellow is salaried according to the State Salary Code, l.pl 17.515, code 1017, LR 20, NOK 436 900 per annum.The position provides for automatic membership in the Norwegian Public Service Pension Fund, which guarantees favorable retirement benefits. Members may also apply for home investment loans at favorable interest rates.

Project description and further information about the position can be obtained from Head of Department Tom Ryen, telephone +47 51832029, email: tom.ryen@uis.no Information about the appointment procedures can be obtained from HR adviser Janne Halseth, telephone +47 51833525, email janne.halseth@uis.no.

The University is committed to a policy of equal opportunity in its employment practices. The University currently employs few female research fellows within this academic field and women are therefore particularly encouraged to apply.

Please register your application in an electronic form on jobbnorge.no. Relevant education and experience must be registered on the form. Certificates/diplomas, references, list of publications and other documentation that you consider relevant, should be submitted as attachments to the application as separate files. If the attachments exceed 30 MB altogether, they will have to be compressed before uploading.

Project description and contact persons:

1. The control systems behind biomolecular sensing and their connection to systems for adaptation.

A hallmark property of living systems, from single cells to complex organisms, is the ability to sense the outside world. Many biochemical sensors can be said to function as differentiators. They react to changes in the outside environment, often with large signal responses that return to basal levels if the change is sustained. This type of behavior is closely related to adaptation and homeostatic mechanisms. An adapting sensor that gives a response and then returns to its original pre-stimuli state, when faced with sustained stimuli, can function over a larger dynamic range in stimuli input.

Applying control theoretic methods and nonlinear analysis, one goal of this project is to identify ways biochemical species in an organism can interact to form simple structures that work as sensors. Another goal is to examine the similarity and connection between adapting systems and sensors in biological systems. A large portion of the work will be theoretical, but the right candidate will also have the possibility to study and implement systems in simple cells, such as bacteria or yeast, in the laboratory.

The applicant should have a master's degree with specialization in control theory, dynamical systems, or other related fields. A background in biology is not required, but certainly a plus, necessary courses in biology will be offered. The successful applicant will join an interdisciplinary group with researchers and other PhD students from both control engineering and molecular biology.

Supervisors: Professor Tormod Drengstig, tormod.drengstig@uis .no and Associate professor Kristian Thorsen, kristian.thorsen@uis.no

2. Deep network representations for scalable graph mining

Recently application of network embeddings has been increasingly popular for graph mining tasks such as community detection, link prediction, node classification, link classification and temporal network analysis. Techniques such as DeepWalk and Node2Vec have been proposed to learn network features vectors to solve these tasks in an unsupervised and generic manner. While these techniques are simple, their genericness renders them ineffective for specific tasks. These existing representations are learned by exploring the graphs locally through random walks and hence are not deep. Most social networks and web graphs on the other hand are known to have hierarchical structures. Learning appropriate representations to capture these hierarchical structures remains to be a challenge. Finally, the existing techniques are computationally expensive and are limited to small and medium sized graphs.

Motivated by the above issues, in this project we seek to solve three main research questions: (1) Using a generic framework can we learn task-specific representations? (2) Can we learn richer representations to capture the hierarchical structures of the networks using recent advances in deep learning rather than simple random walks in the networks? (3) Can we scale the learning process using techniques such as distribution preserving sampling and asynchronous training? This thesis will address these research questions and propose a novel framework for learning task-specific, deep network embeddings for large-scale graphs.

The candidate is required to have a background in machine learning or deep learning and graph mining.

Supervisors: Associate Professor Vinay Setty UiS), vinay.j.setty@uis.no and Junior Professor Avishek Anand (Leibniz Universität Hannover)

3. Modeling and simulation of antimicrobial resistance in microbial communities

This project aims to develop mathematical models to better understand and predict how antimicrobial resistance spreads in microbial communities. Of particular interest is the spread of carriers for antimicrobial resistance (genes) in wastewater treatment plants since such plants are nodal points for further spread of into the environment. Two approaches will be examined in this project. The first is to use deterministic ordinary differential equations. The plant, bacterial populations and resistance genes are treated as continuous concentration state variables, and production and degradation are modeled by pseudo-kinetics and conversion stoichiometries. The second is individual-based and stochastic. An individual based model (IBM) is one where bacterial classes (guilds and genotypes), genetic carriers (plasmids) and viruses (bacteriophages) are treated as individual and discrete populations.

The work in this project will be conducted in collaboration with PhD candidates working on experimental studies on the spreading and ultimate fate of antimicrobial genes in a laboratory scale wastewater treatment system. Experimental data will be used for systems identification and calibration/validation of the proposed model. The candidate will join a group who also work on a closely related EU-funded project under the Joint Programme Initiative on Antimicrobial Resistance (JPI-AMR) with collaboration from top international groups at Lund University (Sweden) and Statens Serum Institute, Copenhagen (Denmark).

Applicants must have a strong academic background with master's degree in dynamical systems, mathematical modelling, control theory/engineering (kybernetikk), or other related fields. A background in biology is not required, necessary courses in biology will be offered.

Supervisors: Associate professor Kristian Thorsen, kristian.thorsen@uis.no and associate professor Roald Kommedal.

4. Orchestration and control in software-defined 5G radio access and core networks

The fifth generation (5G) of cellular networks aims to revolutionize the world of wireless communication. 5G will be characterized by ubiquitous connectivity, extremely low latency, and very high-speed data transfer. These characteristics will enable the use of 5G in a very broad set of application scenarios: from pervasive video to high user mobility; from broadband access everywhere to lifeline communications; from massive Internet of Things to broadcast-like services; from tactile Internet to ultra-reliable communications. For enabling this variety of applications, ambitious improvements with respect to 4G are needed: 10-100 times more connected devices; 1000 times higher mobile data volume per area; 10-100 times higher data rate; 1 ms latency; 99.99% availability; 10 times less energy consumption; 5 times less network management operation expenses.

For achieving the challenging objectives of 5G, the research community has been working on the Software-Defined 5G Radio Access and Core Networks, which extensively use virtualisation and softwarisation technologies, such as Network Function Virtualisation (NFV) and Software-defined Networking (SDN), in order to efficiently, flexibly, and scalably provide 5G network services. NFV and SDN will allow the profitable coordination of the heterogeneous radio network technologies, which include multi Radio Access Technology (multi-RAT) and multi-tier architecture (composed by macro-cells, small-cells, and relays), and device-to-device (D2D) communication, and can additionally enable the network slicing. In this scenario, the realisation of both resource sharing and service differentiation, i.e., low-latency services and ultra-reliable services share the same communication channel and the equipment with best-effort services, is an important issue and research challenge.

The candidate will be working on approaches for the orchestration and control of the 5G radio and core network resources with different objectives, such as energy efficiency, Quality of Service (QoS), economical cost reduction, and dependability.

Knowledge of telecommunication networking is required, experience with optimisation and resource allocation is useful but not required.

Supervisors: Associate professor Gianfranco Nencioni (UiS), gianfranco.nencioni@uis.no and Professor Bjarne E. Helvik (NTNU)

5. Biomedical timelines - development of a data analysis framework

A timeline is a representation summarising the sequence of important events during the course of time within which these events occur. For example, during the time course of resuscitation important events can be start and end of a sequence of chest compressions, the deployment of a electrical shock , and the cardiac rhythm transitions. A timeline can be constructed capturing the therapeutic information which will consist of a sequence of alternating states: pause in therapy, ongoing chest compressions and shock delivery. A parallel timeline will consist of a sequence of states corresponding to the different cardiac rhythms. Whenever an important event has occurred there will be a corresponding state transition. Previous research within this field has demonstrated that the resuscitation timelines can be used as a starting point for a diversity of research objectives.

The purpose of this study is to investigate the potential of timelines as a generic analysis framework. There will be data available from different types of relevant scenarios for development and experimentation: newborn resuscitation, cardiac arrest resuscitation and a 90 km mountain bike race.   There are several methodological aspects to consider.: 1) Develop approaches to analyse a problem domain where the aim is to identify which events are necessary and sufficient to describe a timeline. How many sub timelines are needed to provide a sufficiently detailed combined timeline? 2) What are the requirements to automatically construct timelines using signal processing and machine learning techniques.

Furthermore, it will be important to map out what kind of further analysis can be done with basis in the timeline representations: 1) Develop techniques to search in the timeline representations to extract data for specific study objectives. 2) Generation of time series with covariates that can be used further to develop statistical models to analyse the relationship between therapeutic interventions and patient response. 3) Formulation of state sequences that can be used to identify which combinations of therapeutic steps that will have a positive effect on the patient and which will not.

The applicant should have a Master's degree with specialization in signal processing, machine learning, statistics and/or mathematics.

Supervisors: Professor Trygve Eftestøl, trygve.eftestol@uis.no and Professor Kjersti Engan, kjersti.engan@uis.no and Professor Jan T. Kvaløy.

6. Image analysis on computer tomographic (CT) perfusion images of acute stroke patients - Prediction of final stroke volume

Motivation: In Norway, 15 000 persons suffer from acute cerebral stroke annually. Acute cerebral stroke is the leading cause of adult long term severe disability, the leading cause for admission to nursing homes, and the third leading cause of death in adults in Norway [1]. Cerebral stroke is a common disease which has an enormous negative impact on the quality of life for the patients and a mortality of up to 25% in the acute phase [2], additional costs of health care in the acute and chronic phase are enormous for the society [1]. At Stavanger University Hospital (SUS) patients are routinely investigated using perfusion CT, and parametric colour coded maps describing the blood perfusion of the stroke area are calculated. These maps aid in the decision on who needs immediate thrombolytic treatment and are important in saving lives and reducing the possibility of severe disability. These parametric maps are far from perfect in diagnostic accuracy and further improvement of the methods in use is needed [3]. More accurate evaluation of perfusion CT may lead to better guidance of thrombolytic therapy and thereby better treatment of the patients.

The objective of the current project is to characterize the properties of tissue affected by stroke by utilizing advanced image processing and machine learning methods. It is especially important to be able to discriminate between infarcted tissue (irreversibly damaged tissue), hypoperfused tissue at risk for being irreversible damaged if not better perfusion is restored fast, and healthy tissue, since the relative sizes of these tissue classes have a major impact on patient life and probability of disability.

Methods: The supervision team has long experience in medical image analysis and the use of machine learning techniques. Classical image processing and analysis in terms of automatic segmentation, shape and size characterization as well as texture analysis of risk areas will be performed to extract relevant features from the images. Such features can be used as input to machine learning systems, classifying tissue areas. In addition, artificial intelligence (AI) in terms of deep learning neural networks will be explored. Deep learning neural networks have had a tremendous success in later years, providing state of the art results in many computer vision and image analysis applications. The use of autoencoder in deep nets provides a method for training nets for unlabeled or sparsely labeled data, which can be necessary for the dataset at hand. Also deep nets can provide a method for identifying the regions of an image that are important in terms of discriminating between patient classes, or tissue classes.

Dataset: All images needed for analysis are already collected making the feasibility very high. The available data set from SUS includes more than 1000 cerebral stroke subjects with completed perfusion CTs and a secondary CT or MRI after therapy. An additional note to the ongoing thrombectomy study protocol is needed to the Regional etic committee, but no new REK application. An important advantage of the available data is that the cohort is population based serving a homogeneous patient group from only one hospital in the entire region.

References: [1] Helsedirektoratet. Nasjonal retningslinje for behandling og rehabilitering ved hjerneslag. Oslo: Helsedirektoratet; 2010. 196 s, [2] Saumya H Mittal, Deepak Goel. Mortality in ischemic stroke score: A predictive score of mortality for acute ischemic stroke. 2017;3(1):29-34. [3] Y.W. Lui, E.R. Tang, A.M. Allmendinger and V. Spektor. Evaluation of CT Perfusion in the Setting of Cerebral Ischemia: Patterns and Pitfalls. AJNR 2010;31 (9):1552-1563.

Supervisors: Professor Kjersti Engan (UiS), kjersti.engan@uis.no and Professor and medical doctor Kathinka D. Kurz (SUS, UiS), Kathinka.dehli.kurz@sus.no

7. Conversational AI for information access and retrieval

Intelligent personal assistants and chatbots (such as Siri, Cortana, the Google Assistant, and Amazon Alexa) are being used increasingly more for different purposes, including information access and retrieval. These conversational agents differ from traditional search engines in several important ways. They enable more naturalistic human-like interactions, where search becomes a dialog between the user and the machine. Unlike in traditional search engines, where a user-issued query is answered with a search result page, conversational agents can respond in a variety of ways, for example, asking questions back to the user for clarification.

The successful candidate will work on the design, development, and evaluation of conversational search systems. In particular, the candidate is expected to employ and develop deep learning techniques for understanding natural language requests and generating appropriate responses.

The candidate is required to have a background in machine learning or information retrieval.

Supervisor: Professor Krisztian Balog, krisztian.balog@uis.no

8. Predictive analytics for smart watches (Heart rate and biomarkers)

Physical inactivity is a major challenge to global health and the problem is increasing rapidly: >5 million deaths each year are attributable to insufficient physical activity. Norway is among the European countries with the lowest level of spontaneous physical activity. Recent technological advances in personal heart rate and activity monitors in form of smart watches may make these devices potentially important tools in combatting physical inactivity by providing automatic motivation and individualized guidance on physical activity. Despite the rapidly increasing use of smart watches there is yet no long-term documentation for their benefit and their potential role as diagnostic tools has not been established.

Characteristics of heart rate and changes in heart rate during exercise and rest, are strong predictors of cardiovascular prognosis . At the same time in the recent years, smart watches with integrated HR monitors for the first time became truly available to the average consumer. This makes meaningful research possible.

Smart watches produce significant amounts of data, what calls for automated data analysis and requires application of big data tools in addition to a mix of other data science concepts such as machine learning and time series analysis.

The research will be performed primarily based on data obtained during the NEEDED 2014 study, containing heart rate (HR), ECG, blood samples, and other data for over 100 subjects collected during “Nordsjørittet”. Additionally, a mechanistic study will be performed during the spring of 2018 (NEEDED 2018), adding vast amounts of data on the relationship between heart rate, direct work measurement (powermeters), 12-lead ECG, and a large number of biomarkers, both during standardized physiological tests and during a bicycle race.

We aim to develop a model that predicts the expected, normal HR response to physical exercise. The algorithm used to determine a normal heart rate response, will be developed using data from the NEEDED 2014 and 2018 studies. Following the determination of a normal (physiological) heart rate response to exercise, we will define an abnormal (pathological) response in each individual. This algorithm for the detection of a pathological heart rate response will be tested in future studies comparing subjects with and without cardiac disease.

The data abundance might be useful in early stages of analysis, nevertheless, it is important to determine a minimal set of inputs that can provide useful and conclusive information to the user and physician. This minimization leads to an improved long-term accuracy and security. Another important question is to what extant causal conclusions could be drawn for largely observational data and if it is possible to design simple controlled experiments to strengthen the causal arguments. These questions will drive further stages of the PhD work.

Supervisors: Associate Professor Tomasz Wiktorski, tomasz.wiktorski@uis.no and Professor Trygve Eftestøl and Professor II Stein Ørn.

Jobbnorge ID: 147261, Deadline: Closed