ANNUAL REPORT 2020

CAISR

Center for Applied Intelligent System Research

HALMSTAD UNIVERSITY

Cover: On March 16, 2020, the vice chancellor decided on Halmstad University's strategy for digitalization with goals to achieve for 2020-2025. A few months later, we had by necessity implemented most of it since the teaching and research went online due to covid-19. 2020 became the year of zoom meetings (or Microsoft Teams, or Skype), and our cover illustrates this.

CAISR

Center for Applied
Intelligent Systems Research

Annual Report 2020

Knowledge Foundation

Table of contents

CAISR

Director's statement

"2020, a year so bad they named it twice" was a joke on the internet last year. And, certainly, 2020 was terrible in many aspects. The covid-19 pandemic struck the world hard in March, with many markets coming to a stand-still (tourism and travel being the hardest hit). The education moved almost completely online, with a few exceptions where laboratory exercises were allowed. The manufacturing industry, especially vehicles, stopped and staff were placed on temporary (government supported) lay-offs. The situation for some of our projects with industrial partners was suddenly uncertain, would there be room for innovation and development at the companies after the pandemic? Our staff, many of whom had commuted weekly to our industrial partners for cooperation, suddenly were not traveling, neither to our industrial partners nor to international conferences. Education visits to foreign countries were cancelled. Meetings moved online (see cover) and our usually busy research center was suddenly almost empty.

Our students moved online and this probably felt ok initially. However, after a full nine months of online teaching and not so much social interaction we can tell that this has not been good. This is not unique for our students, the situation is the same and perhaps even worse at other universities worldwide.

However, all was not bad. We digitalized our educations and offered them "online". Our staff thought of how to offer relevant continued education courses online for our industry partners. Several new course offerings were developed, tested against industrial partners and alumni, and the best selected for a new "covid-19" program offer. Our engagement and volume in online education for professionals grew substantially. This was very good.

Another positive and surprising effect was that we published more papers than ever before, and in more high ranking journals. It seems the decrease in travel time freed up time to finally get those results summarized into papers.

We were also granted several new projects in 2020. One particularly important is the new profile funding CAISR Health, stretching eight years forward, directed at information driven healthcare. This profile is a collaboration between our AI researchers, healthcare researchers at Halmstad University, Region Halland and several healthcare industry partners. Being awarded this grant is a huge success for us, with the potential to position Halmstad University nationally.

In 2020 Halmstad University conducted a university-wide strategy process, with external panels reviewing strategic plans. The outcome being that the organization that the CAISR center is part of was considered to have well developed strategies, a good connection between research and education, and to be a strong research environment in general with excellent industrial relationships. A very concrete advice from the external panels to us was to develop a broader "AI for social good" education program, and spread the good AI research and education both wider within the university and to other subjects. We took this advice to our hearts and have the ambition to offer such a program from 2022.

Thorsteinn Rögnvaldsson

CAISR **scientific agenda**

The ability to create and transfer knowledge efficiently is a key competitive advantage for a company or an organization. It follows that being able to use computers to automatically, or autonomously, create transferable knowledge from product and customer data is a key competitive advantage. Autonomous knowledge creation is the common research vision for CAISR, and we refer to a system that can autonomously create knowledge as an *aware* system.

A good formalism for discussing how to create knowledge is the *Data, Information, Knowledge, and Wisdom* (DIKW) hierarchy[1] , often illustrated with a pyramid (see figure below); the higher a system reaches on the pyramid, the more aware it can be.

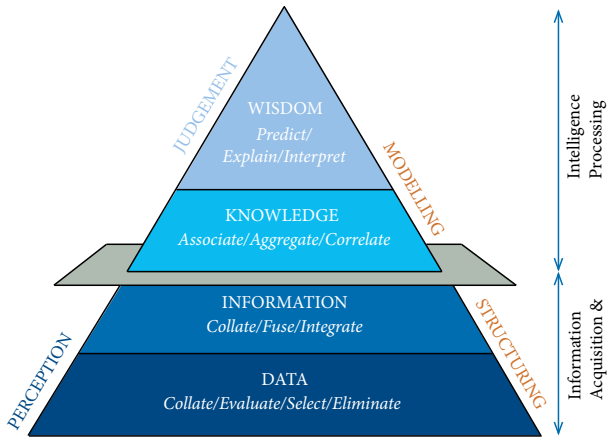


Figure 1. The knowledge pyramid, adapted from Ackoff (1989). "From Data to Wisdom". Journal of Applied Systems Analysis 16: 3–9.

The bottom level in the pyramid, *data*, deals with collecting and representing data. A key research question here is how to autonomously select what data to collect. How can a system decide what data are (or will be) relevant, and can features/representations be learned? With endless streams of data, it is impossible to save all raw data; it is necessary to work with representations of the data.

1 Rowley, J. (2007), "The wisdom hierarchy: representations of the DIKW hierarchy", Journal of Information Science, 33, pp. 163-180.

The *information* level relates to questions that begin with "who, what, when, and how many", creating "events" from the data in the layer below. This deals with classification, rearranging/sorting, aggregating, performing calculations, and selection. Much machine learning research is devoted to this stage. Important open research questions here regard autonomous clustering and categorization of events.

The *knowledge* level is about creating "rules" from the information, which requires combining information from different sources. An obvious example is supervised learning, which matches "events" (input) with correct responses (target) provided by an expert. A relevant question deals with knowledge representations; can knowledge be represented so that it can be used better for reasoning and prediction, or easier to transfer from one scenario to another? A knowledge structure should evolve from experience, allowing for learning from data and human experts, and be capable of taking into account initial domain knowledge.

The top level, denoted the *wisdom* level, relates to the question "why" or "what will happen"? It is about the ability to project into the future and reason back into the past. An aware system must be capable of extrapolating information into the future, to evaluate the consequences of actions, and able to explain why something happened.

It is obvious that to do tasks on each of these levels autonomously would be a sought after ability, and even more attractive to merge them into an autonomous knowledge-creating, or even wisdom-creating, system. Hence, the CAISR scientific vision of aware systems. Two clear examples where these abilities can be demonstrated are predictive maintenance in machines and for people (healthcare). Here, the complexity of the problem(s) is so high that it is difficult for a human expert to grasp it all, but the amount of data is growing fast and the aim is to have AI systems uncover (surprising) knowledge for human experts and to illustrate relations that are not apparent to the experts. Information-driven healthcare represents a step up in awareness from data-driven healthcare (although we would call it "knowledge-driven" rather than "information-driven" to match with the DIKW hierarchy).

CAISR **future**

Where is CAISR heading from 2020? Over the last decade, CAISR was very successful in managing the different aspects of a cooperating strong research and education environment. CAISR developed a productive, high quality research and education environment and also met the expectations of being a closely cooperating and value creating environment; no research profile evaluated over the years 2016-2020 received a higher overall score than CAISR in their final evaluation (a total of 12 evaluated profile projects). CAISR was also awarded a continuation funding, CAISR+, by the Knowledge Foundation from 2020.

Ten years ago, we identified two core application areas for CAISR: intelligent vehicles (or intelligent machines) and health technology. These are the areas where we have focused our external cooperation relations and research. They have develop very well, CAISR has expanded a lot, and we now have two main research directions with industrial cooperation in CAISR, one on predictive maintenance on machines with machine learning, and one on information driven healthcare, which can be labelled predictive maintenance for humans. Both directions are described later in this report and there is substantial staff overlap between these two directions since many of the algorithmic questions are very similar. We view that as a strength.

The first direction, intelligent machines and predictive maintenance form the core of the CAISR+ project. The latter direction, information driven healthcare, was granted a large long-term profile funding by the Knowledge Foundation in 2020. They are now "budding off" and forming a large research and education center together with researchers in health sciences.

During 2020, and into 2021, Halmstad University conducted a university-wide research strategy process with external evaluations of the strategic plans. A possible outcome of this may be a reorganization of CAISR, combining it with other parts of Halmstad University, so that AI can come into more education and research programs at the university.

Information Driven Care - IDC

Mattias Ohlsson, director CAISR Health, and Farzaneh Etminani

CAISR Health

In December 2020, the Knowledge Foundation granted Halmstad University a new 8 year research profile grant: CAISR Health. It builds on some of the successful research developed in CAISR, and will focus on information-driven care, understanding the chain from formulating and prioritizing questions, to algorithms, to data collection, to engagement, to explainability, and to implementation. Halmstad University's long-term investments in Health Innovation and our close collaboration with Region Halland, ranging from data access to medical expertise, are vital for this venture. CAISR Health will be run in cooperation with Region Halland, Brigham and Women's Hospital (Boston) and the industrial partners Cambio, Capio, Hallandia V, Intersystems, Mölnlycke, Novartis and Visiba Care.

Lena-Karin Erlandsson, Dean for the School of Health and Welfare

Petra Svedberg, deputy director CAISR Health

The availability of data is increasing rapidly in healthcare. The information-driven care vision is to make use of all this data, together with data analytics and machine learning, to improve the healthcare system. Region Halland has established a unique infrastructure for synchronizing and making healthcare data available, and is at the forefront of adopting information-driven care. This has already contributed to concrete improvements for their healthcare system.

CAISR Health's scientific focus is on three related and interacting research areas: Precision Healthcare and Management, Connected Health, and Healthcare Implementation. They are essential components for the development of the information-driven care concept and for the needs of our industrial partners. Precision Healthcare aims to deliver the right treatment to the patient at the right time with data driving the decisions. Machine learning plays an important role in this development. Information-driven care will not be confined to traditional appointments with healthcare professionals but will encompass terms such as mobile and smart home environments. Connected Health is the research on such a decentralized, connected, healthcare system. And, finally, one of the biggest challenges of the information-driven care concept is to have the AI-based tools and services implemented in daily routines. Successful implementation often requires an active change process on the organizational level as well as use on the individual level. Healthcare implementation is the research area that addresses this last and very important issue.

Magnus Clarin, Dean for the School of Information Technology

CAISR Health is placed at both the School of Information Technology and the School of Health and Welfare.

Leap for Life

Leap for Life is Halland's new collaborative effort with information driven care. It is a innovation centre for Region Halland, Halmstad University, all municipalities in Halland and the business sector in their joint quest to change and develop future healthcare. Leap for Life is a development and renewal of the Centre for Health Technology Halland (HCH) which started in 2009. Halmstad University is the host organisation for Leap for Life.

Our society and our healthcare system are facing a number of great challenges. Pandemics, an aging population and fewer caring hands require new solutions in order to maintain good healthcare. By using artificial intelligence (AI) to draw conclusions about collected health data, care givers and hospital managements can make better informed decisions and care can be even more individualised. The concept is called information driven care and is the focus of the innovation centre Leap for Life.

"We need to work together in order to solve the healthcare challenges. With Leap for Life, we gather partners to collaborate, enable innovation and act as the driving force for change within healthcare – regionally, nationally and internationally", says Anne-Christine Hertz, Manager for Leap for Life.

The broad and long-term purpose of Leap for Life is to give people – regardless of their gender, age, ethnicity, religion or other belief, sexual orientation, financial conditions or other social or personal characteristics – the best possible care. That means care in the right place, as soon as possible and in a way that makes every individual feel safe in the situation that they are in.

It happens in Halland

Leap for Life started in September 2020 and is a development and renewal of the Centre for Health Technology Halland (HCH) which started in 2009. Just like HCH, Leap for Life is co-owned by Halmstad University, Region Halland and the municipalities in Halland – Halmstad, Laholm, Hylte, Falkenberg, Varberg and Kungsbacka. Leap for Life has its facilities at Halmstad University, which is the host organisation for the innovation centre. The collaboration between academia and the business and public sectors is central to Leap for Life, just as it has been for HCH.

"Leap for Life gathers the necessary ecosystem of competences – care development, business development and research – that are needed for Halland's unique venture in information driven care. There are many actors who, in different ways, can and want to contribute to developing and innovating healthcare. What makes Leap for Life unique is that the centre – with a relatively small and quick moving organisation – gathers the world's leading healthcare actors", says Magnus Clarin, Dean of the School of Information Technology at Halmstad University.

Health data factory

Through a new developed health data factory, the partners of Leap for Life create new knowledge and solutions which can be used by both companies and healthcare actors. Leap for Life builds a data infrastructure that has been missing and connects healthcare and self-care with the region and municipalities as active collaboration partners. This attracts the world's leading businesses and researchers within AI to develop new solutions for more digitalised healthcare.

Currently, Leap for life focuses on four areas: innovation support, professional development, research and health data factory. In these areas, the innovation centre's primary role is to initiate and coordinate actions with partners from the academic, healthcare, and business sectors.

Research projects - IDC

Swedish Research Council

AIR

In this project, researchers from Lund University, Halmstad University and Region Halland will determine how AI, when applied on the Swedish register infrastructure, can contribute to increased quality and efficiency of healthcare.

The overall aim of the Artificially Intelligent use of Registers (AIR Lund) is to assess critically how machine learning methods applied on the Swedish register infrastructure can contribute to increased quality and efficiency of healthcare, while addressing well-founded ethical and legal concerns related to the use of complex data-demanding algorithms in clinical practice. Specific projects will focus on cardiometabolic diseases, including early identification and prevention, improved diagnosis at the emergency department and improved long-term forecasting of patient outcomes and healthcare needs.

VINNOVA

Information driven healthcare

This project is part of a national innovation environment with the aim to develop Swedish healthcare to be more information-driven, personalised and scalable by using artificial intelligence (AI).

Halmstad University, Region Halland, the Swedish Association of Local Authorities and Regions (SKR) and AI Innovation of Sweden will together establish an innovation environment to improve Swedish healthcare. The initiative is financed by Vinnova and aims to develop healthcare by applying AI methods. This is done in close cooperation with public, private and academic parties.

HIPATCH – Halland Intelligent Patient-Centered Healthcare

Managed by Affecto and owned by Region Halland, we use the Strategic Healthcare Analysis and Research Platform (SHARP) which is a unique integration of data sources from all levels of the care chain including measurements from primary care, ambulance, emergency care, inpatient care as well as the traditional EHR's. This enables us to have a system's approach to healthcare delivery which has shown to be an effective methodology to promote better health at a lower cost.

Health spending as a share of GDP in Sweden (11.0%) remains well above the OECD average (8.9%). In addition to ageing and advanced treatment procedures, a fundamental source of escalating costs is the unawareness of how and to what extent different sub-groups within healthcare utilize resources and contribute to quality. Hence, it gets challenging to unveil critical areas within healthcare that are truly responsible for high costs and low quality.

Advancement in computing technologies and machine learning algorithms has enabled us to analyze big amounts of data to enhance the efficiency and productivity of businesses in every industry. Healthcare is no different. The recent decade has witnessed huge advances in the amount of medical data generated and stored in almost every domain in the healthcare sector. The primary purpose of Electronic Health Records (EHR) is to facilitate and improve individual patient care. In addition to it, EHRs today, also serve as a data center for clinical research to improve healthcare management, patient safety and clinical decision support.

VINNOVA

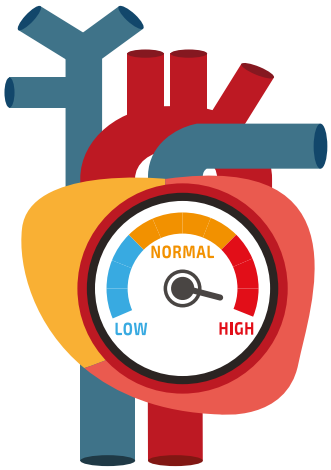
iMedA

The iMedA project will improve medication adherence for hypertensive patients through an AI agent that supports doctor and patient in collaboratively understanding key individual adherence risk factors and designing an appropriate intervention plan. iMedA will deliver the selected intervention through a mobile app and follow-up on its effectiveness improving the system over time.

The combination of person-centered care and self-management interventions will lead to significantly improved health outcomes and reduced healthcare costs. iMedA empowers hypertensive patients to take responsibility for their health through self-management, and provides doctors with information they need for person-centered care.

To identify risks and intervention strategies, iMedA uses health records as well as self-reported input. The AI agent understands how both medical and personal factors interact with respect to medication adherence, and display this information on a 'dashboard' that guides patient-doctor conversation. The AI monitors the effectiveness of interventions in order to improve over time.

The iMedA agent will be built by combining three important AI techniques. First is to create a meaningful and comprehensive representation of each patient based on information fusion and representation learning. Second is to use peer group analysis and interpretable supervised machine learning methods to predict non-adherence for concrete patients. Finally, intervention strategies that are the most appropriate for a particular patient we will selected by combining data-driven and knowledge-driven approaches.



Medtech4Health

Evaluation of deep learning to predict the diagnosis of LBD using 18F-FDG PET

The main purpose of this project is to compare deep machine learning methods to human visual interpretation in clinical applications, specifically when it comes to PET brain scans of patients with Lewy body dementia, LBD.

The main purpose of this project is to compare deep machine learning methods to human visual interpretation in clinical applications. We want to evaluate whether Artificial Intelligence (AI) models – including shallow and deep learning algorithms – could be trained to predict the final clinical diagnoses in patients who underwent 18F-fluorodeoxyglucose Positron Emission Tomography scans (18F-FDG PET scans) of the brain and, once trained, how these algorithms compare with the current standard clinical reading methods in differentiation of patients with final diagnosis of Lewy body dementia (LBD) or no evidence of dementia.

We hypothesized that the AI model could detect features or patterns that are not evident on standard clinical review of images (both visual and quantitatively with the available commercial programs for brain quantification) and thereby an earlier detection of pathology, improving the final diagnostic classification of individuals.

There are various problems within this domain including intra-observer differences and limited number of nuclear medicine specialists with experience in 18F-FDG PET brain scans. We believe that we can contribute to develop an AI algorithm that is more invariant to different nuclear medicine specialist and help in coming faster to a diagnosis from the images thus improving healthcare for these patients.

It all started in 2001 with the "innovation city", a project funded by Vinnova (Sweden's innovation agency) to support HU, the municipalities, Region Halland, and industry partners in identifying a regional specialization for Halland. The project identified the intersection of technology and healthcare. To support this specialization, an informal partnership called the Health Technology Alliance was established in 2002, with members from academia, the public sector, and industry. Driving forces in this were Pär-Urban Fryklind (HU), Max Lundberg (HU), Professor Albert-Jan Baerveldt (pro vice chancellor HU), Professor Berndt Hofmaier (HU), Johan Hörberg from Innovation Team, and Bertil Allard from CAMP Scandinavia. Baerveldt was professor in mechatronics/robotics in the research environment that later became CAISR.

From Health Technology Alliance to CAISR Health and Leap for Life

The Health Technology Alliance was formally established as an organization in 2005, with Johan Hörberg as its first chairman, and Bertil Allard as chairman after the second year (see separate article). The Health Technology Alliance was very successful in branding HU and Halland in the health technology area. This was achieved through awards, networking meetings, conferences, seminars, and by pilot projects. One project from this early period developed into the company Phoniro Systems AB. In 2008 the Health Technology Alliance arranged a well noticed conference in Stockholm where the main speaker was Bengt Westerberg, former Swedish Minister of Social Affairs.

The Health Technology Alliance work resulted in a concrete opportunity for HU when we together with Region Halland were awarded EU-support for the Health Technology Center Halland. The center was inaugurated in March 2010 and directed by Dr. Magnus Clarin, member of CAISR and today Dean for the School of Information Technology. The center was very successful, resulting in several new products, patents, and visits by parliament members as well as the King and Queen of Sweden. The most noticed project from the center was the BikeAround, which in 2013 was mentioned by Google CEO Eric Schmidt as an excellent example of using Google services to help elderly.

Virtual biking for elderly in Bikearound

In 2010 the work started with establishing CAISR as an international level center for research and education in applied intelligent systems. Many of the researchers who formed the base for CAISR were also active in the Health Technology Center, and health technology was one of two key application areas chosen for CAISR in 2012. CAISR and Health Technology Center Halland have since then developed together, e.g., by jointly building up the intelligent home laboratory for both research and demonstrations.

HU became part of the Knowledge Foundation's Knowledge and Competence Center program in 2012. This meant that the university started a ten-year development journey with the ambition to establish a stronger position and profile in a national context. Health technology was mentioned specifically in the plan for this development, and a very early decision in this program was to initiate a university-wide profile area: Health Innovation, to serve as a platform for joint research and education between schools at the university. Thorsteinn Rögnvaldsson, then pro vice chancellor but also director of CAISR, was given the task to get the Health Innovation profile area going, with a profile area manager, management structure, and an external advisory board.

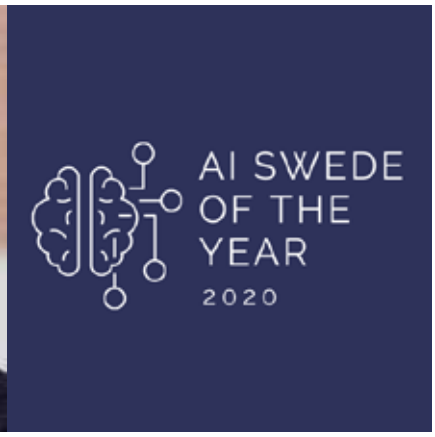
In 2015, Region Halland started a collaboration with Brigham and Women's hospital in Boston on information driven care. CAISR researchers and Health Technology Center Halland were part of these discussions and in 2016 a decision was taken in CAISR to invest more into research in information driven care, with new PhD students, assistant professors, and a full professor. Current CAISR staff also directed more time to information driven care, and several successful research proposals were made. The dialogue between CAISR and Region Halland increased, especially with Markus Lingman (MD and chief strategist at Region Halland – see separate article). The strategic recruitments were done over the period 2017-2018, resulting in, e.g., the recruiting of Professor Mattias Ohlsson, Assistant Professor Farzaneh Etminani, and PhD student Awais Ashfaq.

HU decided in 2019 to get a large profile project funded through the Knowledge Foundation, building on information driven care and implementation science. Mattias Ohlsson and Farzaneh Etminani took the main responsibilities for writing the CAISR Health proposal, which was approved in 2020 (see separate article on this). At about the same time, the Health Technology Center Halland transformed into Leap-for-life, focusing completely on information driven care.

The AI Swede of the Year prize aims to recognize the person who has contributed most during the year to the development and visibility of Swedish AI. The prize 2020 was awarded to Markus Lingman, MD and chief strategist in Region Halland, for his successful work with promoting the use of AI technology in healthcare.

Markus Lingman
AI Swede of the Year

In their motivation, the jury stated that "Markus Lingman's successful efforts has the potential to change how healthcare is practiced and implemented both in Sweden and globally", that "Markus Lingman leads the way for increased use of AI that creates real value", and that "he possesses a unique ability to make the complex understandable and has concretely made the technology accessible and useful"



Markus Lingman once studied for a Master's degree in engineering, but decided to switch track and become a cardiac specialist. He has a research background from the Sahlgrenska Academy in Gothenburg and continued research with Harvard affiliates and colleagues at UC Berkeley. For the past ten years, he has worked more and more in a managerial position, and today he is in the management of Halland's three hospitals.

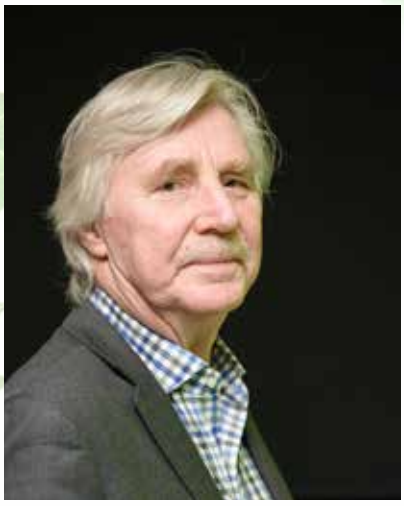
The researchers in CAISR are very proud to be partners in the cooperation with Region Halland and with Markus Lingman, on CAISR Health and on the Leap-for-life initiative.

The AI Swede of the Year prize is awarded by the Swedish IT and Telecom Industries, together with the Association of Swedish Engineering Industries.

Bertil Allard
appointed
Honorary Doctor

In 2020, Halmstad University appointed the entrepreneur Bertil Allard as an honorary doctor in innovation sciences. This is the Research and Education board's motivation.

With his long experience of entrepreneurship and company building in orthopedic technology, Bertil Allard has been an active and driving partner in Halmstad University's collaboration with the surrounding community. He has for many years been involved in the university's education and research and been both a mentor and inspirer in student and doctoral projects. On several occasions, he has made significant contributions as a critical friend and business representative in the university's investments in knowledge development



Bertil Allard

in health technology with people's improved quality of life in focus.

Bertil Allard's involvement in the early non-profit association Health Technology Alliance laid the foundation for the Health Technology Center Halland at Halmstad University, which in turn created the basic conditions for the University's profile area Health Innovation. The Health Technology Alliance started as a collaborative project with the aim of stimulating and building knowledge about how new technology can constitute solutions to health-related challenges. The association's influence on the University's activities and long-term development was considerable and can be seen today in the scholarships that are awarded annually to students at the university, who develop ideas in the field of health technology.

Bertil Allard has been an entrepreneur all his life but is now retired. Most often, his interest and business orientation has revolved around technical aids for people with disabilities, and health innovation. He has been chairman of the board and owner of Camp Scandinavia AB and Hörsam.

Predictive Maintenance

Predictive maintenance is about predicting when a system needs to be maintained (e.g., repaired, serviced, parts replaced, etc.). It builds upon the idea that components or subsystems can be monitored such that it is possible to estimate their health status and predict their remaining useful life. This enables optimization of the maintenance operations. Predictive maintenance is very different from prescriptive or time-based maintenance, which has been the industry standard for a long time.

Predictive maintenance is a core research direction in CAISR. It fits our scientific agenda perfectly: the operation and service histories of machines is an excellent testing ground for knowledge creation algorithms. As more operation data become available for machines and better data become available for service histories, the combination of predictive maintenance and machine learning (ML) emerges as a hot topic, and this is evident in the publication statistics on the topic. Predictive maintenance is a prioritized research and development field for CAISR industrial partners.

There are four main directions in our research in predictive maintenance: machine activity recognition, survivability analysis, early failure detection, and deployment of ML-based algorithms and services on-board machines. Machine activity recognition is about labeling and characterizing the use of machines, using streaming (on-board) data. Survival analysis is about modeling the expected duration of time until the occurrence of an event (the end-of-life of the equipment). Censoring is a particular tough issue in survival analysis, since machines in operation are generally not allowed to run to their end-of-life. Early failure detection builds on our several years' work on change detection and predicting time to failure, using either onboard data or off-board aggregated data. Finally, the deployment of ML algorithms encompasses the practical aspects of getting a solution to work together with our industrial partners.

Professor Slawomir Nowaczyk

Slawomir Nowaczyk was promoted to professor in 2020. He was recruited to CAISR more than ten years ago as a young assistant professor in a strategic recruitment in collaboration with Volvo. His assignment was to build up the predictive maintenance field using machine learning (ML) in collaboration between CAISR and Volvo. Slawomir's systematic work and excellent strategic abilities have established CAISR as a strong hub for the use of AI and ML for predictive maintenance in Sweden, with both national and international partners. The volume of cooperation projects between CAISR and Volvo has never been larger than now, and we are now getting large EU projects in the field too. This is very much the result of Slawomir's work and thinking, and we are appreciative and proud to have him as a leader on the CAISR team. Through his hard work and success, he demonstrates the great opportunities that come with working within CAISR.

Professor Slawomir Nowaczyk

New CHIST-ERA project

In December 2020, CAISR was granted funding for the project eXplainable Predictive Maintenance (XPM) within the Horizon 2020 CHIST-ERA/FTE program. The XPM project was the only granted project with Swedish participants in that call and the Swedish support comes from the Research Council. The PI, and coordinator, in CAISR is Professor Slawomir Nowaczyk.

The specific subtopic in the call was Explainable Machine Learning-based Artificial Intelligence (XAI) and we are very proud to be singled out for this since it is spot on with our scientific agenda. The XPM project aims to integrate explanations into AI solutions within the area of Predictive Maintenance (PM). The project will develop several different types of explanations (anything from visual analytics through prototypical examples to deductive argumentative systems) and demonstrate their usefulness in four selected case studies: electric vehicles, metro trains, steel plants, and wind farms.

Four selected case studies: electric vehicles, metro trains, steel plants, and wind farms

Battery cortex

Battery Cortex is a Eurostars project aiming at anomaly and fault detection in Electric Vehicle (EV) batteries, including early discovery of issues affecting lifetime of battery packs and cells, as well as understanding the conditions affecting capacity and (dis)charging behavior under different usages and environments. The project is a collaboration between Stratio (Portugal, project main responsible), Caetanobus (Portugal), and Halmstad University. The project manager at Stratio, Rune Prytz, is a former industrial PhD student with CAISR, whose PhD studies were perfectly in line with his current role.

Governments around the world are pushing for more electric mobility, not least for public transport. The EV bus market is young and increasing at a very rapid rate, which creates ideal conditions for an SME like Stratio to successfully enter the market, grow, and build barriers to successfully compete with larger companies in the long run. The battery pack is at the very core of EVs and its performance determines the lifespan and total cost of ownership. Automated battery condition and performance analysis will be critical for OEMs to mitigate the risks with this still somewhat immature technology and control warranty costs; for the operators it will ensure uptime and enable fair warranty claims when necessary.

The Battery Cortex project uses Machine Learning (ML) to provide insights into quality, faults and anomalies, enabling faster R&D iterations and a continuous enhancement of the customer offers. The ML models fed by vehicle signals and parameters continuously assess the condition and performance of the batteries. The approach builds upon the "wisdom of the crowd" approach called COSMO we have developed in CAISR over the last decade. It is an anomaly detection method capable of handling non-stationary data while maintaining low communication requirements due to performing comparative analysis in model space. It relies on identifying a "reference group" of similar units that provide a baseline on expected variability in behavior and operation. The core idea behind such analysis is that with an overwhelming amount of information (each vehicle has hundreds of sensors that produce millions of data points every day) identifying suspicious patterns in the data manually is too time consuming and the cost of doing so will exceed the benefits by far.

The battery pack is at the very core of EVs

International AI competition

A team from CAISR presented a very successful solution in the Aramis challenge arranged by the European Safety and Reliability Conference, ESREL. Thirteen international teams signed up for the challenge, seven completed the task, and the CAISR team came in second place.

”We believe our success originates from a deep understanding of the data, following the principle of simplicity[1] and taking advantage of the concept wisdom of the crowd[2], says Peyman Sheikholharam Mashhadi, postdoctoral researcher at Center for Applied Intelligent Systems Research (CAISR) and one of the team members in the Aramis challenge.

The objective of the Aramis challenge was to build AI models (specifically machine learning models) to accurately detect faults and predict failures in industrial equipment that is operating under a constantly changing and evolving environment, for example heavy-duty vehicles for transportation tasks, like electric buses and trucks. The team built these AI models based on a large dataset, containing sensor data from industrial equipment, given by the Aramis challenge organisors.

Using AI to predict failure and plan maintenance

In reality, for example when applied to a fleet of city busses, this sort of AI system can be used to predict machine failure and plan the maintenance accordingly.

”The beauty in what we did from my point of view is that we applied the concept wisdom of the crowd to the way we operated as a team. At first, each team member worked on resolving the challenge individually. Only at a later stage, we combined our efforts and created an ensemble solution that consume our individual solutions predictions as an input. The resulting ‘team predictor’ proved to be more capable than any individual solution”, says Mohammed Ghaith Altarabichi, PhD student at CAISR.

The beauty in what we did from my point of view is that we applied the concept wisdom of the crowd to the way we operated as a team.

Mohammed Ghaith Altarabichi

1 The principle of simplicity, or Occam’s razor, states that the simplest explanation is usually the right one.

2 Wisdom of the crowd” refers to the collective opinion of a group of individuals that, in most cases, is more rational and wise than the opinon of an individual member of the group.

AI fuelling a fourth **industrial revolution**

Mahmoud Rahat

The interest of Mahmoud Rahat in artificial intelligence sparked when he was only eleven years old. He started programming at home in Tehran on his IBM 386 computer. In a class at summer school he developed a chess program for two players and showed it to his father. The father tried it, but soon said: "If I want to play with another human, I'd rather use a real chessboard. But if I could play chess against the computer, that would be interesting."

Mahmoud tried but couldn't fulfil his father's request. He kept thinking about the problem, and many years later at university he found that the solution to this challenge was called artificial intelligence.

– That's what triggered my passion for AI, and that's what still drives me in what I do. It's like playing a computer game! But my goal is not just to make life more fun, but also easier with AI..

Repair and replace at the right time

Mahmoud Rahat did his PhD studies in the US and Iran, then moved to Sweden and CAISR to work as a post doc.

– I am very happy to be part of CAISR. It is a positive and open research environment where I can discuss research ideas with my colleagues. Here I have developed lots of important scientific as well as technical skills, since I have the opportunity to collaborate with industrial partners such as Volvo, AlfaLaval, and WirelessCars.

The work has two main focuses; predictive maintenance and sustainable mobility. Together with Volvo, Mahmoud Rahat and his colleagues develop methods to predict machine failures. The goal is to use AI to estimate the remaining time a machine part can be used, and then replace it before it breaks.

– The traditional approach for expensive equipment in non-critical applications is often to run until failure. This is not very smart but is a consequence of the lack of good methods to predict equipment health.. If a component breaks, that can lead to damage to other components. We analyze logged vehicle data, which are like the heartbeat patterns of a human, from a fleet of trucks in different countries. Thanks to the huge number of trucks, it is possible to find outliers compared to the population of trucks. With data driven methods we can look for early signs of degradation, aiming to replace each part at the right time and right place. It saves time, energy, and enables Volvo to give better uptime promises to their customers.

A promising recent direction in his research is multitask learning where he analyzes collective survivability of multiple correlated components of a vehicle system.

"This approach could lead to superior results because gradients that the model receives from related tasks helps to improve its generalization." He explains.

Unique data analyzed for optimal transportation

In his sustainable mobility project, Mahmoud Rahat works with WirelessCar, a Swedish company specialized in digitalizing the automotive industry. The company provides CAISR researchers with data from a fleet of combustion as well as hybrid Volvo cars moving in the Gothenburg area.

– This is a highly interesting and unique data set, showing GPS positions in a time sequence. We can investigate a number of things, such as if the drivers use the hybrid cars in an efficient way, what the optimal driving speed is under different conditions and what solutions could be developed to help people to convenient and sustainable transportation.

The analysis is done with so called graph neural networks, an emerging field within machine learning. The graph structure helps to model the spatial aspect of the data while the temporal aspect is captured using recurrent neural networks implemented in each node. In spite of the large amount of data, one of the biggest challenges is having to work blindly in some aspects. Two examples are how weather and road conditions affect the cars' energy consumption. These are data that the researchers do not have access to, yet.

– My ultimate goal doing research is always to improve the quality of human life. Each time there is an industrial revolution, life becomes easier. The first revolution was the steam engine, the second combustion engines and electricity. After that, many call the internet the third industrial revolution – and AI can fuel a fourth. That is the ultimate goal, from my point of view.

The computer games that first brought Mahmoud Rahat to AI are set aside for the moment. But he explains with a smile that his passion for AI has never been diminished.

Peyman Mashhadi

Enforcing diversity improves deep ensembles

Deep neural networks are powerful tools for making analyses and predictions based on large amounts of data – but they have their limitations. One is that many kinds of deep neural networks are very susceptible to adversarial attacks; events that contradict the normal, and risk steering the system towards making erroneous conclusions. For instance, a deliberate small perturbation of an image of a panda can fool a deep model to confidently recognize it as a gibbon.

Peyman Mashhadi and his colleagues at CAISR have proposed a method promising for tackling such challenges. It is called Parallel Orthogonal Deep Neural Network. The idea is to make a number of deep neural networks parallel to each other in an ensemble setting, with an orthogonalization constraint that forces them to be diverse. A real challenge when using deep neural networks in ensembles is a computational one. To train a set of deep networks without specific regularities, hoping for a desired level of diversity, would require lots of trials and be immensely computational-heavy. In the proposed method, the orthogonalization constraint forces the outputs of different models at different layers to be orthogonal to each other, which enforces diversity.

– Similar to the wisdom of the crowd concept, every person has their opinion and view, and the collective opinion works better than a single one. The idea is the same with ensemble networks. Different deep networks produce different information that can be exploited, says Peyman Mashhadi.

Given that these models are enforced to be diverse, they will be more robust to adversarial attacks.

– Imagine ten people in a room – you can trick one of them, but it is hard to trick them all. Especially if you select them based on the fact that they should have different capabilities.

Disentanglement helps in transfer learning

The new method also creates other possibilities, for example in so called representation learning. In an ensemble of networks each one can be trained to learn different representations of the same data. A simple example would be if the data is a picture of a face. With orthogonalization, one network would specialize on the nose, another on the eyes etc. This means that the representations in the trained model can be disentangled, making it possible to adjust a specific part for a desired effect. Disentanglement could also make it easier to transfer a model from one environment to another.

– I am fascinated with what is called transfer learning. That is when you train a model on one domain and then transfer the knowledge to another domain, where you do not have enough labelled information to train the model.

Peyman Mashhadi explains that having a set of disentangled models, it is possible to transfer a subset of them relevant to other domains.

– CAISR runs a project where we build a model with data from the company WirelessCar, predicting energy consumption for vehicles in Gothenburg. If we would like to transfer that to Lund, for example, some things would be the same, some would be different. That is one situation where transfer learning could be helpful.

Moving towards Artificial General Intelligence

Peyman Mashhadi has always been fascinated by the difference between computers and the human mind and the generalization abilities of the human brain. When he was younger, he played chess professionally and competed internationally, but when he was at the peak of his game he decided to stop playing.

– I started thinking; was chess what I wanted to dedicate my life to – something that computers are superior at? Instead, I decided to go into the world of computer science and AI to study why computers are getting better than humans on specific tasks. A fundamental weakness for computers is generalizing.

– Deep neural networks can be quite successful on specific tasks, but they cannot easily use their skill to meet a novel challenge. Humans are capable of understanding different mechanisms in how the world works and make almost infinite use of their finite learned mechanisms. Given the huge success of deep neural networks and new developments in the field of causality, achieving Artificial General Intelligence seems more feasible.

Peyman Mashhadi worked as an assistant professor in Iran before moving to Halmstad and CAISR for a postdoctoral position.

– It is very good for me to get to apply my knowledge and ideas to more practical problems, and CAISR has many collaborations with industry around AI. To me, AI still has a long way to go, but the pace of development is tremendously fast.

Hadi Fanaee

Future AI needs to solve problems without labels

Wind turbines is a common sight in our landscape. Constructions up to 70 meters tall, majestically spinning their rotor blades. But if the winds get hard and the spinning gets out of control, the effects can be disastrous.

– If the braking systems fail, a high wind situation can lead to the turbine exploding. Preventive maintenance is essential, but it is also costly and dangerous, says Hadi Fanaee.

Potential problems need to be detected at a very early stage, and the same can be said about a vast number of industrial appliances. That is why anomaly detection is a field for researchers working on data mining and machine learning. It is also one of Hadi Fanaee's main focuses in his work as assistant professor of data mining at CAISR. In short, anomaly detection builds on algorithms that combine a large amount of sensor input with external parameters – in the case of wind turbines, those parameters can be wind speed and temperature. From a very large data set, the algorithm is designed to predict abnormal states as early as possible, so that problems can be solved before they get serious.

IoT gives mining opportunities

Hadi Fanaee describes his own overarching research goal as trying to find impactful data problems, preferably examples seen in many different fields, and develop efficient AI solutions to them. The core challenge is always to find interesting patterns in a large amount of data, within a reasonable timeframe. Aside from anomaly detection, he works with analysis of multi-way data and with time series mining. An important collaboration partner is the international industry giant Alfa Laval, producers of heat exchangers, separators and more.

– Recently they have started connecting their machines to the internet of things, so they now have measurements from sensors on multiple machines, all collected in one portal. We apply time series mining to mine frequent patterns and detect important changes in them.

Unsupervised learning is the future

Hadi Fanaee was born in Iran and always loved to travel and experience different cultures. This brought him to Portugal for his PhD, and then to Norway.

– Halmstad was only four hours away from where I lived in Norway. When this position in CAISR was advertised, I felt it was just right for me. I didn't want to work only in industry or only with theoretical research. I wanted to do both. I had other options, but CAISR was the best choice for me.

At Halmstad University he has also started a course teaching AI to executives. The aim is to present an overview of AI's current possibilities, technical tools and applications.

– I want to give managers a realistic image of AI, not the exaggerated one that comes from AI vendors or the negative one that comes from Hollywood.

When he looks ahead, he is convinced that the greatest possibilities for AI lie in so called unsupervised learning. The standard paradigm today is supervised learning, which means training machines with carefully labelled data. A human expert must label data and tells the algorithm whether it's normal or abnormal, before the algorithm can learn to find similar abnormalities in a new data set. This labelling is very time consuming and expensive. Furthermore, the data quality depends heavily on the expertise of the person doing the labelling. With unsupervised learning, the data is instead unlabelled, and the algorithm must be designed to look for interesting patterns unconditionally.

– By comparing patterns with older data records, the algorithm should figure it out eventually and be able to predict abnormalities. I think this is where the greatest potential of AI lies. An expert cannot predict all possible causes of anomalies, and you don't find high quality data in most companies. How do we make sure that the labelled data is accurate at all? This question needs to be solved, and I believe that can be done through putting more time and energy into unsupervised learning. There is less research on that than on supervised learning, but that's not a problem for me. I like more challenging tasks!

Computer Vision

Semantic Perception in Traffic

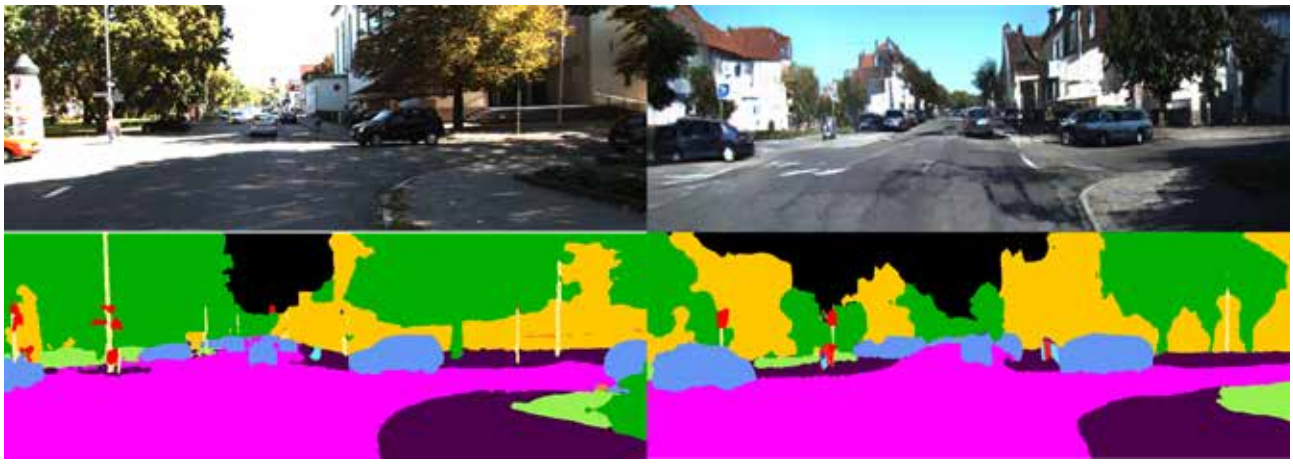
Semantic perception of the surrounding environment plays a vital role in scene understanding and control to reach full autonomy in self-driving vehicles. For instance, estimating the free drivable space together with vehicles in the front in real-time can lead to safe maneuver planning and decision-making. Most state-of-the-art methods approach the perception problem in an end-to-end fashion: receiving the raw sensory data and returning the detected objects without any explicit extraction of semantic intermediate knowledge. Furthermore, these approaches omit sensor failures in multi-modal sensor setups where cameras and LiDARs work together.

Tiago Cortinhal, in his PhD thesis project, investigates the problem of handling sensor failures by introducing the term sensor-to-sensor mapping, which relies on the semantic scene perception. Derived semantic information essentially bridges the gap between the raw sensor readings and high-level symbolic concepts such as detected object labels. Therefore, the ultimate aim in his thesis is to design AI-based modular perception units, each of which rely on the semantics of the perceived sensory input.

Tiago has implemented an advanced deep semantic segmentation network that takes 3D raw LiDAR data and returns semantic segments together with uncertainty scores. He has also customized a similar state-of-the-art network for the 2D RGB image streams. Finally, he has implemented a new deep generative neural network to solve the domain transfer problem, i.e. mapping between the two different sensor readings. For instance, generating synthetic failed camera sensor readings from the semantic segments of a functioning LiDAR sensor data. Such domain translations between different modalities are of utmost importance to solve the sensor fusion tasks in autonomous vehicles.

Tiago's research receives funding from the Vinnova FFI project SHARPEN, which aims at developing real-time semantics-aware deep neural networks for 3D object and free-space detection working in tough weather conditions.

Tiago Cortinhal



Our model consists of a Conditional Generative Model, where the inputs are the LiDAR Point Cloud and segmentation maps. We try to find a mapping to the RGB space using the semantic representation as an intermediate step. As we can see, the model learns to find a mapping between these two distinct domains and preserves, to a great extent, the scene information and could help us in the case of a sensor failure scenario

IEEE RA-L **Outstanding** Associate **Editor** Award

In June 2020, Eren Aksoy received the Distinguished Service Award as an Outstanding Associate Editor for the IEEE Robotics and Automation Letters.

The IEEE Robotics and Automation Letters (RA-L) Distinguished Service Awards are given annually to Associate Editors in recognition of their contributions to RA-L. Candidates for the "RA-L Outstanding Associate Editor Award" are nominated by the Editor in Chief, Deputy Editor-in-Chief and Senior Editors. The announcement of the recipients is made at the annual IEEE International Conference on Robotics and Automation (ICRA) awards ceremony.

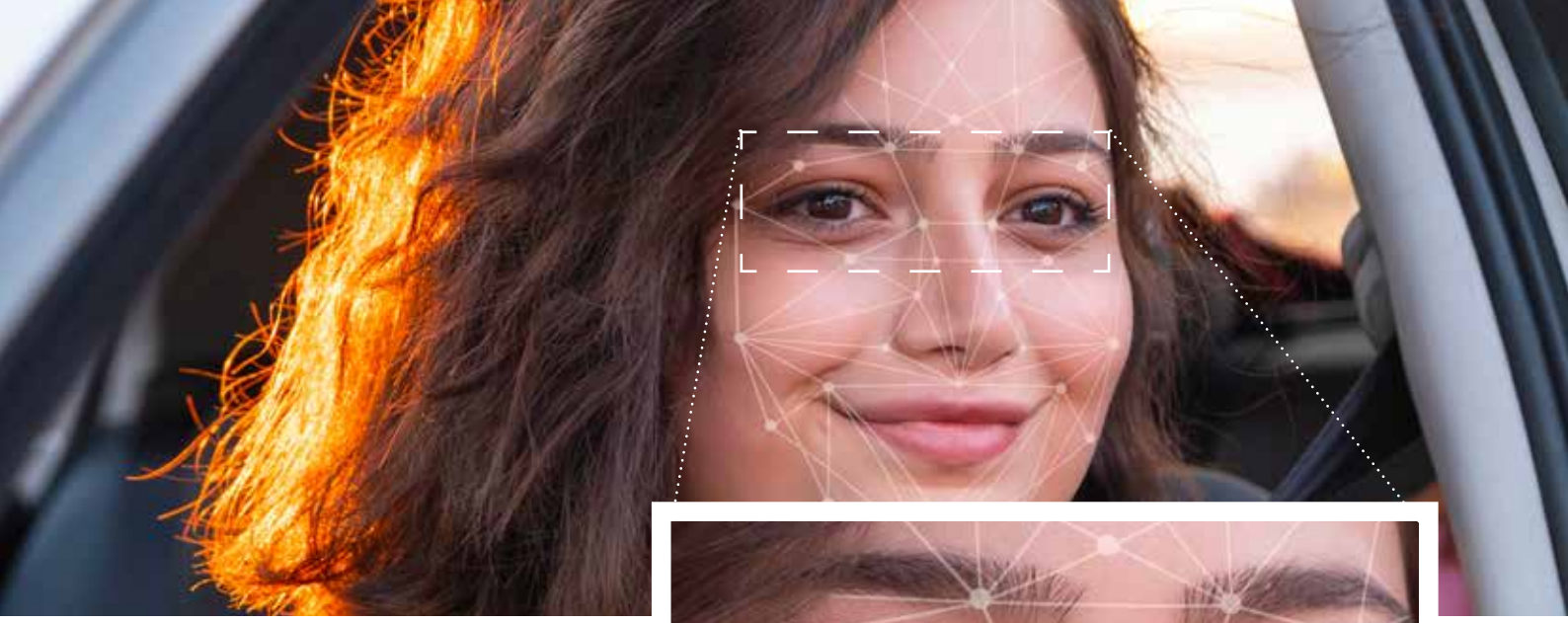
The recipients of the "RA-L Outstanding Associate Editor Award" for each year can be found at https://www.ieee-ras.org/publications/ra-l/ra-l-distinguished-service-awards

Eren Erdal Aksoy

New collaboration with **Zenseact AB**

Camera and LiDAR sensors are commonly used modalities in autonomous vehicles to achieve robust environment perception. Adverse weather conditions, however, significantly diminish the performance of camera- and/or LiDAR-based perception systems by injecting undesired noisy measurement samples. This often leads to missing or false positive perception, which introduces high-risk in safety-critical systems such as autonomous vehicles.

The collaborative research between Zenseact AB and CAISR is addressing the problem of sensor de-noising in adverse weather conditions such as rain, fog, snow, and dust. The research particularly focuses on the LiDAR sensor that provides a 360-degrees scan of the environment in 3D point cloud format. The main goal is to develop an advanced AI-based perception system that can detect, identify, and filter out noisy LiDAR readings on the fly.



Identity management

Kevin Hernandez Diaz PhD thesis project focuses on ocular biometric in unconstrained environments, with special attention to the periocular zone for its high discrimination ability. The work involves ocular recognition under different light spectra, resolution, illumination, distance and amount of data available. To alleviate the lack of large periocular databases, Kevin has focused on transfer learning based on Deep Representation of networks pre-trained in the context of the ImageNet Large Scale Visual Recognition Challenge. Initially trained for generic object recognition, they have also proven to be very successful for many other vision tasks. In the cross-spectral recognition arena, he has applied Conditional Generative Adversarial Networks, trained to convert periocular images between visible and near-infrared spectra, so that biometric verification is carried out in the same spectrum. This setup has allowed the use of existing feature methods, typically optimized to operate in a single spectrum.

Kevin's research integrates into a group at CAISR that focuses on biometrics recognition. Connected with his research, recent contributions include the use of images of the ocular region for various purposes, including the recognition of facial expressions, or the estimation of soft-biometrics indicators such as gender and age. The results obtained are competitive compared to using images of the entire face, demonstrating the power of the ocular region as a standalone region for a variety of purposes. There is a research tradition of several years at Halmstad University on the use of images of the ocular region. The topic has become mainstream during the last year due to the mandatory use of face masks in many countries because of the covid-19 pandemic, leaving the ocular region as the only visible area of the face even in cooperative settings. In the research that Kevin participates in there has also been a focus during the last year on the use of solutions tailored to mobile devices, not only because such devices now incorporate many biometric sensors, but because of the pandemic further accelerating the migration of all kind of services to the digital domain. This has converted mobiles in data hubs that are used for all type of identity-sensitive operations.

During his PhD studies, Kevin has also collaborated with 365id AB within the AI.m collaborative project, whose goal is to increase the innovation capabilities of Halland-based SMEs through AI-based service development. In the context of identity management, 365id offers an ID security solution, 365id Scanner, which enables to verify the authenticity and validity of physical IDs. Kevin's research has received support from the Swedish Research Council, from Vinnova (Sweden's Innovation Agency), and from the AI.m project.

Kevin Hernandez Diaz

Anonymizing data collection for traffic safety

MIDAS

Artificial Intelligence (AI), and specifically machine learning (ML), are enablers for many traffic safety enhancing functions, e.g., automated vehicles, active safety and connected infrastructure. AI and ML can also be used to understand how infrastructure is used by road users and what behavior patterns there are. The advantage of ML is that computers can be trained to recognize patterns, dangers and obstacles based on images of real events in real traffic.

To train models, images of the environment are often required and there is a real risk that the data collected will contain information covered by the GDPR (General Data Protection Regulation).

For example: A vehicle with a forward-facing camera collects data on a street in a residential area to be able to practice recognizing objects in traffic. There, both adults and children may appear, and there are cars parked along the road. All this data is necessary for an ML network to learn about how people move near roads, how we interact with vehicles, and how other vehicles look and move in relation to each other. But in the collected data there will be faces, clothes, and number plates, which are personal data. Such data cannot be stored without anonymization.

The immediate solution is to anonymize images by blurring faces and number plates, or placing a box over faces and number plates, thus securely storing data without being affected by GDPR. This solves the GDPR problem. Unfortunately, the data becomes useless because much of the information that ML algorithms can use is lost, e.g. facial expressions and attention indicators - eye contact is important for building trust and safe traffic environments. In addition, the ML network risks using blurred fields or boxes in the image to recognize people and cars. Another more studied alternative is to replace the faces with a standard face and the number plates with a standard sign. Unfortunately, it doesn't work either: then the ML system will learn to recognize the exact standard face and standard sign.

The MIDAS project explores the possibility of creating anonymized but unique faces and number plates in video data to replace personal data in pictures. Thus, as much as possible of the real environment and interactions are retained in data collected in road safety-related research projects.

The project involves two PhD students: Felix Rosberg, who is industrial PhD student at Berge, and Martin Torstensson, who is an industrial research institute PhD student at RISE (Sweden's research institute).

Personal data that needs to be anonymized

Cristofer Englund Adjunct Professor

Cristofer Englund started his academic career at Halmstad University and graduated with a MSc in computer science in 2003, and defended his PhD thesis in Halmstad 2007, with focus on machine learning, supervised by professor Antanas Verikas. After his PhD he worked a few years in industrial R&D, but soon moved on to Sweden's research institute RISE (in 2010) 2010. At RISE, Cristofer has worked within active safety in close collaboration with the Swedish vehicle and transportation industry. His research interest is about data mining and machine learning to model the interaction between humans and vehicles to allow for design of social acceptance of road vehicle automation. Cristofer has been adjunct lecturer with CAISR for some years, and in 2020 he was appointed Halmstad University's first adjunct Professor of Information Technology, with a focus on machine learning and computer science.

Cristofer Englund

PhD Graduation Yuantao Fan

Wisdom of the Crowd for Fault Detection and Prognosis

Abstract

Monitoring and maintaining the equipment to ensure its reliability and availability is vital to industrial operations. With the rapid development and growth of interconnected devices, the Internet of Things promotes digitization of industrial assets, to be sensed and controlled across existing networks, enabling access to a vast amount of sensor data that can be used for condition monitoring. However, the traditional way of gaining knowledge and wisdom, by the expert, for designing condition monitoring methods is unfeasible for fully utilizing and digesting this enormous amount of information. It does not scale well to complex systems with a huge amount of components and subsystems. Therefore, a more automated approach that relies on human experts to a lesser degree, being capable of discovering interesting patterns, generating models for estimating the health status of the equipment, supporting maintenance scheduling, and can scale up to many equipment and its subsystems, will provide great benefits for the industry.

This thesis demonstrates how to utilize the concept of "Wisdom of the Crowd", i.e. a group of similar individuals, for fault detection and prognosis. The approach is built based on an unsupervised deviation detection method, Consensus Self-Organizing Models (COSMO). The method assumes that the majority of a crowd is healthy; individual deviates from the majority are considered as potentially faulty. The COSMO method encodes sensor data into models, and the distances between individual samples and the crowd are measured in the model space. This information, regarding how different an individual performs compared to its peers, is utilized as an indicator for estimating the health status of the equipment. The generality of the COSMO method is demonstrated with three condition monitoring case studies: i) fault detection and failure prediction for a commercial fleet of city buses, ii) prognosis for a fleet of turbofan engines and iii) finding cracks in metallic material. In addition, the flexibility of the COSMO method is demonstrated with: i) being capable of incorporating domain knowledge on specializing relevant expert features; ii) able to detect multiple types of faults with a generic data- representation, i.e. Echo State Network; iii) incorporating expert feedback on adapting reference group candidate under an active learning setting. Last but not least, this thesis demonstrated that the remaining useful life of the equipment can be estimated from the distance to a crowd of peers.

More information about the thesis

The case study on a fleet of commercial heavy-duty vehicles is a collaboration with Volvo Group Trucks Technology and Volvo Bus Corporation. The case study on non-destructive testing for metallic material is a collaboration with researchers from the Key Laboratory of Modern Acoustics at Nanjing University and Shanghai University of Engineering Science. Yuantao Fan and his fellow researchers have also been collaborating with researchers from Federal University of Santa Catarina in Brazil and from Luxembourg University on utilizing Echo State Networks for fault detection.

Yuantao Fan, former PhD-student at the School of Information Technology at Halmstad University defended his doctoral thesis on January 31, 2020. He did his doctoral education within the Embedded and Intelligent Systems Industrial Graduate School (EISIGS). His research has also been part of the Vinnova financed project ReDi2Service.

Wisdom of the Crowd

"This thesis demonstrates how to detect faults and monitor the condition of industrial equipment, for example a commercial fleet of city buses, by using artificial intelligence (AI) through the concept of "Wisdom of the Crowd". The proposed method, Consensus Self-Organizing Models (COSMO), assumes that the majority of a crowd is 'healthy' and individuals that deviate from the majority are considered as potentially faulty. In my research, I have studied and applied the method to several condition monitoring applications, detecting faults and predicting failures for fleets of industrial assets", says Yuantao Fan.

Are any results surprising to you?

"The COSMO method is generic and can work with many different types of systems or equipment for predictive maintenance purposes. This is demonstrated in my thesis through three case studies: condition monitoring for a fleet of city buses, non-destructive testing for metallic material and prognosis for a fleet of turbofan engines. The approach has several benefits, for example improving safety and reliability of equipment, that is making the transportation systems safer by indicating incoming faults and failures proactively and thus reducing and eliminating accidents and unplanned stops. It is interesting to see an unsupervised system, without learning from failure cases in advance, can proactively indicate upcoming faults and predicting failures. This is demonstrated in a case study on the air system of a commercial bus fleet, the proposed approach achieved similar performance compared to an expert knowledge-based system."

How did you pick the subject or theme for your thesis?

"I am interested in Artificial Intelligence in general and was happy to explore any relevant topics. In particular, I like to work with real-world problems where the research contribution could potentially make an impact in reality as part of industrial applications and solutions. This research education matches my interest well since it is based on collaboration with our industrial partner at Volvo, where we develop, test and apply machine learning methods for predicting the maintenance need for heavy-duty vehicles. The method is receiving more and more attention from the industry in general and the research community. There are still many aspects to explore".

PhD Defense facts
Title: Wisdom of the Crowd for Fault Detection and Prognosis
Author Yuantao Fan
Supervisors at Halmstad University Thorsteinn Rögnvaldsson, Professor, Halmstad University Sławomir Nowaczyk, Professor Halmstad University
Supervisor at Volvo Ervin Omerspahic, Volvo Group Corporation
Opponent: Olga Fink, Professor, ETH Zürich, Switzerland
Grading committee: Joao Gama, Professor, University of Porto Erik Frisk, Professor, University of Linköping Patrik Edén Docent, Lund University

Licentiate exam

Ece Calikus

Self-Monitoring using Joint Human-Machine Learning: Algorithms and Applications

Abstract

The ability to diagnose deviations and predict faults effectively is an important task in various industrial domains for minimizing costs and productivity loss and also conserving environmental resources. However, the majority of the efforts for diagnostics are still carried out by human experts in a time-consuming and expensive manner. Automated data-driven solutions are needed for continuous monitoring of complex systems over time. On the other hand, domain expertise plays a significant role in developing, evaluating, and improving diagnostics and monitoring functions. Therefore, automatically derived solutions must be able to interact with domain experts by taking advantage of available a priori knowledge and by incorporating their feedback into the learning process.

This thesis and appended papers tackle the problem of generating a real-world self-monitoring system for continuous monitoring of machines and operations by developing algorithms that can learn data streams and their relations over time and detect anomalies using joint-human machine learning. Throughout this thesis, we have described a number of different approaches, each designed for the needs of a self-monitoring system, and have composed these methods into a coherent framework. More specifically, we presented a two-layer meta-framework, in which the first layer was concerned with learning appropriate data representations and detectinganomalies in an unsupervised fashion, and the second layer aimed at interactively exploiting available expert knowledge in a joint human-machine learning fashion.

Furthermore, district heating has been the focus of this thesis as the application domain with the goal of automatically detecting faults and anomalies by comparing heat demands among different groups of customers. We applied and enriched different methods on this domain, which then contributed to the development and improvement of the meta-framework. The contributions that result from the studies included in this work can be summarized into four categories: (1) exploring different data representations that are suitable for the self-monitoring task based on data characteristics and domain knowledge, (2) discovering patterns and groups in data that describe normal behavior of the monitored system/systems, (3) implementing methods to successfully discriminate anomalies from the normal behavior, and (4) incorporating domain knowledge and expert feedback into self-monitoring.

Licentiate exam facts
Title: Self-Monitoring using Joint Human-Machine Learning: Algorithms and Applications
Author Ece Calikus
Supervisor Sławomir Nowaczyk, Professor, Halmstad University
Second supervisors Onur Dikmen, Senior Lecturer Stefan Byttner, Senior Lecturer, Halmstad University
Opponent: Rita P. Riberio, Assistant Professor, University of Porto
Examiner Björn Åstrand, Associate professor, Halmstad University

Joint human-machine learning can improve district heating

By combining machine learning and human knowledge in self-monitoring and intelligent systems, failures and deviations can automatically be detected. Research at CAISR shows that when these systems are applied to district heating, money can be saved, and efficiency improved – leading to a more sustainable energy supply.

Many industries today produce and save large amounts of data from their operations. By using data driven models, the operations can continuously be monitored and adjusted for maximum efficiency. Ece Calikus is a PhD student working with research and development of so-called self-monitoring systems that use machine learning in combination with human expertise for industrial applications.

An intelligent and self-monitoring system is when industrial equipment monitors its own operation. It can learn over time and automatically identify problems or deviations. There is, however, always a need for human interpretation and evaluation of these systems. Human experts can add other aspects, for example business and societal aspects, to achieve a holistic improvement of the operations.

Humans and machines work better together

"The goal with joint human-machine learning is to create a collaborative process where machines and humans learn from each other. People should be able to observe, interpret and learn from the self-monitoring results, as well as provide domain knowledge or feedback to the intelligent system", says Ece Calikus who published her licentiate thesis on the subject in 2020.

Ece Calikus is working at CAISR in a research project called Self-Monitoring for Innovation (SeMI). Her licentiate thesis focuses on generating a real-world self-monitoring system that can learn data behaviors and their relations over time and detect anomalies and discover faults using joint-human machine learning.

"Throughout the thesis, I have described a number of different approaches, each designed for the needs of a self-monitoring system, and I have composed these methods into a coherent framework", says Ece Calikus.

Improving district heating by automatic detection of faults

Self-monitoring systems can be applied to a range of different industries. Ece Calikus focuses her research on applying these intelligent systems to district heating in order to increase the efficiency in that domain. The research is done in collaboration with two district heating companies, HEM and Öresundskraft. They have provided both data used in the research and expert knowledge about district heating.

"When applied to district heating, the self-monitoring system can automatically detect faults and abnormal patterns in district heating networks by comparing heat demands among different groups of customers", says Ece Calikus.

When faults and deviations are detected in time, the districts heating companies can use this information for further investigation, to repair faults and optimize their operations.

"Future energy systems are facing critical challenges such as the steady growth of energy demand, energy resource depletion, and increasing emissions of carbon dioxide and other greenhouse gases. District heating can play a vital role in the implementation of future sustainable energy systems that will contribute to a decrease in carbon emissions. However, the current generation district heating technologies have problems that prevent them from operating efficiently. I hope that my research can lead to more efficient district heating and thus contribute to a more sustainable energy supply system", says Ece Calikus.

Her method takes minutes – instead of years

One goal with Ece Calikus' research has been to automate a very time-consuming manual method of analyzing heat load patterns for identifying unsuitable behaviors of buildings in a district heating network.

"The manual analysis was restricted to 140 buildings and took several years for a group of researchers to conclude. My goal was to automate their manual effort with a data-driven approach so that it can be applied to thousands of buildings in less than 10 minutes", says Ece Calikus.

She expected to discover the same patterns they did, but automatically and much faster. However, Ece Calikus and her colleagues' method not only successfully captured the same heat load patterns, but also discovered novel and abnormal patterns that were unknown before.

"It was surprising and very exciting to see that our results provided completely new knowledge to the district heating community. Furthermore, my work also revealed the limitations of the previous knowledge within this area and the importance of intelligent systems for energy efficiency", says Ece Calikus.

Education

Evaluations of two Master programs

The CAISR staff participate in many programs and courses, and our ambition is that all courses and programs where our staff teach should receive good ratings and be considered of high quality.

Two technical master's programs where CAISR staff teach were part of a large-scale quality evaluation in 2020, these are the Master of Science in Embedded and Intelligent Systems (TAEIS), and the Master of Science in Information Technology (TAITE).The evaluation involved preparing various documents describing the programs in detail, obtaining feedback from students, alumni, industry representatives, and teachers, sending random selections of master theses to external reviewers, and hearings with other external reviewers (professors from other universities) to discuss the programs in detail.

The TAITE program received an evaluation of *High quality*, which was the highest possible outcome. The TAEIS program received an evaluation of *High quality with reservations,* the second highest possible outcome.

In general, the reviewers thought that good learning of skills was visible, e.g., in good performance of students in competitions. The education is doing good things with diversity and equality, and collaboration with companies is working well. The courses are relevant and there is no doubt they build upon on a scientific basis.

The students indicated that they believed that teachers were always trying to improve the contents for the following semesters, that in some courses teachers are really interested to hear about the course contents and try to get our suggestions, and that students can have a crucial role in contributing to the development of the education. The industry had a positive, long, and strong collaboration with the program and CAISR, and that there is a good exchange of experience that supports in setting expectations from the program graduates. The programs contain the subjects that they see as valuable for the continued development of their products and services. Their current view, and also their outlook for what skills and knowledge that will be needed, is in line with the program content. Both TAEIS and TAITE seemed very relevant.

Some lessons learned were that for TAITE, we should consider having more elective courses, and for TAEIS, we should ensure that the course material is more current. For both programs, we should look into further incorporating sustainable development, and our alumni would like to see more advanced/specialized courses and prominent guest lecturers in the area of AI.

Sparbanksstiftelsen Kronan scholarship

In November Sparbanksstiftelsen Kronan awarded scholarships to four students at the School of Information Technology. To get awarded the work must show evidence of high creativity, new technology, practical relevance, technical benefit, business potential, new entrepreneurship or great societal benefit in welfare, health care and the public sector.

Robin Landin and Martin Asplund awarded 50 000 SEK from Sparbanksstiftelsen Kronan Photo: From Video Sparbanksstiftelsen Kronan

Steering of the second front axle in Volvo trucks

Martin Asplund & Robin Landin
Mechatronical Engineering
Supervisor: Pablo del Moral
SEK 50,000

Manipulation Action Recognition and Reconstruction using a Deep Scene Graph Network

Dawid Ejdeholm & Jacob Harsten
Master of Science in Computer Science
Supervisor: Eren Erdal Aksoy
SEK 25,000

AI.m

The AI.m 2.0 project is a continuation of our AI.m pilot project from 2019. The sole purpose of the project is to help SME-companies in the Halland region with knowledge of AI-based service development to increase their innovation capabilities and competitiveness. The project is a collaboration between Halmstad University and HighFive (Halmstad municipality's business incubator). Halmstad University and CAISR has the overall management responsibility while HighFive has the operative management responsibility. The project is funded through the European Regional funds (ERUF) and runs until April 2022 when in total 20 SMEs will have passed through the innovation process. The expected long-term effect is to have established a regional AI-hub that supports local companies to work strategically with AI-driven service development.

AI.m works in an agile way with participating companies to learn, analyze, evaluate and implement AI-driven service innovation from the companies' identified challenges. The main activities in the project include recruitment of companies (inspiration and spreading of knowledge, as well as analyzing their abilities to implement AI-activities in their organizations), performing the innovation process itself where each company goes through the steps of Strategic business design, Human-centered service design, and Rendering of prototypes (UX design). Finally, the companies are supported in developing a strategy to implement the results in their organizations, and in applying for soft funding for further development. The innovation process has been developed by Associate professors Pontus Wärnestål and Stefan Byttner at Halmstad University, and Anna Petersson at HighFive and has, e.g., led to a new set of service design tools for data-driven service development.

AI education for professionals

Expert competence

In December 2020, the Knowledge Foundation granted phase 2 of the educational Expert Competence Programme MAISTR at Halmstad University. MAISTR (Data analytics and service innovation based on artificial intelligence) combines artificial intelligence with service and business development and is primarily aimed at professionals. Phase 2, which is a continuation of MAISTR phase 1, will start in the autumn of 2021.

MAISTR is directed at professionals who want continued education in Artificial Intelligence (AI) technologies, specifically Machine Learning (ML), and business and service development techniques with AI/ML. It is an educational programme on advanced level comprising courses corresponding to a total of 120 credits (hp). The programme is flexible and can be carried out at the same time as an ongoing professional career. MAISTR has unique aspects by combining courses on both AI technology and courses on service design with AI. It's not enough to understand the technology alone – AI needs to be linked to people-centred service design in order to create value and benefit. This means that not only technology companies, but also design agencies and the public sector are affected by this area.

Project leader for MAISTR is Stefan Byttner, Associate Professor in Information Technology at the School of Information Technology. All programmes and courses within service design and AI for professional are developed in collaboration with companies and the public sector. The programmes and courses are led by Halmstad University in collaboration with University of Skövde and RISE SICS. They are supported by Volvo Cars, AB Volvo, Autoliv, ZenseAct, Stena Line, Easyserv, Fysiotest, Hotswap, Jayway, Digital Reliance, InUse, RISE Viktoria and Nibe.

The covid-19 pandemic hit the industry swiftly and hard. Temporary layoffs with government support kicked in on large scale by mid-March 2020, and for many production industries this meant that staff were placed off work from mid-March until October (and sometimes even longer). There was also a noticeable change of focus in the industry, with more emphasis on sustainable technologies. The Tesla stock price rocketed from roughly US$88 (Jan. 2020) to almost US$706 (Dec. 2020), an eightfold growth.

The staff who were on temporary layoffs were encouraged to use the time for competence development, and many engineers saw this as a window of opportunity to get training in subjects that they saw would become more and more important in their work. The Knowledge Foundation also reacted quickly and launched an emergency program for supporting flexible courses on advanced level for professionals who were temporary off work. By doing this it was hoped that Sweden would emerge from covid-19 with a better qualified workforce, and that the economic effects for Sweden would be milder.

Halmstad University was successful with two bids within this program: RELIFE and DIGIBUS. Both program offerings were designed based on analysis of what sectors were most affected by the pandemic. This analysis was done with help from the Region Halland analysis office, the Confederation of Swedish Enterprise, and TRR (Trygghetsrådet). Also, polls were done with our alumni and industrial partners to see how to design the most relevant efforts, and the most sought-after content. The target groups for the program offerings were people with a basic university engineering degree or degree in business/economics, and some years of work experience, e.g. working as consultants, entrepreneurs, and with industrial services.

Courses for professionals in covid-19 times

DIGIBUS

DIGIBUS offers an exciting mixture of AI and business. Increasingly businesses are using AI to drive activities such as marketing, management, and decision making. Rapid transfer and analysis of data means many opportunities are opening up on a global level. However, this change means that managers and decision makers in business need to understand what AI is, what it can do and how to apply it successfully. That does not mean they necessarily have to be technical experts, but they have to be able to communicate with, and understand, people who are. The DIGIBUS course package was developed in cooperation between researchers in Information Technology (CAISR) and in Innovation Sciences.

The courses were all delivered on-line, with lectures and other sessions timetabled so that students working would find it relatively easy to participate. In addition, lectures were recorded to make the courses accessible even for people with very busy schedules. Some practical work was facilitated by the use of software in the public domain, for business intelligence a bespoke SQL server was set up so that the students could try their hand at data warehousing. Assessment was largely through work that could be done at home (lab reports, multiple choice tests, projects) but all students had to also present work in on-line seminars. The projects were particularly appreciated since the students worked in small groups and could share experiences across workplaces and different backgrounds.

The courses also involved several guest lecturers invited across a range of different industries business and the public sector. These guest lectures were certainly one of the highlights of DIGIBUS.

Professor Mark Dougherty, responsible for the course in Business Intelligence

The course modules within the programme are:

Course Module	Responsible	Registered students	Passed students
AI for managers	Hadi Fanaee	44	16
Global Entrepreneurship	Vicky Long	52	18
Digital Marketing	Klaus Solberg Søilen	53	16
Business Intelligence	Mark Dougherty	42	14

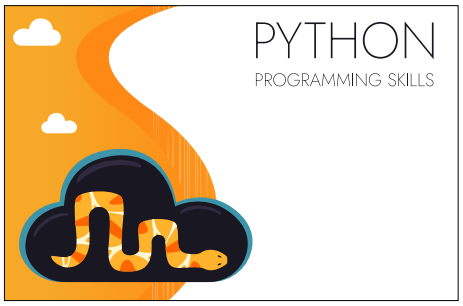
RELIFE

RELIFE focuses on competence on machine learning, data analytics, and cybersecurity. It has been clear for some years now that these are subjects that are asked for more and more in industry, and our engineering poll group for the covid-19 offerings (about 150 respondents from partners companies and alumni) highlighted this competence as a top choice.

The RELIFE package consists of five courses, and is intended to bring an engineer from a basic understanding of data, programming, and math (what you get in a basic engineering degree) up to being able to do construct advanced machine learning models like deep neural networks. The package includes a special course on cybersecurity issues when working from home (or remote).

The RELIFE courses were all delivered online and used lecture recordings and project hand-ins so that they would be easy for the participants to follow at their convenience.

Python - a gateway to Machine Learning



Voices from course participant:

"this was the best course I have done . . . it was so nice! I would love to go a second course if you organise one :)"

Verónica Gaspes

Supervised Machine Learning

Voices from course participant:

"The lectures were fantastic. The lecture is able to explain difficult concepts in simple words and with simple examples."

Mohamed-Rafik Bouguelia

Course Module	Teachers	Registered students	Passed students
Python - a gateway to Machine Learning	Verónica Gaspes Alexander Galozy	52	16
Cybersecurity challenges with distributed workplaces	Mohamed Eldefrawy Yousra Alkabani	19	7
Supervised Machine Learning	Mohamed-Rafik Bouguelia Onur Dikmen	53	36
Applied Data Mining and Data Science	Slawomir Nowaczyk Mahmoud Rahat Abbas Orand Reza Khoshkangini	26	14
Applied Deep Learning with TensorFlow	Mattias Ohlsson Eren Erdal Aksoy Sepideh Pashami Tiago Fernandes Cortinhal	21	11

Outreach

Restart Sweden

In September, Professor Mattias Ohlsson gave an invited talk at the national web-based seminar "Restart Sweden" (after the first pandemic spring/summer wave). He presented how AI and healthcare data can be used to design more precise healthcare services, and our plans for this in Halmstad and Halland. Other presenters at the seminar were, e.g., the Swedish Minister of Health and Social Affairs, heads of government authorities, and representatives for Swedish Regions and municipalities.

AI Sweden

CAISR is a partner in AI Sweden and CAISR researchers have presented at their morning seminars. In June Pontus Wärnestål gave a presentation on "Human-Centered Machine Learning: A podcast-based course for professionals" (this was described already in the CAISR annual report for 2019). In October, Sepideh Pashami gave a presentation on "Transfer Learning for predictive maintenance in electromobility".

AI4Health Lecture Series

Starting in 2019 Christoph Schommer at University of Luxembourg arranged the AI4Health Lecture Series, with invited European presenters on how to use AI for improving healthcare. Professor Mattias Ohlsson and Dr. Markus Lingman presented together in November 2020 on the work in Region Halland with information driven care and the cooperation between CAISR and Region Halland.

Smart Energy summer school and workshop

August 23rd-29th 2020, Slawomir Nowaczyk and Kobra Etminani organized the 8th DHC+ Summer School 2020 in district heating and cooling with NetPort Science Park in Karlshamn and NODA Intelligent Systems held by Euroheat & Power in Belgium. The topic of the summer school was "Creating a Sustainable Ecosystem in District Heating and Cooling, using Artificial Intelligence". The summer school was due to take place in Karlshamn. However, due to the pandemic, DHC+ experienced its first online summer school in 2020!

Kobra Etminani gave a talk entitled "Introduction to digitalization/AI" and Slawomir Nowaczyk gave "Anomaly Detection for Predictive Maintenance". They also arranged the "Hands on Data Analytics" workshop, where various machine learning techniques were presented and applied to district heating real-world data. Participants had the chance to scrutinize various methods and find interesting patterns on their own. The event brought together 25 students and young professionals from the industry and provided participants with an in-depth look into the current and future state of District Energy and digitalization.

ECML/PKDD workshop

CAISR researchers co-organized a special workshop on predictive maintenance and stream data mining in connection with the ECML/PKDD conference in September 2020 (Ghent). This was the second time this workshop was held. In 2019 it was so popular that the number of seats in the room were insufficient. However, in 2020 the whole event was moved online and seating no problem anymore.

The topics were very much centered around the CAISR scientific agenda and ongoing work in predictive maintenance. The workshop covered presentations on how to estimate components current and future status, how to determine what data to use, etc., and in general how new methods for stream data mining and machine learning can contribute to predictive maintenance.

The workshop was organized by Slawomir Nowaczyk and Sepideh Pashami from CAISR, together with Joao Gama (U. Porto), Albert Bifet (U. Waikato), Moamar Sayed Mouchaweh (École des Mines de Douai), Grzegorz J. Nalepa (AGH U. Science and Technology), Olga Fink (ETH Zürich), and Jessika Bulthé (Volvo Trucks).

Schlumberger seminar

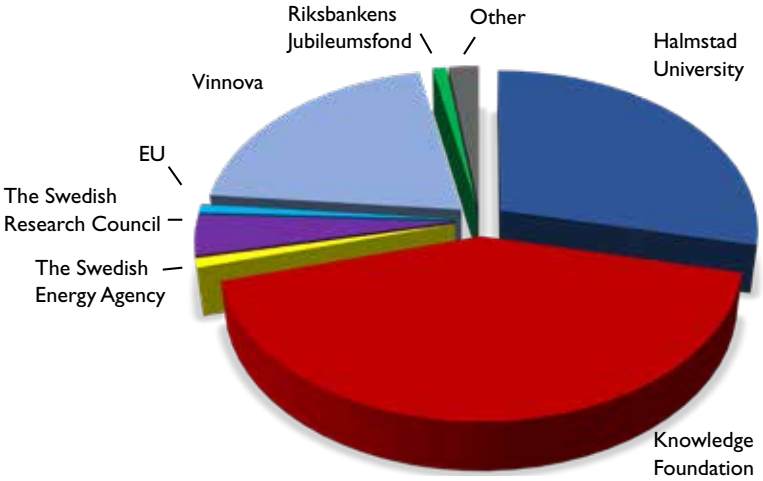
In October 2020, Professor Slawomir Nowaczyk gave an invited talk in the Schlumberger internal forum on predictive maintenance. The topic was "Data driven predictive maintenance". The seminar was packed (250+ attendants) and Slawomir gave an overview of ongoing predictive maintenance in CAISR, with reflections on the issues that we face in real data from systems like buses and trucks, which operate in varying contexts, with weak fault indicators.

Funding

The research turnover 2020 in CAISR was 26.1 MSEK (million Swedish kronor) on the university side (not including in-kind efforts by our partners). This is 5% lower than our research turnover for 2019 but less than 80% of what we had budgeted for. The main reason for the drop was the covid-19 situation, which affected many of our industrial partners and we had to place projects on a lower burn rate than planned, awaiting the outcome of the pandemic and possible new industrial priorities.

The external funding ratio remains very high (72% in 2020). The different sources of research funds to CAISR (on the Halmstad University side) are illustrated in the pie diagram. The Knowledge Foundation was the largest contributor, with almost 60% of the external funding to CAISR in 2020, and more than 40% of the total research funding. The second largest external funder was Vinnova (Sweden's Innovation Agency). Together, the Knowledge Foundation and Vinnova annually contribute more funding to CAISR than Halmstad University. The basis for this is of course our close cooperation with industry partners and the public sector. These partners in turn contribute with substantial amounts of in-kind but we have not followed this up in detail for all projects. In 2020 we aim to summarize all in-kind in CAISR projects over the years 2012-2021 to provide a more comprehensive picture in our next annual report.

Funding on the University side 2020



Organization

CAISR is managed by the CAISR director, with support from the academic advisory group and a research coordinator overseeing details regarding reporting, coproduction, and information management. The academic advisory group consists of the professors in CAISR, the head for the department where CAISR is placed, the research manager for the school of information technology (ITE), and the dean for the school of information technology (ITE).

The intention was to change the organization of CAISR somewhat in 2020 and appoint a broad Industrial Advisory Board during 2020 as well as a new a Scientific Advisory Board. However, the covid-19 pandemic put all those things on hold and we will pick this up in 2021. CAISR will also recruit a new research coordinator during 2021, since Roland Thörner is retiring in early 2021. He has been a truly excellent research coordinator for CAISR ever since 2012.

Thorsteinn Rögnvaldsson, Director of CAISR.

Magnus Clarin, Dean

Sławomir Nowaczyk, Professor

Roland Thörner, Coordinator

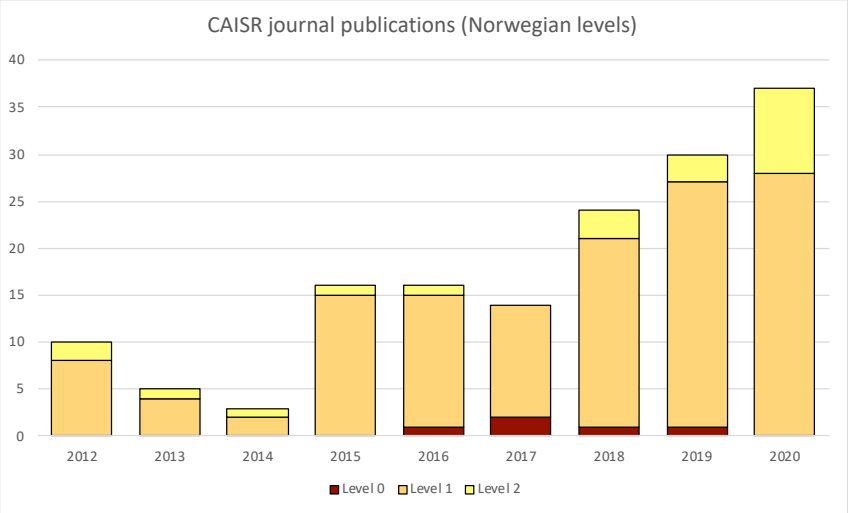
Scientific publications and impact

CAISR was evaluated by DAMVAD in 2019, and the first eight years of Knowledge Foundation funding ended in December 2019. The ambition was to achieve high impact research during this time, but our own analysis and DAMVAD's analysis both indicate that the scientific impact of CAISR publications 2012-2019 has been average, compared to Swedish universities, Nordic universities and OECD. This is of course not bad but below our ambition.

There are, nevertheless, several very positive things that can be said about the scientific output and impact from CAISR researchers. One is the strong CAISR presence in scientific journals focusing on applied AI. Over the years 2012-2017 CAISR researchers published more papers than any other Swedish university in *Expert Systems with Applications, Engineering Applications of Artificial Intelligence, and Neural Computing and Applications*. This is a clear indicator of CAISR's strong focus on applied AI.

Another very positive thing is the increase in quality (or prestige) in the journals where CAISR researchers publish. The figure below shows the development of CAISR journal publications in channels categorized in the Norwegian register for scientific journals, series and publishers . The register categorizes publication channels into three levels: zero (0 = unscientific), one (1 = scientific), and two (2 = highest scientific level). Only 20% of the scientific journals are allowed to be level 2. Over the last years, the annual output of CAISR journal publications has been steadily increasing, and the fraction of Norwegian level 2 publications is going up, reaching almost 25% in 2020. This is a clear indicator of CAISR's work with increasing the presence in level 2 channels.

The three most cited papers (see publication list at end) from CAISR, normalized by year, in the recent years are: "Improving Automated Latent Fingerprint Identification using Extended Feature Sets" (Krish et al. 2019), "Agreeing to disagree?: active learning with noisy labels without crowdsourcing" (Bouguelia et al. 2018), and "Evaluation of the performance of accelerometer-based gait event detection algorithms in different real-world scenarios using the MAREA gait database" (Khandelwal & Wickström 2017). The work presented in the latter one also formed the basis for a spin-off company started by Siddhartha Khandelwal in 2018.



Co-production research projects

The research in CAISR is to a very high degree done in close cooperation with partners from industry or the public sector. Our external partners contribute with work, infrastructure, or cash. Their contribution is substantial and our strong development from 2012 would have been impossible without this. As an example, CAISR's total research volume over the years 2012-2020 was roughly 190 million SEK (about €18 million), and the total estimated in-kind, value of research infrastructure, or cash contribution from our partners over the same period was roughly 110 million SEK (about €10 million).

Cooperation is very important for us, and it is a modus operandi in CAISR. We do follow-ups with our external partners, to monitor the quality of our cooperation, and the conclusions so far have been that we are very appreciated collaboration partners. Clearly, we appreciate our collaboration partners very much too.

CAISR Staff Researchers

Bigun, Josef

Prof., Doctor
Professor signal analysis
josef.bigun@hh.se

Computer Vision, human vision, pattern recognition, biometrics, image processing, signal analysis, machine learning, AI

Dougherty, Mark

Prof., Doctor
Professor Information Technology
mark.dougherty@hh.se

Acoustic analysis, smart sensors, medical informatics, decision support systems, forensic science, ethics of AI

Nowaczyk, Sławomir

Prof., Doctor
Professor machine learning
slawomir.nowaczyk@hh.se

Data Mining, knowledge representation, joint human-machine learning, self-organising anomaly detection, big data.

Ohlsson, Mattias

Prof., Doctor
Professor machine learning
mattias.ohlsson@hh.se

Machine learning, deep learning, neural networks, medical informatics, medical decision support

Rögnvaldsson, Thorsteinn

Prof., Doctor
Professor computer science
thorsteinn.rognvaldsson@hh.se

Neural networks, self-organizing models, predictive maintenance.

Verikas, Antanas

Honorary Professor, Doctor
Professor pattern recognition
antanas.verikas@hh.se

Classification committees, feature selection; semi-supervised learning, fuzzy logic, analysis of pathological speech.

Vinel, Alexey

Prof., Doctor
Prof. computer communications
alexey.vinel@hh.se

Wireless communications, vehicular networking, smart mobility.

Englund, Cristofer

Docent, Doctor
Adjunct professor
cristofer.englund@hh.se

Machine learning for automated driving, vehicular behavioral modeling, connected vehicles, situation awareness.

Alonso-Fernandez, Fernando

Docent, Doctor
Associate professor
fernando.alonso-fernandez@hh.se
Biometrics recognition, image/signal processing, computer vision, machine learning and pattern recognition.

Bouguelia, Mohamed-Rafik

Docent, Doctor
Associate Professor
mohamed-rafik.bouguelia@hh.se

Active learning; classification; data stream mining; anomaly and novelty detection; big data; predictive maintenance.

Byttner, Stefan

Docent, Doctor
Associate professor
stefan.byttner@hh.se

Self-organizing algorithms, interestingness measures of patterns and joint human-machine learning.

Wickström, Nicholas

Docent, Doctor
Associate professor
nicholas.wickstrom@hh.se

Signal analysis of human motion, incorporateing expert knowledge in the modelling, and making models possible to interpret.

Åstrand, Björn

Docent, Doctor
Associate professor
bjorn.astrand@hh.se

Mechatronics, perception, mobile robots, semantic mapping, AGV/ truck safety.

Wärnestål, Pontus

Docent, Doctor
Associate Professor
pontus.warnestal@hh.se

Digital Service Innovation, Service Design, UX Design, Informatics, Human-Computer Interaction.

Aksoy, Eren Erdal

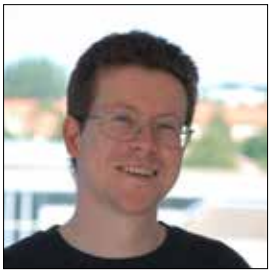
Doctor
Assistant professor
eren.aksoy@hh.se

Computer Vision, Cognitive Robotics, Machine Learning, Imitation Learning, and Autonomous Systems

Clarin, Magnus

Doctor
Dean, School of Information Technology
magnus.clarin@hh.se

Health technology, e-health, data mining, applied physics, signal analysis.



Cooney, Martin

Doctor
Assistant professor
martin.cooney@hh.se

Social robotics, recognition, human-robot interaction, well-being

Dikmen, Onur

Doctor
Senior Lecturer
onur.dikmen@hh.se

Statistical machine learning, change-point and outlier detection, predictive maintenance, causal inference

Etminani, Kobra

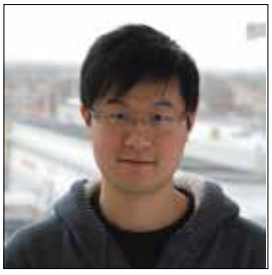
Doctor
Associate Professor
kobra.etminani@hh.se

Data Mining, Healthcare informatics, anomaly detection, big data.

Fan, Yuantao

Doctor
Postdoc
yuantao.fan@hh.se

Anomaly detection, unsupervised learning, data mining, predictive maintenance.



Fanaee, Hadi

Doctor
Assistant professor
hadi.fanaee@hh.se

Data Mining, Machine Learning, Tensor Analysis, Anomaly Detection, Time series Analysis, Spatio-temporal Data Mining

Järpe, Eric

Doctor
Senior lecturer
eric.jarpe@hh.se

Change-point and outlier detection, smart homes monitoring, communication security, cryptology.

Khan, Taha

Doctor
Researcher
taha.khan@hh.se

Computer Vision, image and signal analysis of human motion, speech analysis, machine learning, medical informatics.

Khoshkangini, Reza

Doctor
Postdoc
reza.khoshkangini@hh.se

Artificial intelligence, machine learning, data mining and decision making

Mashhadi, Peyman

Doctor
Senior Lecturer
peyman.mashhadi@hh.se

Statistical Machine Learning, Deep Learning, Data Mining, Predictive Maintenance

de Morais, Wagner

Doctor
Research Engineer
wagner.demorais@hh.se

Smart environments, ambient intelligence, Ambient Assisted Living, edge computing, mixed reality

Orand, Abbas

Doctor
Researcher
abbas.orand@hh.se

Biomedical Engineering, Robotics, Health & Rehabilitation, Machine Learning, Signal Processing

Pashami, Sepideh

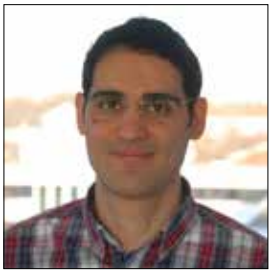
Doctor
Senior lecturer
sepideh.pashami@hh.se

Predictive maintenance, causal inference, representation learning, machine learning, data mining.

Rahat, Mahmoud

Doctor
Assistant Professor
mahmoud.rahat@hh.se

Machine Learning, Predictive Maintenance, Natural Language Processing



Sant'Anna, Anita

Doctor
Senior lecturer
anita.santanna@hh.se

Wearable sensors, human motion analysis, tele-monitoring, e-health, signal processing, data mining, joint human-machine learning.

Soliman, Amira

Doctor
Post Doc
amira.soliman@hh.se

Big data, Graph analytics, Federated and decentralized learning, Deep learning, Healthcare informatics

PhD Students

Alabdallah, Abdallah

M.Sc.
Doctoral student
abdallah.alabdallah@hh.se

Machine Learning, Data Mining, Survival Analysis, Deep Learning, Representation Learning, Explainable AI

Ali Hamad, Rebeen

M.Sc.
Doctoral student
rebeen.ali_hamad@hh.se

Transfer Learning, manifold learning, human behavior patterns, smart homes.

Altarabichi, Mohammed Ghaith

M.Sc.
Doctoral student
mohammed_ghaith.altarabichi@hh.se
Machine Learning, Transfer Learning, Representation Learning, Evolutionary Computation

Ashfaq, Awais

Lic.Tech
Lic.Tech
awais.ashfaq@hh.se

Descriptive, predictive and prescriptive analytics on EHRs, medical image processing, neural networks and deep learning.

Calikus, Ece

Lic.Tech
Doctoral student
ece.calikus@hh.se

Data Mining, big data, predictive maintenance, deviation detection, joint human-machine learning.

Chang, Jose Ramon

M.Sc
Guest researcher

Artificial intelligence, Deep learning

Chen, Kunru

M.Sc.
Doctoral student
kunru.chen@hh.se

Usage Analysis, Activity Recognition, Learning Representation, Semi-supervised Learning.

Cortinhal, Tiago

M.Sc.
Doctoral student
tiago.cortinhal@hh.se

Computer Vision, Sensor Fusion, Adversarial Networks, Scene Understanding

David, Jennifer

M.Sc.
Doctoral student
jennifer.david@hh.se

Mobile robotics, intelligent vehicles, multi-robots, path planning, task scheduling.

del Moral, Pablo

M.Sc.
Doctoral student
pablo.del_moral@hh.se

Machine learning, predictive maintenance, survival analysis, time series analysis, data stream mining.

Galozy, Alexander

Dipl.-Ing(FH), M.Sc.
Doctoral Student
alexander.galozy@hh.se

Data mining, machine learning, reinforcement learning, deep neural networks, predictive health

Farouq, Shiraz

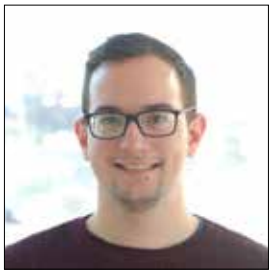
Lic.Tech
Doctoral student
shiraz.farouq@hh.se

Machine learning, signal processing, artificial intelligence.

Hernandez Diaz, Kevin

M.Sc.
Doctoral student
kevin.hernandez-diaz@hh.se

Computer Vision, biometrics, pattern recognition, machine learning, image processing, signal analysis



Rosberg, Felix

M.Sc.
Industrial Doctoral student
felix.rosberge@berge.io

Generative models, AI-based Image manipulation, AI-based anonymization, feature interpretation, identity swap

Taghiyarrenani, Zahra

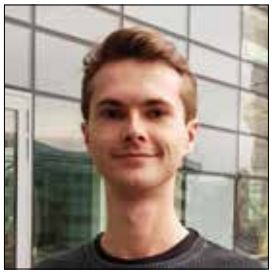
M.Sc.
Doctoral student
zahra.taghiyarrenani@hh.se

Predictive Maintenance, Transfer Learning, Neural Networks

Martin Torstensson

M.Sc.
Industrial Doctoral student
martin.torstensson@ri.se

Explainable machine learning, driver behavior modeling, predictive machine learning



Lecturers, technical and administrative personnel

Carlsson, Roger

Research Engineer
nils_roger.carlsson@hh.se

Neural networks, Machine Learning

Recena Menezes, Maria Luiza

M.Sc.
Research engineer
maria.menezes@hh.se
Intelligent systems, smart homes, BCI, affective computing, signal analysis, data mining, machine learning.

van Esch, Johannes

B.Sc.
Research Engineer
johannes.van_esch@hh.se

Data management, Software Development, Intelligent systems, smart homes, embedded systems

Salomonsson, Tommy

M.Sc.
Lecturer
tommy.salomonsson@hh.se

Mechatronics with focus on embedded systems and actuators. Autonomous mechatronic systems.

Jannesari, Mahboubeh

M.Sc.
Research engineer
mahboubeh.jannesari@hh.se

Machine Learning, Federated Learning, Image Processing, Natural Language Processing and Health data Analysis

Thörner, Roland

M.Sc.
Coordinator
roland.thorner@hh.se

Research support; Internal and external relations, funding, agreements, reports.

Munther, Thomas

M.Sc.
Lecturer
thomas.munther@hh.se

Electronics, Electronics Design and Implementation, Control Theory, Electrical Power Systems, Electrical Machines and Drives

CAISR Publications 2012–2020

JOURNAL PAPERS

2020

Ali Hamad, R., Salguero Hidalgo, A., Bouguelia, M.-R., Estevez, M. E., & Quero, J. M. (2020). Efficient Activity Recognition in Smart Homes Using Delayed Fuzzy Temporal Windows on Binary Sensors. IEEE Journal of Biomedical and Health Informatics, 24(2), 387–395.

Ali Hamad, R., Kimura, M., & Lundström, J. (2020). Efficacy of Imbalanced Data Handling Methods on Deep Learning for Smart Homes Environments. SN Computer Science, 1(4).

Amoozegar, M., Minaei-Bidgoli, B., Mansoor, R., & Fanaee Tork, H. (2020). Extra-adaptive robust online subspace tracker for anomaly detection from streaming networks. Engineering Applications of Artificial Intelligence, 94.

Aramrattana, M., Larsson, T., Englund, C., Jansson, J., and Nåbo, A., (2020) A Simulation Study on Effects of Platooning Gaps on Drivers of Conventional Vehicles in Highway Merging Situations, IEEE Transactions on Intelligent Transportation Systems.

Athshfaq, A., Lönn, S., Nilsson, H., Eriksson, J., Kwatra, J., Yasin, Z., … Lingman, M. (2020). Data resource profile : Regional healthcare information platform in Halland, Sweden. International Journal of Epidemiology, 49(3), 738–739f.

Atabaki-Pasdar, N., & Ohlsson, M. et al. (2020). Predicting and elucidating the etiology of fatty liver disease : A machine learning modeling and validation study in the IMI DIRECT cohorts. PLoS Medicine, 17(6).

Bae, J., Helldin, T., Riveiro, M., Nowaczyk, S., Bouguelia, M.-R., & Falkman, G. (2020). Interactive Clustering : A Comprehensive Review. ACM Computing Surveys, 53(1).

Calikus, E., Nowaczyk, S., Pinheiro Sant'Anna, A., & Dikmen, O. (2020b). No free lunch but a cheaper supper : A general framework for streaming anomaly detection. Expert Systems with Applications, 155.

Duracz, A., Aljarbouh, A., Bartha, F. A., Masood, J., Philippsen, R., Eriksson, H., … Grante, C. (2020). Advanced Hazard Analysis and Risk Assessment in the ISO 26262 Functional Safety Standard Using Rigorous Simulation. Lecture Notes in Computer Science, 11971, 108–126.

Etminani, K., Engström, A. T., Göransson, C., Sant'Anna, A., & Nowaczyk, S. (2020). How Behavior Change Strategies are Used to Design Digital Interventions to Improve Medication Adherence and Blood Pressure Among Patients With Hypertension : Systematic Review. Journal of Medical Internet Research. Toronto: J M I R Publications, Inc.

Evdokimova E, Vinel A, Lyamin N, Fiems D. Internet Provisioning in VANETs : Performance Modeling of Drive-Thru Scenarios. Piscataway, NJ: Institute of Electrical and Electronics Engineers (IEEE); IEEE transactions on intelligent transportation systems (Print). 2020;21(7):2801-2815.

Fan, Y., Nowaczyk, S., & Rögnvaldsson, T. (2020). Transfer learning for remaining useful life prediction based on consensus self-organizing models. Reliability Engineering & System Safety, 203.

Farouq, S., Byttner, S., Bouguelia, M.-R., Nord, N., & Gadd, H. (2020). Large-scale monitoring of operationally diverse district heating substations : A reference-group based approach. Engineering Applications of Artificial Intelligence, 90.

Fernandes, S., Fanaee Tork, H., & Gama, J. (2020). NORMO : A new method for estimating the number of components in CP tensor decomposition. Engineering Applications of Artificial Intelligence, 96.

Fernandes, S., Fanaee Tork, H., & Gama, J. (2020). Tensor decomposition for analysing time-evolving social networks : an overview. Artificial Intelligence Review. Dordrecht: Springer Netherlands.

Galozy, A., & Nowaczyk, S. (2020). Prediction and pattern analysis of medication refill adherence through electronic health records and dispensation data. Journal of Biomedical Informatics: X, 6–7.

Galozy, A., Nowaczyk, S., Pinheiro Sant'Anna, A., Ohlsson, M., & Lingman, M. (2020). Pitfalls of medication adherence approximation through EHR and pharmacy records : Definitions, data and computation. International Journal of Medical Informatics, 136.

Järpe, E. (2020). An alternative Diffie-Hellman protocol. Cryptography, 4(1).

Khan, T., Zeeshan, A., and Dougherty, M. (2020). A Novel Method for Automatic Classification of Parkinson Gait Severity Using Front-view Video Analysis. 1 Jan. 2020: Technology and Health Care Preprint 1 – 11.

Khan, T., & Jacobs, P. G. (2021). Prediction of Mild Cognitive Impairment Using Movement Complexity. IEEE journal of biomedical and health informatics, 25(1), 227–236.

Khan, T., Lundgren, L., Anderson, D. G., Novak, I., Dougherty, M., Verikas, A., Pavel, M., Jimison, H., Nowaczyk, S., Aharonson, V. (2020). Assessing Parkinson's disease severity using speech analysis in non-native speakers. Computer Speech & Language (Print), 61.

Khoshkangini, R., Sheikholharam Mashhadi, P., Berck, P., Gholami Shahbandi, S., Pashami, S., Nowaczyk, S., & Niklasson, T. (2020). Early Prediction of Quality Issues in Automotive Modern Industry. Information, 11(7).

Lin C, Vinel A. Recent Internet of Things Applications in Smart Grid and Various Industries. New York: Springer; Mobile Networks and Applications 2020.

Lyamin N, Bellalta B, Vinel A. Age-of-Information-Aware Decentralized Congestion Control in VANETs. Piscataway, NJ: IEEE; . IEEE Networking Letters. 2020;2(1):3-37.

Marques Marinho M A, Vinel A, Tufvesson F, Antreich F, Costa J, Pignaton de Freitas E. Spherical Wave Array Based Positioning for Vehicular Scenarios. Piscataway, N.J.: IEEE; IEEE Access. 2020;8:110073-110081.

Miyasaka, H., Kondo, I., Yamamura, C., Fujita, N., Orand, A., & Sonoda, S. (2020). The quantification of task-difficulty of upper limb motor function skill based on Rasch analysis. Topics in Stroke Rehabilitation, 27(1), 49–56.

Molinaro A, Campolo C, Härri J, Rothenberg C E, Vinel A. 5G-V2X Communications and Networking for Connected and Autonomous Vehicles. Basel: MDPI; Future Internet. 2020;12(7):116.

Ni Y, Cai L, He J, Vinel A, Li Y, Mosavat-Jahromi H, et al. Toward Reliable and Scalable Internet-of-Vehicles : Performance Analysis and Resource Management. New York, NY: Institute of Electrical and Electronics Engineers (IEEE); Proceedings of the IEEE. 2020;108(2):324-340.

Ali Hamad, R., Salguero Hidalgo, A., Bouguelia, M.-R., Estevez, M. E., & Quero, J. M. (2020). Efficient Activity Recognition in Smart Homes Using Delayed Fuzzy Temporal Windows on Binary Sensors. IEEE Journal of Biomedical and Health Informatics, 24(2), 387–395.

Ortíz-Barrios, M. A., Lundström, J., Synnott, J., Järpe, E., & Pinheiro Sant'Anna, A. (2020). Complementing real datasets with simulated data : a regression-based approach. Multimedia Tools and Applications, (79), 34301–34324.

Ortíz-Barrios, M. A., Cleland, I., Nugent, C., Pancardo, P., Järpe, E., & Synnott, J. (2020). Simulated Data to Estimate Real Sensor Events—A Poisson-Regression-Based Modelling. Remote Sensing, 12(5).

Pelliccione P, Knauss E, Ågren S M, Heldal R, Bergenhem C, Vinel A, et al. Beyond connected cars: A systems of systems perspective. Amsterdam: Elsevier; Science of Computer Programming. 2020; 191:102414.

Polymeri, E., Sadik, M., Kaboteh, R., Borrelli, P., Enqvist, O., Ulén, J., … Edenbrandt, L. (2020). Deep learning-based quantification of PET/CT prostate gland uptake : association with overall survival. Clinical Physiology and Functional Imaging, 40(2), 106–113.

Rabbani, M., Wang, Y. L., Khoshkangini, R., Jelodar, H., Zhao, R., & Hu, P. (2020). A Hybrid Machine Learning Approach for Malicious Behaviour Detection and Recognition in Cloud Computing. Journal of Network and Computer Applications, 151.

Sheikholharam Mashhadi, P., Nowaczyk, S., & Pashami, S. (2020). Stacked Ensemble of Recurrent Neural Networks for Predicting Turbocharger Remaining Useful Life. Applied Sciences, 10(1).

Ullah, S., Daud, H., Dass, S. C., Fanaee Tork, H., Kausarian, H., & Khalil, A. (2020). Space-Time Clustering Characteristics of Tuberculosis in Khyber Pakhtunkhwa Province, Pakistan, 2015–2019. International Journal of Environmental Research and Public Health, 17(4).

Viteckova, S., Khandelwal, S., Kutilek, P., Krupicka, R., & Szabo, Z. (2020). Gait symmetry methods : Comparison of waveform-based Methods and recommendation for use. Biomedical Signal Processing and Control, 55.

Yasin, Z. M., Anderson, P. D., Lingman, M., Kwatra, J., Ashfaq, A., Slutzman, J. E., & Agvall, B. (2020). Receiving care according to national heart failure guidelines is associated with lower total costs – an observational study in Region Halland, Sweden. European Heart Journal - Quality of Care and Clinical Outcomes.

2019

Abiri, N., Linse, B., Edén, P., & Ohlsson, M. (2019). Establishing strong imputation performance of a denoising autoencoder in a wide range of missing data problems. Neurocomputing, 365, 137-146.

Aein, M. J., Aksoy, E. E., & Wörgötter, F. (2019). Library of actions: Implementing a generic robot execution framework by using manipulation action semantics. The International Journal of Robotics Research, 38(8), 910-934.

Amadeo, M., Campolo, C., Molinaro, A., Harri, J., Rothenberg, C. E., & Vinel, A. (2019). Enhancing the 3GPP V2X Architecture with Information-Centric Networking. Future Internet, 11(9), 199.

Ashfaq, A., Sant'Anna, A., Lingman, M., & Nowaczyk, S. (2019). Readmission prediction using deep learning on electronic health records. Journal of biomedical informatics, 97, 103256.

Blom, M. C., Ashfaq, A., Sant'Anna, A., Anderson, P. D., & Lingman, M. (2019). Training machine learning models to predict 30-day mortality in patients discharged from the emergency department: a retrospective, population-based registry study. BMJ open, 9(8), e028015.

Bocharova, I., Kudryashov, B., Rabi, M., Lyamin, N., Dankers, W., Frick, E., & Vinel, A. (2019). Characterizing Packet Losses in Vehicular Networks. IEEE Transactions on Vehicular Technology, 68(9), 8347-8358.

Bocharova, I., Kudryashov, B., Lyamin, N., Frick, E., Rabi, M., & Vinel, A. (2019). Low Delay Inter-Packet Coding in Vehicular Networks. Future Internet, 11(10), 212.

Calikus, E., Nowaczyk, S., Sant'Anna, A., Gadd, H., & Werner, S. (2019). A data-driven approach for discovering heat load patterns in district heating. Applied Energy, 252, 113409.

Campolo, C., Molinaro, A., Berthet, A. O., & Vinel, A. (2019). On latency and reliability of road hazard warnings over the cellular V2X sidelink interface. IEEE Communications Letters, 23(11), 2135-2138.

Gholami Shabandi, S. & Magnusson, M. (2019). 2D Map Alignment with Region Decomposition. Autonomous Robots, 43, p. 1117-1136

Gonzalez-Sosa, E., Vera-Rodriguez, R., Fierrez, J., Alonso-Fernandez, F., & Patel, V. M. (2019). Exploring Body Texture From mmW Images for Person Recognition. IEEE Transactions on Biometrics, Behavior, and Identity Science, 1(2), 139-151.

Haglund, E., Sant'Anna, A., Andersson, M., Bremander, A., & Aili, K. (2019). Dynamic joint stability measured as gait symmetry in people with symptomatic knee osteoarthritis. Annals of the Rheumatic Diseases, Vol. 78, no Suppl. 2, p. -1458.

Khan, T., Lundgren, L. E., Järpe, E., Olsson, M. C., & Viberg, P. (2019). A Novel Method for Classification of Running Fatigue Using Change-Point Segmentation. Sensors, 19(21), 4729.

Krish, R.P., Fierrez, J., Ramos, D., Alonso-Fernandez, F., and Bigun, J. (2018), Improving Automated Latent Fingerprint Identification using Extended Feature Sets, Information Fusion, Volume 50, p. 9-19, 2019. ISSN 1566-2535.

Lien, S. Y., Kuo, Y. C., Deng, D. J., Tsai, H. L., Vinel, A., & Benslimane, A. (2018). Latency-optimal mmwave radio access for v2x supporting next generation driving use cases. IEEE Access, 7, 6782-6795.

Lyamin, N., Kleyko, D., Delooz, Q., & Vinel, A. (2019). Real-time jamming DoS detection in safety-critical V2V C-ITS using data mining. IEEE Communications Letters, 23(3), 442-445.

Mendoza-Palechor, F., Menezes, M. L., Sant'Anna, A., Ortiz-Barrios, M., Samara, A., & Galway, L. (2019). Affective recognition from EEG signals: an integrated data-mining approach. Journal of Ambient Intelligence and Humanized Computing, 10(10), 3955-3974.

Muhammad, N., & Åstrand, B. (2019). Predicting agent behaviour and state for applications in a roundabout-scenario autonomous driving. Sensors, 19(19), 4279.

Nemati, H. M., Sant'Anna, A., Nowaczyk, S., Jürgensen, J. H., & Hilber, P. (2019). Reliability evaluation of power cables considering the restoration characteristic. International Journal of Electrical Power & Energy Systems, 105, 622-631.

Orand, A., Erdal Aksoy, E., Miyasaka, H., Weeks Levy, C., Zhang, X., & Menon, C. (2019). Bilateral tactile feedback-enabled training for stroke survivors using microsoft Kinect. Sensors, 19(16), 3474.

Polymeri, E., Sadik, M., Kaboteh, R., Borrelli, P., Enqvist, O., Ulén, J., ... & Hoilund Carlsen, P. F. (2019). Deep learning based quantification of PET/CT prostate gland uptake: association with overall survival. Clinical Physiology and Functional Imaging.

Ribeiro, E., Uhl, A., & Alonso-Fernandez, F. (2019). Iris super-resolution using CNNs: is photo-realism important to iris recognition?. IET Biometrics, 8(1), 69-78.

Teng, X., Zhang, X., Fan, Y., & Zhang, D. (2019). Evaluation of cracks in metallic material using a self-organized data-driven model of acoustic echo-signal. Applied Sciences, 9(1), 95.

Thunberg, J., Lyamin, N., Sjöberg, K., & Vinel, A. (2019). Vehicle-to-Vehicle Communications for Platooning: Safety Analysis. IEEE Networking Letters, 1(4), 168-172.

Borrelli, P., Enqvist, O., Polymeri, E., Ohlsson, M., & Edenbrandt, L. (2019). Prognostic value of automatically acquired biomarkers using artificial intelligence in 18F-Choline PET/CT in high-risk prostate cancer. Journal of Nuclear Medicine, 60(supplement 1), 1592-1592.

Ortiz Barrios, M., Nugent, C., Cleland, I., Donnelly, M., & Verikas, A. (2019). Selecting the most suitable classification algorithm for supporting assistive technology adoption for people with dementia: A multicriteria framework. Journal of Multi Criteria Decision Analysis.

Cooney, M., & Leister, W. (2019). Using the engagement profile to design an engaging robotic teaching assistant for students. Robotics, 8(1), 21.

Pejner, M. N., de Morais, W. O., Lundström, J., Laurell, H., & Skärsäter, I. (2019). A Smart Home System for Information Sharing, Health Assessments, and Medication Self-Management for Older People: Protocol for a Mixed-Methods Study. JMIR research protocols, 8(4), e12447.

Miyasaka, H., Takeda, K., Ohnishi, H., Orand, A., & Sonoda, S. (2019). Effect of Sensory Loss on Improvements of Upper-Limb Paralysis Through Robot-Assisted Training: A Preliminary Case Series Study. Applied Sciences, 9(18), 3925.

Zarzoura, M., del Moral, P., Awad, M. I., & Tolbah, F. A. (2019). Investigation into reducing anthropomorphic hand degrees of freedom while maintaining human hand grasping functions. Proceedings of the Institution of Mechanical Engineers, Part H: Journal of Engineering in Medicine, 233(2), 279-292.

Zhang, K., Mao, Y., Leng, S., Maharjan, S., Vinel, A., & Zhang, Y. (2019). Contract-theoretic approach for delay constrained offloading in vehicular edge computing networks. Mobile Networks and Applications, 24(3), 1003-1014.

2018

Alonso-Fernandez, F., Farrugia, R.A., Bigun, J, Fierrez, J., and Gonzalez-Sosa, E. (2018), A Survey of Super-Resolution in Iris Biometrics with Evaluation of Dictionary-Learning, IEEE Access, vol. 7, pp. 6519-6544, 2019.

Medved, D., Ohlsson, M., Höglund, P., Andersson, B., Nugues, P., and Nilsson, J. (2018), Improving prediction of heart transplantation outcome using deep learning techniques, Scientific Reports 8, 3613 (2018)

Bouguelia, M.-R., Nowaczyk, S., Santosh, K. C., & Verikas, A. (2018). Agreeing to disagree: active learning with noisy labels without crowdsourcing. International Journal of Machine Learning and Cybernetics, 9(8), 1307–1319.

Bouguelia, M.-R., Nowaczyk, S., & Payberah, A. H. (2018). An adaptive algorithm for anomaly and novelty detection in evolving data streams. Data Mining and Knowledge Discovery, 32(6), 1597–1633.

Cooney, M., & Menezes, M. L. R. (2018). Design for an Art Therapy Robot: An Explorative Review of the Theoretical Foundations for Engaging in Emotional and Creative Painting with a Robot. Multimodal Technologies and Interaction. Special Issue Emotions in Robots: Embodied Interaction in Social and Non-Social Environments. Basel.

Ericson, S. K., & Åstrand, B. (2018). Analysis of two visual odometry systems for use in an agricultural field environment. Biosystems Engineering, 166, 116–125.

Farouq, S., Byttner, S., & Gadd, H. (2018). Towards understanding district heating substation behavior using robust first difference regression. Energy Procedia (Vol. 149, pp. 236–245).

Rimavicius, T., Gelžinis, A., Verikas, A., Vaiciukynas, E., Bacauskiene, M., & Šaškov, A. (2018). Automatic benthic imagery recognition using a hierarchical two-stage approach. Signal, Image and Video Processing, 12(6), 1107–1114.

Rothfuss, J., Ferreira, F., Aksoy, E., Zhou, Y., & Asfour, T. (2018). Deep Episodic Memory: Encoding, Recalling, and Predicting Episodic Experiences for Robot Action Execution. IEEE Robotics and Automation Letters, 3(4), 4007–4014.

Chen, L., & Englund, C. (2018). Every Second Counts: Integrating Edge Computing and Service Oriented Architecture for Automatic Emergency Management. Journal of Advanced Transportation, 13.

Gonzalez-Sosa, E., Fierrez, J., Vera-Rodriguez, R., & Alonso-Fernandez, F. (2018). Facial Soft Biometrics for Recognition in the Wild: Recent Works, Annotation and Evaluation. IEEE Transactions on Information Forensics and Security, 13(8), 2001–2014.

Ploeg, J., Englund, C., Nijmeijer, H., Semsar-Kazerooni, E., Shladover, S. E., Voronov, A., & van de Wouw, N. (2018). Guest Editorial Introduction to the Special Issue on the 2016 Grand Cooperative Driving Challenge. IEEE Transactions on Intelligent Transportation Systems (Print), 19(4), 1208–1212.

Muhammad, N., & Åstrand, B. (2018). Intention Estimation Using Set of Reference Trajectories as Behaviour Model. Sensors, 18(12).

Vaiciukynas, E., Ulicný, M., Pashami, S., & Nowaczyk, S. (2018). Learning Low-Dimensional Representation of Bivariate Histogram Data. IEEE Transactions on Intelligent Transportation Systems (Print), 19(11), 3723–3735.

Bouguelia, M.-R., Karlsson, A., Pashami, S., Nowaczyk, S., & Holst, A. (2018). Mode tracking using multiple data streams. Information Fusion, 43, 33–46.

Rosenstatter, T., & Englund, C. (2018). Modelling the Level of Trust in a Cooperative Automated Vehicle Control System. IEEE Transactions on Intelligent Transportation Systems (Print), 19(4), 1237–1247.

Gholami Shahbandi, S., Magnusson, M., & Iagnemma, K. (2018). Nonlinear Optimization of Multimodal Two-Dimensional Map Alignment with Application to Prior Knowledge Transfer. IEEE Robotics and Automation Letters, 3(3), 2040–2047.

Khandelwal, S., & Wickström, N. (2018). Novel methodology for estimating Initial Contact events from accelerometers positioned at different body locations. Gait & Posture, 59, 278–285.

Calikus, E., Nowaczyk, S., Pinheiro Sant'Anna, A., & Byttner, S. (2018). Ranking Abnormal Substations by Power Signature Dispersion. Energy Procedia, 149, 345–353.

Rögnvaldsson, T., Nowaczyk, S., Byttner, S., Prytz, R., & Svensson, M. (2018). Self-monitoring for maintenance of vehicle fleets. Data Mining and Knowledge Discovery, 32(2), 344–384.

Mashad Nemati, H., Laso, A., Manana, M., Pinheiro Sant'Anna, A., & Nowaczyk, S. (2018). Stream Data Cleaning for Dynamic Line Rating Application. Energies, 11(8).

Parker, J., & Lundgren, L. (2018). Surfing the Waves of the CMJ: Are There between-Sport Differences in the Waveform Data? Sports, 6(4), 1–12.

Aramrattana, M., Detournay, J., Englund, C., Frimodig, V., Jansson, O. U., Larsson, T., Mostowski, W., Rodríguez, V.D., Rosenstatter, T., and Shahanoor, G. (2018). Team Halmstad Approach to Cooperative Driving in the Grand Cooperative Driving Challenge 2016. IEEE Transactions on Intelligent Transportation Systems (Print), 19(4), 1248–1261.

2017

Andersson, J., Habibovic, A., Klingegård, M., Englund, C. & Malmsten-Lundgren, V. (2017). Hello human, can you read my mind? ERCIM News. Sophia Antipolis Cedex: European Research Consortium for Informatics and Mathematics (ERCIM).

Bouguelia, M.-R., Gonzalez, R., Iagnemma, K. & Byttner, S. (2017). Unsupervised classification of slip events for planetary exploration rovers. Journal of Terramechanics, 73, 95–106.

Cooney, M. & Bigun, J. (2017). PastVision+: Thermo-visual Inference of Unobserved Recent Events, Frontiers in Robotics and AI Computational Intelligence: Intentions in HRI, 2017.

Cooney, M. & Sant'Anna, A. (2017). Avoiding Playfulness Gone Wrong: Exploring Multi-objective Reaching Motion Generation in a Social Robot. International Journal of Social Robotics, 9(4), 545–562.

Englund, C., Estrada, J., Jaaskelainen, J., Meisner, J., Satyavolu, S., Serna, F. & Sundararajan, S. (2017). Enabling Technologies for Road Vehicle Automation. In Road Vehicle Automation 4 (pp. 177–185). Leiden: VSP.

Gelzinis, A., Verikas, A., Vaiciukynas, E. & Bacauskiene, M. (2017). Parkinson's disease detection from speech using convolutional neural networks, Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering (LNICST), 2017, 1-10.

Khandelwal, S. & Wickström, N. (2017). Evaluation of the performance of accelerometer-based gait event detection algorithms in different real-world scenarios using the MAREA gait database. Gait & Posture, 51, 84–90.

Manasa, J., Varghese, V., Kosakovsky Pond, S., Rhee, S.-Y., Tzou, P., Fessel, J., Jang, K., White, E., Rögnvaldsson, T., Katzenstein, D. & Shafer, R. (2017) Evolution of gag and gp41 in Patients Receiving Ritonavir-Boosted Protease Inhibitors, Scientific Reports.

Minelga, J., Verikas, A., Vaiciukynas, E., Gelzinis, A. & Bacauskiene, M. (2017). A Transparent Decision Support Tool in Screening for Laryngeal Disorders Using Voice and Query Data. Applied Sciences, 7(10), 1–15.

Ranftl, A., Alonso-Fernandez, F., Karlsson, S. & Bigun, J. (2017). A Real-Time AdaBoost Cascade Face Tracker Based on Likelihood Map and Optical Flow. IET Biometrics, 6(6), 468–477.

Ražanskas, P., Verikas, A., Viberg, P.-A. & Olsson, M. C. (2017). Predicting physiological parameters in fatiguing bicycling exercises using muscle activation timing. Biomedical Signal Processing and Control, 35, 19–29.

Recena Menezes, M. L., Samara, A., Galway, L., Sant'Anna, A., Verikas, A., Alonso-Fernandez, F., Bond, R. & Wang, H. (2017). Emotion recognition in virtual environments - Feature extraction and modelling using EEG data, Personal and Ubiquitous Computing, Special Issue on Virtual Environments and Applications, Springer, 2017.

Vaiciukynas, E., Verikas, A., Gelzinis, A. & Bacauskiene, M. (2017). Detecting Parkinson's disease from sustained phonation and speech signals. PLoS ONE, 12(10).

Verikas, A., Parker, J., Bacauskiene, M. & Olsson, M. C. (2017). Exploring relations between EMG and biomechanical data recorded during a golf swing. Expert Systems with Applications, 88, 109–117.

2016

Alonso-Fernandez, F. & Bigun, J. (2016). A survey on periocular biometrics research. Pattern Recognition Letters, 82, part 2, 92-105.

Chen, L. & Englund, C. (2016). Cooperative Intersection Management: A Survey. IEEE transactions on intelligent transportation systems (Print), 17(2), 570-586.

Englund, C., Chen, L., Ploeg, J., Semsar-Kazerooni, E., Voronov, A., Hoang Bengtsson, H. & Didoff, J. (2016). The Grand Cooperative Driving Challenge 2016: Boosting the Introduction of Cooperative Automated Vehicles. IEEE wireless communications, 23(4), 146-152.

Fan, Y., Aramrattana, M., Shahbandi, S. G., Nemati, H. M. & Åstrand, B. (2016). Infrastructure Mapping in Well-Structured Environments Using MAV. Lecture Notes in Computer Science, 9716, 116-126.

Camelo, G. A., Recena Menezes, M. L., Sant'Anna, A., Vicari, R. M., Pereira, C. E., (2016). Control of Smart Environments Using Brain Computer Interface Based on Genetic Algorithm. Lecture Notes in Computer Science, 9622, p 773-781.

Hofbauer, H., Alonso-Fernandez, F., Bigun, J. & Uhl, A. (2016). Experimental Analysis Regarding the Influence of Iris Segmentation on the Recognition Rate. IET Biometrics, 5(3), 200-211.

Khandelwal, S. & Wickström, N. (2016). Gait Event Detection in Real-World Environment for Long-Term Applications: Incorporating Domain Knowledge into Time-Frequency Analysis. IEEE transactions on neural systems and rehabilitation engineering, 24(12), 1363-1372.

Lundström, J., Järpe, E. & Verikas, A. (2016). Detecting and exploring deviating behaviour of smart home residents. Expert systems with applications, 55, 429-440.

Mashad Nemati, H., Fan, Y. & Alonso-Fernandez, F. (2016). Hand Detection and Gesture Recognition Using Symmetric Patterns. Studies in Computational Intelligence, 642, 365-375.

Midtiby, H. S., Åstrand, B., Jørgensen, O. & Jørgensen, R. N. (2016). Upper limit for context-based crop classification in robotic weeding applications. Biosystems Engineering, 146, 183-192.

Mühlfellner, P., Bürki, M., Bosse, M., Derendarz, W., Philippsen, R. & Furgale, P. (2016). Summary Maps for Lifelong Visual Localization. Journal of Field Robotics, 33(5), 561-590.

Olenina, I., Vaiciukynas, E., Sulcius, S., Paskauskas, R., Verikas, A., Gelzinis, A., Olenin, S. (2016). The dinoflagellate Prorocentrum cordatum at the edge of the salinity tolerance: The growth is slower but cells are larger. Estuarine, Coastal and Shelf Science, 168(5), 71-79.

Spinsante, S., Angelici, A., Lundström, J., Espinilla, M., Cleland, I. & Nugent, C. D. (2016) A Mobile Application for Easy Design and Testing of Algorithms to Monitor Physical Activity in the Workplace. Mobile Information Systems, Hindawi Publishing, 2016. 1-17

Vaiciukynas, E., Verikas, A., Gelzinis, A., Bacauskiene, M., vicius, K., Uloza, V., Ciceliene, J. (2016). Fusing Various Audio Feature Sets for Detection of Parkinson's Disease from Sustained Voice and Speech Recordings. Lecture Notes in Computer Science, 9811, 328-337.

Verikas, A., Vaiciukynas, E., Gelzinis, A., Parker, J. & Olsson, M. C. (2016). Electromyographic Patterns during Golf Swing: Activation Sequence Profiling and Prediction of Shot Effectiveness. Sensors, 16(4), Article ID 592.

Zeng, Y., Chad, R., Taha, W., Duracz, A., Atkinson, K., Philippsen, R., O'Malley, M. (2016). Modeling Electromechanical Aspects of Cyber-Physical Systems. Journal of Software Engineering for Robotics, 7(1), 100-119.

2015

Gelzinis, A. Verikas, A., Vaiciukynas, E. & Bacauskiene, M. (2015). A novel technique to extract accurate cell contours applied to analysis of phytoplankton images. Machine Vision and Applications, 26(2-3), 305-315.

Alonso-Fernandez, F. & Bigun, J. (2015). Near-infrared and visible-light periocular recognition with Gabor features using frequency-adaptive automatic eye detection. IET Biometrics, 4(2), 74-89.

Fan, Y., Nowaczyk, S. & Rögnvaldsson, T. (2015). Evaluation of Self-Organized Approach for Predicting Compressor Faults in a City Bus Fleet. INNS Conference on Big Data, San Francisco, CA, USA, 8-10 August, 2015. Procedia Computer Science, 53, 447-456.

Fan, Y., Nowaczyk, S. & Rögnvaldsson, T. (2015). Incorporating Expert Knowledge into a Self-Organized Approach for Predicting Compressor Faults in a City Bus Fleet. The 13th Scandinavian Conference on Artificial Intelligence (SCAI), Halmstad University, Halmstad, Sweden, 5-6 November, 2015. Frontiers in Artificial Intelligence and Applications, 278, 58-67.

Gelzinis, A., Verikas, A., Vaiciukynas, E., Bacauskiene, M., Šulčius, S., Staniulis, J. & Paškauskas, R. (2015). Automatic detection and morphological delineation of bacteriophages in electron microscopy images. Computers in Biology and Medicine, 64, 101-116.

Krish, R. P., Fierrez, J., Ramos, D., Ortega-Garcia, J. & Bigun, J. (2015). Pre-registration of latent fingerprints based on orientation field. IET Biometrics, 4(2), 42-52.

Prytz, R., Nowaczyk, S., Rögnvaldsson, T. & Byttner, S. (2015). Predicting the need for vehicle compressor repairs using maintenance records and logged vehicle data. Engineering applications of artificial intelligence, 41, 139-150.

Razanskas, P., Verikas, A., Olsson, C. & Wiberg, P.-A. (2015). Time Domain Features of Multi-channel EMG Applied to Prediction of Physiological Parameters in Fatiguing Bicycling Exercises. Frontiers in Artificial Intelligence and Applications, 278, 118-127.

Ražanskas, P., Verikas, A., Olsson, C. & Wiberg, P.-A. (2015). Predicting Blood Lactate Concentration and Oxygen Uptake from sEMG Data during Fatiguing Cycling Exercise. Sensors, 15(8), 20480-20500.

Rögnvaldsson, T., You, L. & Garwicz, D. (2015). State of the art prediction of HIV-1 protease cleavage sites. Bioinformatics, 31(8), 1204-1210.

Uloza, V., Padervinskis, E., Uloziene, I., Saferis, V. & Verikas, A. (2015). Combined Use of Standard and Throat Microphones for Measurement of Acoustic Voice Parameters and Voice Categorization. Journal of Voice, 29(5), 552-559.

Uloza, V., Padervinskis, E., Vegiene, A., Pribuisiene, R., Saferis, V., Vaiciukynas, E., Verikas, A. (2015). Exploring the feasibility of smart phone microphone for measurement of acoustic voice parameters and voice pathology screening. European Archives of Oto-Rhino-Laryngology, 272(11), 3391-3399.

Vaiciukynas, E., Verikas, A., Gelzinis, A., Bacauskiene, M., Minelga, J., Hållander, M., Uloza, V. (2015). Fusing voice and query data for non-invasive detection of laryngeal disorders. Expert systems with applications, 42(22), 8445-8453.

Vaiciukynas, E., Verikas, A., Gelzinis, A., Bacauskiene, M. & Olenina, I. (2015). Exploiting statistical energy test for comparison of multiple groups in morphometric and chemometric data. Chemometrics and Intelligent Laboratory Systems, 146, 10-23.

Verikas, A., Gelzinis, A., Bacauskiene, M., Olenina, I. & Vaiciukynas, E. (2015). An Integrated Approach to Analysis of Phytoplankton Images. IEEE Journal of Oceanic Engineering, 40(2), 315-326.

Verikas, A., Gelzinis, A., Vaiciukynas, E., Bacauskiene, M., Minelga, J., Hållander, M., Padervinskis, E. (2015). Data dependent random forest applied to screening for laryngeal disorders through analysis of sustained phonation: Acoustic versus contact microphone. Medical Engineering and Physics, 37(2), 210-218.

2014

Ourique de Morais, W., Lundström, J. & Wickström, N. (2014). Active In-Database Processing to Support Ambient Assisted Living Systems. Sensors, 14(8), 14765-14785.

Vachkov, G., Byttner, S. & Svensson, M. (2014). Detection of Deviation in Performance of Battery Cells by Data Compression and Similarity Analysis. International Journal of Intelligent Systems, 29(3), 207-222.

Vaiciukynas, E., Verikas, A., Gelzinis, A., Bacauskiene, M., Kons, Z., Satt, A. & Hoory, R. (2014). Fusion of voice signal information for detection of mild laryngeal pathology. Applied Soft Computing, 18 (May 2014), 91-103.

2013

Kalsyte, Z. & Verikas, A. (2013). A novel approach to exploring company's financial soundness: Investor's perspective. Expert systems with applications, 40(13), 5085-5092.

Kalsyte, Z., Verikas, A., Bacauskiene, M. & Gelzinis, A. (2013). A novel approach to designing an adaptive committee applied to predicting company's future performance. Expert systems with applications, 40(6), 2051-2057.

Lundström, J. & Verikas, A. (2013). Assessing print quality by machine in offset colour printing. Knowledge-Based Systems, 37, 70-79.

Lundström, J., Verikas, A., Tullander, E. & Larsson, B. (2013). Assessing, exploring, and monitoring quality of offset colour prints. Measurement, 46(4), 1427-1441.

Sentis, L., Petersen, J. & Philippsen, R. (2013). Implementation and stability analysis of prioritized whole-body compliant controllers on a wheeled humanoid robot in uneven terrains. Autonomous Robots, 35(4), 301-319.

2012

Alonso-Fernandez, F., Fierrez, J. & Ortega-Garcia, J. (2012). Quality Measures in Biometric Systems. IEEE Security and Privacy, 10(6), 52-62.

Bacauskiene, M., Verikas, A., Gelzinis, A. & Vegiene, A. (2012). Random forests based monitoring of human larynx using questionnaire data. Expert systems with applications, 39(5), 5506-5512.

Englund, C. & Verikas, A. (2012). A novel approach to estimate proximity in a random forest: An exploratory study. Expert systems with applications, 39(17), 13046-13050.

Galbally, J., Alonso-Fernandez, F., Fierrez, J. & Ortega-Garcia, J. (2012). A High Performance Fingerprint Liveness Detection Method Based on Quality Related Features. Future generations computer systems, 28(1), 311-321.

Lidström, K., Sjöberg, K., Holmberg, U., Andersson, J., Bergh, F., Bjäde, M. & Mak, S. (2012). A modular CACC system integration and design. IEEE transactions on intelligent transportation systems (Print), 13(3), 1050-1061.

Magnenat, S., Philippsen, R. & Mondada, F. (2012). Autonomous construction using scarce resources in unknown environments: Ingredients for an intelligent robotic interaction with the physical world. Autonomous Robots, 33(4), 476-485.

Stasiunas, A., Verikas, A., Bacauskiene, M. & Miliauskas, R. (2012). An adaptive panoramic filter bank as a qualitative model of the filtering system of the cochlea: The peculiarities in linear and nonlinear mode. Medical Engineering and Physics, 34(2), 187-194.

Vaiciukynas, E., Verikas, A., Gelzinis, A., Bacauskiene, M. & Uloza, V. (2012). Exploring similarity-based classification of larynx disorders from human voice. Speech Communication, 54(5), 601-610.

Verikas, A., Bacauskiene, M., Gelzinis, A., Vaiciukynas, E. & Uloza, V. (2012). Questionnaire- versus voice-based screening for laryngeal disorders. Expert systems with applications, 39(6), 6254-6262.

Verikas, A., Gelzinis, A., Bacauskiene, M., Olenina, I., Olenin, S. & Vaiciukynas, E. (2012). Automated image analysis- and soft computing-based detection of the invasive dinoflagellate Prorocentrum minimum (Pavillard) Schiller. Expert systems with applications, 39(5), 6069-6077.

Verikas, A., Gelzinis, A., Bacauskiene, M., Olenina, I., Olenin, S. & Vaiciukynas, E. (2012). Phase congruency-based detection of circular objects applied to analysis of phytoplankton images. Pattern Recognition, 45(4), 1659-1670.

CONFERENCES WITH FULL-PAPER REVIEW

2020

Aksoy, E., Baci, S., & Cavdar, S. (2020). SalsaNet : Fast Road and Vehicle Segmentationin LiDAR Point Clouds for Autonomous Driving. In IEEE Intelligent Vehicles Symposium : IV2020.

Alonso-Fernandez, F., Hernandez-Diaz, K., Ramis, S., Perales, F. J., & Bigun, J. (2020). Soft-Biometrics Estimation In the Era of Facial Masks. In 2020 International Conference of the Biometrics Special Interest Group (BIOSIG) (pp. 1–6).

Alonso-Fernandez, F., Barrachina, J., Hernandez-Diaz, K., & Bigun, J. (2020). SqueezeFacePoseNet: Lightweight Face Verification Across Different Poses for Mobile Platforms. IAPR TC4 Workshop on Mobile and Wearable Biometrics, WMWB, in conjunction with Intl Conf on Pattern Recognition, ICPR, 2020.

Aramrattana, M., Larsson, T., Englund, C., Jansson, J., and Nåbo, A., (2020) A Novel Risk Indicator for Cut-In Situations, The IEEE 23rd International Conference on Intelligent Transportation Systems (ITSC), Rhodes, Greece, 2020.

Belvisi, N. M. S., Muhammad, N., & Alonso-Fernandez, F. (2020). Forensic Authorship Analysis of Microblogging Texts Using N -Grams and Stylometric Features. In 2020 8th International Workshop on Biometrics and Forensics (IWBF).

Cheng, L., Sundaresh, S., Bouguelia, M.-R., & Dikmen, O. (2020). Interactive Anomaly Detection Based on Clustering and Online Mirror Descent. IoTStream Workshop at ECML-PKDD, Ghent-Belgium, September 14 –18, 2020.

Dahl, O., Johansson, F., Khoshkangini, R., Pashami, S., Nowaczyk, S., & Pihl, C. (2020). Understanding Association Between Logged Vehicle Data and Vehicle Marketing Parameters : Using Clustering and Rule-Based Machine Learning. In Proceedings of the 2020 3rd International Conference on Information Management and Management Science, IMMS 2020 (pp. 13–22).

Delooz Q, Riebl R, Festag A, Vinel A. (2020) Design and Performance of Congestion-Aware Collective Perception. In: 2020 IEEE Vehicular Networking Conference (VNC)

Duracz, A., Aljarbouh, A., Bartha, F. A., Masood, J., Philippsen, R., Eriksson, H., … Grante, C. (2020). Advanced Hazard Analysis and Risk Assessment in the ISO 26262 Functional Safety Standard Using Rigorous Simulation. In Cyber Physical Systems. Model-Based Design : 9th International Workshop, CyPhy 2019, and 15th International Workshop, WESE 2019, New York City, NY, USA, October 17-18, 2019, Revised Selected Papers (Vol. 11971 LNCS, pp. 108–126).

Englund, C. (2020). Aware and intelligent infrastructure for action intention recognition of cars and bicycles. 6th International Conference on Vehicle Technology and Intelligent Transport Systems - Volume 1 : VEHITS (pp. 281–288).

Fanaee Tork, H., & Thoresen, M. (2020). Iterative Multi-mode Discretization : Applications to Co-clustering (Vol. 12323, pp. 94–105). The 23rd International Conference on Discovery Science 2020, 19-21 October, Thessaloniki, Greece.

Fanaee Tork, H., Bouguelia, M.-R., Rahat, M., Blixt, J., & Singh, H. (2020). CycleFootprint : A Fully Automated Method for Extracting Operation Cycles from Historical Raw Data of Multiple Sensors. In IoT Streams for Data-Driven Predictive Maintenance and IoT, Edge, and Mobile for Embedded Machine Learning (pp. 30–44).

Hernandez-Diaz, K., Alonso-Fernandez, F., Bigun, J. (2020) Cross-Spectral Periocular Recognition with Conditional Adversarial Networks, 2020 IEEE International Joint Conference on Biometrics (IJCB)

Kharazian, Z., Rahat, M., Fatemizadeh, E., & Nasrabadi, A. M. (2020). Increasing safety at smart elderly homes by Human fall detection from video using transfer Learning approaches. In e-proceedings of the 30th European Safety and Reliability Conference and 15th Probabilistic Safety Assessment and Management Conference (ESREL2020 PSAM15).

Nilsson, F., Jakobsen, J., & Alonso-Fernandez, F. (2020). Detection and Classification of Industrial SignalLights for Factory Floors.The 2020 International Conference on Intelligent Systems and Computer Vision (ISCV), Fez, Morocco, June 9-11, 2020.

Rahat, M., Pashami, S., Nowaczyk, S., & Kharazian, Z. (2020). Modeling turbocharger failures using Markov process for predictive maintenance. 30th European Safety and Reliability Conference and 15th Probabilistic Safety Assessment and Management Conference (ESREL2020 PSAM15).

Revanur, V., Ayibiowu, A., Rahat, M., & Khoshkangini, R. (2020). Embeddings Based Parallel Stacked Autoencoder Approach for Dimensionality Reduction and Predictive Maintenance of Vehicles. In IoT Streams for Data-Driven Predictive Maintenance and IoT, Edge, and Mobile for Embedded Machine Learning (pp. 127–141).

Soliman, A., Girdzijauskas, S., Bouguelia, M.-R., Pashami, S., & Nowaczyk, S. (2020). Decentralized and Adaptive K-Means Clustering for Non-IID Data using HyperLogLog Counters. In Advances in Knowledge Discovery and Data Mining : 24th Pacific-Asia Conference, PAKDD 2020, Singapore, May 11–14, 2020, Proceedings, Part I (Vol. 12084, pp. 343–355).

Tkauc, N., Tran, T., Hernandez-Diaz, K., & Alonso-Fernandez, F. (2020). Cloud-Based Face and Speech Recognition for Access Control Applications. 6th International Workshop on Security and Privacy in the Cloud (SPC 2020), in conjunction with the eight IEEE Conference on Communications and Network Security (CNS 2020), Avignon, France, June 29-30, 2020.

2019

Alonso-Fernandez, F., Bigun, J., & Englund, C. (2018, November). Expression Recognition Using the Periocular Region: A Feasibility Study. 2018 14th International Conference on Signal-Image Technology & Internet-Based Systems (SITIS) (pp. 536-541).

Ashfaq, A., & Nowaczyk, S. (2019). Machine learning in healthcare--a system's perspective. Proceedings of the ACM SIGKDD Workshop on Epidemiology meets Data Mining and Knowledge Discovery (epiDAMIK), 2019, p. 14-17

Bocharova, I., Kudryashov, B., Rabi, M., Lyamin, N., Dankers, W., Frick, E., & Vinel, A. (2019, July). Modeling packet losses in communication networks. In 2019 IEEE International Symposium on Information Theory (ISIT) (pp. 1012-1016).

Calikus, E., Fan, Y., Nowaczyk, S., & Sant'Anna, A. (2019, February). Interactive-COSM;O: Consensus self-organized models for fault detection with expert feedback. Proceedings of the Workshop on Interactive Data Mining (pp. 1-9).

Chen, K., Pashami, S., Fan, Y., & Nowaczyk, S. (2019, September). Predicting air compressor failures using long short term memory networks. EPIA Conference on Artificial Intelligence (pp. 596-609).

David, J., Mostowski, W., Aramrattna, M., Fan, Y., Varshosaz, M., Karlsson, P., ... & Andersson, E. (2019). Design and Development of a Hexacopter for the Search and Rescue of a Lost Drone. IROS 2019-Workshop on Challenges in Vision-based Drones Navigation, Macau, China, November 8, 2019.

Galozy, A., Nowaczyk, S., & Sant'Anna, A. (2019). Towards Understanding ICU Treatments Using Patient Health Trajectories. Artificial Intelligence in Medicine: Knowledge Representation and Transparent and Explainable Systems(pp. 67-81).

Heikkilä, M., Jälkö, J., Dikmen, O., & Honkela, A. (2019). Differentially Private Markov Chain Monte Carlo. Advances in Neural Information Processing Systems (pp. 4115-4125).

Hernandez-Diaz, K., Alonso-Fernandez, F., & Bigun, J. (2019). Cross spectral periocular matching using resnet features. 12th IAPR International Conference on Biometrics, Crete, Greece, June 4-7, 2019.

Holst, A., Bouguelia, M. R., Görnerup, O., Pashami, S., Al-Shishtawy, A., Falkman, G., ... & Nowaczyk, S. (2019). Eliciting structure in data. In 2019 Joint ACM IUI Workshops, ACMIUI-WS 2019, 20 March 2019 (Vol. 2327). CEUR-WS.

Holst, A., Bae, J., Karlsson, A., & Bouguelia, M. R. (2019). Interactive clustering for exploring multiple data streams at different time scales and granularity. Proceedings of the Workshop on Interactive Data Mining (pp. 1-7).

Holst, A., Pashami, S., & Bae, J. (2019, February). Incremental causal discovery and visualization. In Proceedings of the Workshop on Interactive Data Mining (pp. 1-6).

Khoshkangini, R., Pashami, S., & Nowaczyk, S. (2019). Warranty Claim Rate Prediction Using Logged Vehicle Data. EPIA Conference on Artificial Intelligence (pp. 663-674).

Khoshkangini, R., Pini, M. S., & Rossi, F. (2019). Constructing CP-Nets from Users Past Selection. In Australasian Joint Conference on Artificial Intelligence (pp. 130-142).

Najmeh, A., & Ohlsson, M. (2019). Variational auto-encoders with Student's t-prior. 27th European Symposium on Artificial Neural Networks, Computational Intelligence and Machine Learning (ESANN 2019), Bruges, Belgium, April 24-26, 2019 (pp. 415-420).

Pirasteh, P., Nowaczyk, S., Pashami, S., Löwenadler, M., Thunberg, K., Ydreskog, H., & Berck, P. (2019, February). Interactive feature extraction for diagnostic trouble codes in predictive maintenance: A case study from automotive domain. Workshop on Interactive Data Mining (pp. 1-10).

Ribeiro, E., Uhl, A., & Alonso-Fernandez, F. (2019). Super-Resolution and Image Re-projection for Iris Recognition. In 2019 IEEE 5th International Conference on Identity, Security, and Behavior Analysis (ISBA) (pp. 1-7).

Said, A., Parra, D., Bae, J., & Pashami, S. (2019). IDM-WSDM 2019: Workshop on Interactive Data Mining. In Proceedings of the Twelfth ACM International Conference on Web Search and Data Mining (pp. 846-847).

Englund, C., Torstensson, M., & Duran, B. (2019). Using Recurrent Neural Networks for Action and Intention Recognition of Car Drivers. 8th International Conference on Pattern Recognition Applications and Methods (pp. 232-242).

Cooney, M., Ong, L., Pashami, S., Järpe, E., & Ashfaq, A. (2019). Avoiding improper treatment of dementia patients by care robots. In The Dark Side of Human-Robot Interaction: Ethical Considerations and Community Guidelines for the Field of HRI. HRI Workshop, Daegu, South Korea, March 11, 2019.

2018

Aramrattana, M., Patel, R., Englund, C., Härri, J., Jansson, J., Bonnet, C. (2018), Evaluating Model Mismatch Impacting CACC Controllers in Mixed Traffic using a Driving Simulator. Intelligent Vehicles.

Henriksson, J., Borg, M., Englund, C. (2018), Automotive safety and machine learning: Initial results from a study on how to adapt the ISO 26262 safety standard. In: SEFAIAS.

Holst, A., Pashami, S., Bae, J., and Nowaczyk, S. (2018). An Invariant Bayesian Conditional Independent Test for more Sensitive Causal Discovery, Causal-ML Workshop at IJCAI2018, Stockholm, Sweden, July 15, 2018.

Pashami, S., Holst, A., Bae, J., and Nowaczyk, S. (2018). Causal discovery using clusters from observational data, Causal-ML Workshop at IJCAI 2018, Stockholm, Sweden, July 15, 2018.

Varytimidis, D., Alonso-Fernandez, F., Englund, C., & Duran, B. (2018). Action and intention recognition of pedestrians in urban traffic. 2018 14th International Conference on Signal-Image Technology & Internet-Based Systems (SITIS).

Menezes, M. L. R., Pinheiro Sant'Anna, A., Pavel, M., Jimison, H., & Alonso-Fernandez, F. (2018). Affective Ambient Intelligence: from Domotics to Ambient Intelligence. In A2IC 2018: Artificial Intelligence International Conference: Book of Abstract (pp. 25–25).

Alonso-Fernandez, F., Bigun, J., & Englund, C. (2018). Expression Recognition Using the Periocular Region: A Feasibility Study. The 14th International Conference on Signal Image Technology & Internet Based Systems, SITIS 2018, Las Palmas de Gran Canaria, Spain, 26-29 November, 2018.

Femling, F., Olsson, A., & Alonso-Fernandez, F. (2018). Fruit and Vegetable Identification Using Machine Learning for Retail Application. 14th International Conference on Signal Image Technology & Internet based Systems, Las Palmas de Gran Canaria, Spain, 26-29 November, 2018.

Menezes, M. L. R., Pinheiro Sant'Anna, A., & Alonso-Fernandez, F. (2018). Methodology for Subject Authentification and Identification through EEG signal: equipment's and positioning artifacts. A2IC 2018: Artificial Intelligence International Conference: Book of Abstract (pp. 37–37).

Nowaczyk, S., Pinheiro Sant'Anna, A., Calikus, E., & Fan, Y. (2018). Monitoring equipment operation through model and event discovery. Intelligent Data Engineering and Automated Learning – IDEAL 2018: 19th International Conference, Madrid, Spain, November 21–23, 2018, Proceedings, Part II (Vol. 11315, pp. 41–53).

Vaiciukynas, E., Gelzinis, A., Verikas, A., & Bacauskiene, M. (2018). Parkinson's Disease Detection from Speech Using Convolutional Neural Networks. Smart objects and technologies for social good: Third International Conference, GOODTECHS 2017, Pisa, Italy, November 29-30, 2017, Proceedings (Vol. 233, pp. 206–215).

Hernandez-Diaz, K., Alonso-Fernandez, F., & Bigun, J. (2018). Periocular Recognition Using CNN Features Off-the-Shelf. The International Conference of the Biometrics Special Interest Group (BIOSIG), Darmstadt, Germany, Sept. 26-29, 2018.

Cooney, M., Pashami, S., Pinheiro Sant'Anna, A., Fan, Y., & Nowaczyk, S. (2018). Pitfalls of Affective Computing: How can the automatic visual communication of emotions lead to harm, and what can be done to mitigate such risks? In WWW '18 Companion Proceedings of the The Web Conference 2018 (pp. 1563–1566).

Ali Hamad, R., Järpe, E., & Lundström, J. (2018). Stability analysis of the t-SNE algorithm for human activity pattern data. The 2018 IEEE International Conference on Systems, Man, and Cybernetics (SMC2018), Miyazaki, Japan, Oct. 7-10, 2018.

Cooney, M., Yang, C., Arunesh, S., Padi Siva, A., & David, J. (2018). Teaching Robotics with Robot Operating System (ROS): A Behavior Model Perspective. The Workshop on 'Teaching Robotics with ROS', European Robotics Forum 2018, Tampere, Finland, March 15, 2018.

2017

Alonso-Fernandez, F., Farrugia, R. A. & Bigun, J. (2017). Improving Very Low-Resolution Iris Identification Via Super-Resolution Reconstruction of Local Patches. 2017 International Conference of the Biometrics Special Interest Group (BIOSIG) (Vol. P-270).

Alonso-Fernandez, F., Farrugia, R. A. & Bigun, J. (2017). Iris Super-Resolution Using Iterative Neighbor Embedding. 2017 IEEE Conference on Computer Vision and Pattern Recognition Workshops (pp. 655–663).

Alonso-Fernandez, F., Farrugia, R. & Bigun, J. (2017). Learning-Based Local-Patch Resolution Reconstruction of Iris Smartphone Images. IEEE/IAPR International Joint Conference on Biometrics, IJCB, Denver, Colorado, USA, October 1-4, 2017.

Alonso-Fernandez, F., Raja, K. B., Busch, C. & Bigun, J. (2017). Matcher Fusion for Improved Cross-Sensor Smartphone Periocular Recognition. 2017 25th European Signal Processing Conference (EUSIPCO 2017), Kos Island, Greece, August 28 - 2 September, 2017.

Aramrattana, M., Larsson, T., Englund, C., Jansson, J. & Nåbo, A. (2017). Simulation of Cut-In by Manually Driven Vehicles in Platooning Scenarios. 2017 IEEE 20th International Conference on Intelligent Transportation Systems (ITSC) (pp. 315–320).

Ashfaq, A. & Adler, J. (2017). A modified fuzzy C means algorithm for shading correction in craniofacial CBCT images. CMBEBIH 2017 : Proceedings of the International Conference on Medical and Biological Engineering 2017 (Vol. 62, pp. 531–538).

Bellone, M. & Qutteineh, J. (2017). Extension of Trajectory Planning in Parameterized Spaces to Articulated Vehicles. In 2017 22nd IEEE International Conference on Emerging Technologies and Factory Automation.

Bentes, J., Khandelwal, S., Carlsson, H., Kärrman, M., Svensson, T. & Wickström, N. (2017). Novel System Architecture for Online Gait Analysis. 39th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), Jeju Island, South Korea, July 11-15, 2017.

Bouguelia, M.-R., Pashami, S. & Nowaczyk, S. (2017). Multi-task Representation Learning. 30th Annual Workshop of the Swedish Artificial Intelligence Society SAIS. pp. 53-59.

Carpatorea, I., Nowaczyk, S., Rögnvaldsson, T. & Lodin, J. (2017). Features extracted from APPES to enable the categorization of heavy-duty vehicle drivers. Intelligent Systems Conference (IntelliSys 2017), London, United Kingdom, 7-8 September, 2017.

Chen, L. & Englund, C. (2017). Choreographing services for smart cities : smart traffic demonstration. Vehicular Technology Conference (VTC Spring), 2017 IEEE 85th. Sydney, Australia.

Cooney, M. & Bigun, J. (2017). PastVision: Exploring 'Seeing' into the Near Past with Thermal Touch Sensing and Object Detection – For Robot Monitoring of Medicine Intake by Dementia Patients (pp. 30–38). 30th Annual Workshop of the Swedish Artificial Intelligence Society SAIS 2017, May 15–16, 2017, Karlskrona, Sweden.

David, J. Valencia, R., Philippsen, R., & Iagnemma, K. (2017). Local Path Optimizer for an Autonomous Truck in a Harbour Scenario. 11th Conference on Field and Service Robotics (FSR), Zürich, Switzerland, 12-15 September, 2017.

David, J., Valencia, R., Philippsen, R. & Iagnemma, K. (2017). Trajectory Optimizer for an Autonomous Truck in Container Terminal. ICRA 2017 Workshop on Robotics and Vehicular Technologies for Self-driving cars.

David, J., Valencia, R., Philippsen, R., Bosshard, P. & Iagnemma, K. (2017). Gradient Based Path Optimization Method for Autonomous Driving. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Vancouver CB, Canada, Sept. 24-28, 2017.

Durán, B., Englund, C., Habobovic, A. & Andersson, J. (2017). Modeling vehicle behavior with neural dynamics. Future Active Safety Technology - Towards zero traffic accidents. Nara, Japan.

Englund, C., Didoff, J. & Wahlström, B. (2017). A new method for ground vehicle access control and situation awareness : experiences from a real-life implementation at an airport. 24th World Congress on Intelligent Transportation Systems (ITS WC 2017), 29 October - 2 November, 2017, Montréal, Canada.

Habibovic, A., Andersson, J., Malmsten-Lundgren, V., Klingegård, M. & Englund, C. (2017). External vehicle interfaces for communication with other road users. Automated Vehicle Symposium.

Magnusson, M., Kucner, T. P., Gholami Shahbandi, S., H Andreasson, H. & Lilienthal, A. J. (2017) Semi-Supervised 3D Place Categorisation by Descriptor Clustering. 2017 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2017), Vancouver, Canada, 2017.

Ribeiro, E., Uhl, A., Alonso-Fernandez, F. & Farrugia, R. A. (2017). Exploring Deep Learning Image Super-Resolution for Iris Recognition. 2017 25th European Signal Processing Conference (EUSIPCO 2017) (pp. 2240–2244).

Sequeira, A. F., Chen, L., Ferryman, J., Wild, P., Alonso-Fernandez, F., Bigun, J., Raja, K. B., Raghavendra, R., Busch, C., Freitas Pereira, T., Marcel, S., Sangeeta Behera, S., Gour, M. & Kanhangad, V. (2017). Cross-Eyed 2017 : Cross-Spectral Iris/Periocular Recognition Database and Competition. IEEE/IAPR International Joint Conference on Biometrics, IJCB, Denver, Colorado, USA, October 1-4, 2017.

Svensson, O., Thelin, S., Byttner, S. & Fan, Y. (2017). Indirect Tire Monitoring System - Machine Learning Approach. In IOP Conference Series: Materials Science and Engineering (Vol. 252).

Vaiciukynas, E., Ulicny, M., Pashami, S. & Nowaczyk, S. (2017). Low-dimensional Multi-task Representation of Bivariate Histogram Data from Truck On-board Sensors. KnowME workshop, ECML/PKDD, 2017.

Vaske, C., Weckstén, M. & Järpe, E. (2017). Velody - a novel method for music steganography, 3rd International Conference on Frontiers of Signal Processing (ICFSP 2017), September 6-8, 2017, Paris, France.

2016

Taha W, Hedstrom LG, Xu F, Duracz A, Bartha FA, Zeng Y, David J, Gunjan G. (2016) Flipping a first course on cyber-physical systems: an experience report. Proceedings of the 2016 Workshop on Embedded and Cyber-Physical Systems Education, Oct 1 (p. 8).

Alonso-Fernandez, F., Farrugia, R. & Bigun, J. (2016). Very Low-Resolution Iris Recognition Via Eigen-Patch Super-Resolution and Matcher Fusion. 2016 IEEE 8th International Conference on Biometrics Theory, Applications and Systems (BTAS).

Alonso-Fernandez, F., Mikaelyan, A. & Bigun, J. (2016). Compact Multi-scale Periocular Recognition Using SAFE Feature. 23rd International Conference on Pattern Recognition, ICPR, Cancún, Mexico, 4-8 December, 2016.

Carpatorea, I., Nowaczyk, S., Rögnvaldsson, T., Elmer, M. & Lodin, J. (2016). Learning of aggregate features for comparing drivers based on naturalistic data. 2016 IEEE 14th International Conference on Machine Learning and Applications, ICMLA 2016.

David, J., Valencia, R. & Iagnemma, K. (2016). Task Assignment and Trajectory Planning in Dynamic environments for Multiple Vehicles. RSS 2016 Workshop on Task and Motion Planning, Ann Arbor, Michigan, USA, June 19, 2016.

Fan, Y., Nowaczyk, S., Rögnvaldsson, T. & Antonelo, E. A. (2016). Predicting Air Compressor Failures with Echo State Networks. PHME 2016: Third European Conference of the Prognostics and Health Management Society 2016.

Gangwar, A., Joshi, A., Singh, A., Alonso-Fernandez, F. & Bigun, J. (2016). IrisSeg: A Fast and Robust Iris Segmentation Framework for Non-Ideal Iris Images. 9th IAPR International Conference on Biometrics, Halmstad, Sweden, June 13-16, 2016.

Gonzalez, R., Byttner, S. & Iagnemma, K. (2016). Comparison of Machine Learning Approaches for Soil Embedding Detection of Planetary Exploration Rovers. 8th ISTVS Americas Conference, Detroit, September 12-14, 2016.

Helldin, T., Riveiro, M., Pashami, S., Falkman, G., Byttner, S. & Nowaczyk, S. (2016). Supporting Analytical Reasoning: A Study from the Automotive Industry. Human Interface and the Management of Information: Applications and Services: 18th International Conference, HCI International 2016: Toronto, Canada, July 17-22, 2016.

Lundström, J., De Morais, W., Menezes, M., Anita Sant'Anna, A., Bentes, J., Synnott, J., Nugent, C., & Gabrielli, C. (2016) Halmstad Intelligent Home - Capabilities and Opportunities. In: The 3rd EAI International Conference on IoT Technologies for HealthCare, October 18-19, 2016, Västerås, Sweden. Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering, 187, pp 9-15.

Mair, J., Cleland, I., Nugent, C., Rafferty, J. & Sant'Anna, A. (2016) Sensorized Workplaces for Monitoring Sedentary Behavior. 38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, August 17-20, 2016, Walt Disney World Resort, Orlando, FL, USA, 2016, 1-6.

Mashad Nemati, H., Gholami Shahbandi, S. & Åstrand, B. (2016). Human Tracking in Occlusion based on Reappearance Event Estimation. ICINCO 2016: 13th International Conference on Informatics in Control, Automation and Robotics: Proceedings, Volume 2.

Mashad Nemati, H., Sant´Anna, A. & Nowaczyk, S. (2016). Bayesian Network Representation of Meaningful Patterns in Electricity Distribution Grids. 2016 IEEE International Energy Conference (ENERGYCON), 4-8 April, Leuven, Belgium, 2016.

Nugent, C., Synnott, J., Gabrielli, C., Zhang, S., Espinilla, M., Calzada, A., Lundstrom, J., Cleland, I., Synnes, K., Hallberg, J., Spinsante, S., & Ortíz, M. A. (2016) Improving the quality of user generated data sets for activity recognition In: 10th International Conference on Ubiquitous Computing and Ambient Intelligence UCAmI 2016, (IWAAL & AmIHEALTH included), Canary Islands, (Spain). November, 29 - December 2, 2016. Lecture Notes in Computer Science, Volume 10070, 104-110.

Sequeira, A. F., Chen, L., Wild, P., Ferryman, J., Alonso-Fernandez, F., Bigun, J., Busch, C. (2016). Cross-Eyed: Cross-Spectral Iris/Periocular Recognition Database and Competition. 15th International Conference of the Biometrics Special Interest Group, BIOSIG, Darmstadt, Germany, 21-23 September, 2016.

Synnott, J., Nugent, C. D., Zhang, S., Calzada, A., Cleland, I., Espinilla, M., Javier, M. & Lundström, J. (2016) Environment Simulation for the Promotion of the Open Data Initiative. 2016 IEEE International Conference on Smart Computing, May 18-20, St. Louis, Missouri, USA, 2016, 1-6.

Teng, X., Fan, Y. & Nowaczyk, S. (2016). Evaluation of Micro-flaws in Metallic Material Based on A Self-Organized Data-driven Approach. 2016 IEEE International Conference on Prognostics and Health Management, Carleton University, Ottawa, ON, Canada, June 20-22, 2016.

Uličný, M., Lundström, J. & Byttner, S. (2016). Robustness of Deep Convolutional Neural Networks for Image Recognition. First International Symposium, ISICS 2016, Mérida, México, March 16-18 2016 (pp. 16-30).

Yu, T., Edén, J., Englund, C. & Larsson, T. (2016). Traffic Situation Estimator for Adaptive Cruise Control. 17th WoWMoM 2016, International Symposium on a World of Wireless, Mobile and Multimedia Networks, Coimbra, Portugal, 21-24 June, 2016.

2015

Alonso-Fernandez, F., Farrugia, R. A. & Bigun, J. (2015). Eigen-Patch Iris Super-Resolution For Iris Recognition Improvement. 23rd European Signal Processing Conference, EUSIPCO, Nice, France, 31 August–4 September, 2015 (pp. 76-80).

Alonso-Fernandez, F., Farrugia, R. A. & Bigun, J. (2015). Reconstruction of Smartphone Images for Low Resolution Iris Recognition. 7th IEEE International Workshop on Information Forensics and Security, WIFS, Rome, Italy, 16-19 November, 2015.

Wonneberger, S., Mühlfellner, P., Ceriotti, P., Graf, T., Ernst, R. (2015). Parallel feature extraction and heterogeneous object-detection for multi-camera driver assistance systems. 25th International Conference on Field Programmable Logic and Applications (FPL 2015).

Alonso-Fernandez, F., Mikaelyan, A. & Bigun, J. (2015). Comparison and Fusion of Multiple Iris and Periocular Matchers Using Near-Infrared and Visible Images. 3rd International Workshop on Biometrics and Forensics, IWBF 2015, Gjøvik, Norway, 3-4 March, 2015.

Aramrattana, M., Larsson, T., Jansson, J. & Englund, C. (2015). Dimensions of Cooperative Driving, ITS and Automation. 2015 IEEE Intelligent Vehicles Symposium, Seoul, South Korea, June 28 - July 1, 2015 (pp. 144-149).

Cooney, M. & Karlsson, S. M. (2015). Impressions of Size-Changing in a Companion Robot. 2nd International Conference on Physiological Computing Systems, PhyCS 2015, ESEO, Angers, Loire Valley, France, 11-13 February, (pp. 118-123).

Gholami Shahbandi, S., Åstrand, B. & Philippsen, R. (2015). Semi-Supervised Semantic Labeling of Adaptive Cell Decomposition Maps in Well-Structured Environments. 7th European Conference on Mobile Robots 2015, Lincoln, United Kingdom, 2-4 September, 2015.

Gottschlich, C., Mikaelyan, A., Olsen, M. A., Bigun, J. & Busch, C. (2015). Improving Fingerprint Alteration Detection. 9th International Symposium on Image and Signal Processing and Analysis, Zagreb, Croatia, September 7-9, 2015 (pp. 83-86).

Lundström, J., Ourique de Morais, W. & Cooney, M. (2015). A Holistic Smart Home Demonstrator for Anomaly Detection and Response. SmartE: Closing the Loop – The 2nd IEEE PerCom Workshop on Smart Environments, St. Louis, Missouri, USA, March 23-27, 2015 (pp. 330-335).

Lundström, J., Synnott, J., Järpe, E. & Nugent, C. (2015). Smart Home Simulation using Avatar Control and Probabilistic Sampling. SmartE: Closing the Loop – The 2nd IEEE PerCom Workshop on Smart Environments, St. Louis, Missouri, USA, March 23-27, 2015 (pp. 336-341).

Mashad Nemati, H., Sant'Anna, A. & Nowaczyk, S. (2015). Reliability Evaluation of Underground Power Cables with Probabilistic Models. The 11th International Conference on Data Mining (DMIN'15), Las Vegas, Nevada, USA, July 27-30, 2015 (pp. 37-43).

Ranftl, A., Alonso-Fernandez, F. & Karlsson, S. (2015). Face Tracking Using Optical Flow: Development of a Real-Time AdaBoost Cascade Face Tracker. 14th International Conference of the Biometrics Special Interest Group, BIOSIG, Darmstadt, Germany, 9-11 September, 2015.

Vaiciukynas, E., Verikas, A., Gelzinis, A., Bacauskiene, M., Minelga, J., Hållander, M., Uloza, V. (2015). Towards Voice and Query Data-based Non-invasive Screening for Laryngeal Disorders. 14th International Conference on Artificial Intelligence, Knowledge Engineering and Data Bases (AIKED '15): Tenerife, Canary Islands, Spain, January 10 -12, 2015, (pp. 32- 39).

Weman Josefsson, K., Ebbesson, E., Halila, F., Johnson, U., Lund, J., Wickström, N. & Wärnestål, P. (2015). Application of self-determination theory in the e-health industry – promoting sustainable exercise motivation. 14th European Congress of Sport Psychology, FEPSAC 2015, Bern, Switzerland, July 14-19th, 2015 (pp. 372-372).

Weman Josefsson, K., Halila, F., Johnson, U., Wickström, N. & Wärnestål, P. (2015). Digital interventions in self-determined exercise motivation – interdisciplinary innovations. ISBNPA 2015 - Conference for International Society for Behavioral Nutrition and Physical Activity, Advancing Behavior Change Science, 3rd - 6th June, 2015, Edinburgh, Scotland (pp. 592-592).

Weman-Josefsson, K. A., Halila, F., Johnson, U., Wickström, N. & Wärnestål, P. (2015). Digital Innovations and Self-determined exercise motivation: an interdisciplinary approach. The 6th International Multi-Conference on Complexity, Informatics and Cybernetics: IMCIC 2015, Orlando, Florida, United States, March 10-13, 2015.

2014

Alonso-Fernandez, F. & Bigun, J. (2014). Exploting Periocular and RGB Information in Fake Iris Detection. 2014 International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO): 26 – 30 May 2014 Opatija, Croatia.

Alonso-Fernandez, F. & Bigun, J. (2014). Eye Detection by Complex Filtering for Periocular Recognition. 2nd International Workshop on Biometrics and Forensics (IWBF2014): Valletta, Malta (27-28th March 2014).

Alonso-Fernandez, F. & Bigun, J. (2014). Fake Iris Detection: A Comparison Between Near-Infrared and Visible Images. In: Workshop on Insight on Eye Biometrics, IEB, in conjunction with the International Conference on Signal Image Technology & Internet Based Systems, SITIS, Marrakech, Morocco, 23-27 November, 2014.

Alonso-Fernandez, F. & Bigun, J. (2014). Best Regions for Periocular Recognition with NIR and Visible Images. In: 2014 IEEE International Conference on Image Processing (ICIP): IEEE International Conference on Image Processing, ICIP, Paris, France, 27-30 October, 2014 (pp. 4987-4991).

Carpatorea, I., Nowaczyk, S., Rögnvaldsson, T. & Elmer, M. (2014). APPES Maps as Tools for Quantifying Performance of Truck Drivers. The 10th International Conference on Data Mining, DMIN'14, July 21-24, Las Vegas, Nevada, USA (pp. 10-16).

Fan, Y., Nowaczyk, S. & Rögnvaldsson, T. (2014). Using Histograms to Find Compressor Deviations in Bus Fleet Data. The Swedish AI Society (SAIS) Workshop 2014, Stockholm, Sweden, May 22-23, 2014.

Gelzinis, A., Verikas, A., Vaiciukynas, E., Bacauskiene, M., Minelga, J., Hållander, M., Padervinskis, E. (2014). Exploring sustained phonation recorded with acoustic and contact microphones to screen for laryngeal disorders. CICARE 2014 – 2014 IEEE Symposium on Computational Intelligence in Healthcare and e-health, Orlando, Florida, USA, December 9-12, 2014 (pp. 125-132).

Gholami Shahbandi, S. & Åstrand, B. (2014). Modeling of a Large Structured Environment: With a Repetitive Canonical Geometric-Semantic Model. Advances in Autonomous Robotics Systems: 15th Annual Conference, TAROS 2014, Birmingham, UK, September 1-3, 2014.

Gholami Shahbandi, S., Åstrand, B. & Philippsen, R. (2014). Sensor Based Adaptive Metric-Topological Cell Decomposition Method for Semantic Annotation of Structured Environments. 13th International Conference on Control, Automation, Robotics and Vision, ICARCV 2014, Marina Bay Sands, Singapore, December 10-12, 2014.

Hofbauer, H., Alonso-Fernandez, F., Wild, P., Bigun, J. & Uhl, A. (2014). A Ground Truth for Iris Segmentation. 22nd International Conference on Pattern Recognition, ICPR, Stockholm, Sweden, August 24-28, 2014 (pp. 527-532).

Carpatorea, I., Nowaczyk, S., Rögnvaldsson, T. & Elmer, M. (2014). Towards Data Driven Method for Quantifying Performance of Truck Drivers. 28th Annual workshop of the Swedish Artificial Intelligence Society (SAIS), Stockholm, Sweden, May 22-23, 2014.

Khandelwal, S. & Wickström, N. (2014). Identification of Gait Events using Expert Knowledge and Continuous Wavelet Transform Analysis. 7th International Conference on Bio-inspired Systems and Signal Processing (BIOSIGNALS 2014), Angers, France, March 3-6, 2014 (pp. 197-204).

Khandelwal, S. & Wickström, N. (2014). Detecting Gait Events from Outdoor Accelerometer Data for Long-term and Continuous Monitoring Applications. 13th International Symposium on 3D Analysis of Human Movement (3D-AHM 2014), 14–17 July, 2014, Lausanne, Switzerland (pp. 151-154).

Krish, R. P., Fierrez, J., Ramos, D., Ortega-Garcia, J. & Bigun, J. (2014). Partial Fingerprint Registration for Forensics using Minutiae-generated Orientation Fields. IWBF 2014 – 2nd International Workshop on Biometrics and Forensics 2014, Valletta, Malta, 27-28th March, 2014.

Krish, R. P., Fierrez, J., Ramos, D., Ortega-Garcia, J. & Bigun, J. (2014). Pre-registration for Improved Latent Fingerprint Identification. 22nd International Conference on Pattern Recognition, Stockholm, Sweden, August 24-28, 2014 (pp. 696-701).

Mashad Nemati, H., Sant'Anna, A. & Nowaczyk, S. (2014). Overview of Smart Grid Challenges in Sweden. 28th annual workshop of the Swedish Artificial Intelligence Society (SAIS), Stockholm, Sweden, May 22-23, 2014. .

Masood, J., Philippsen, R., Duracz, J., Taha, W., Eriksson, H. & Grante, C. (2014). Domain Analysis for Standardised Functional Safety: A Case Study on Design-Time Verification of Automatic Emergency Breaking. International Federation of Automotive Engineering Societies 2014 World Automotive Congress, Maastricht, The Netherlands, 2-6 June, 2014.

Mikaelyan, A., Alonso-Fernandez, F. & Bigun, J. (2014). Periocular Recognition by Detection of Local Symmetry Patterns. Workshop on Insight on Eye Biometrics (IEB) in conjunction with The 10th International Conference on Signal Image Technology & Internet Based Systems (SITIS), Marrakech, Morocco, 23-27 November, 2014.

Mikaelyan, A. & Bigun, J. (2014). Symmetry Assessment by Finite Expansion: application to forensic fingerprints. 2014 International Conference of the Biometrics Special Interest Group (BIOSIG), Darmstadt, Germany, 10-12 September, 2014 (pp. 87-98).

Mikaelyan, A. & Bigun, J. (2014). SAFE features for matching fingermarks by neighbourhoods of single minutiae. 14th International Symposium on Communications and Information Technologies (ISCIT 2014), Incheon, South Korea, September 24-26, 2014 (pp. 181-185).

Minelga, J., Gelzinis, A., Vaiciukynas, E., Verikas, A., Bacauskiene, M., Padervinskis, E. & Uloza, V. (2014). Comparing Throat and Acoustic Microphones for Laryngeal Pathology Detection from Human Voice. ECT 2014 – The 9th International Conference on Electrical and Control Technologies, Kaunas, Lithuania, 8-9 May, 2014 (pp. 50-53).

Nemati, H. & Åstrand, B. (2014). Tracking of People in Paper Mill Warehouse Using Laser Range Sensor. 2014 UKSim-AMSS 8th European Modelling Symposium, EMS 2014, Pisa, Italy, 21-23 October, 2014 (pp. 52-57).

Ourique de Morais, W., Mayr, M., Wickström, N. & Philippsen, R. (2014). Ambient Intelligence and Robotics: complementing one another to support Ambient Assisted Living. 13th International Conference Intelligent Autonomous Systems, Padova & Venice, Italy, 15-19 July, 2014.

Ourique de Morais, W. & Wickström, N. (2014). A lightweight method for detecting sleep-related activities based on load sensing. IEEE 3rd International Conference on Serious Games and Applications for Health (SeGAH 2014), Rio de Janeiro, Brazil, May 14-16, 2014.

Rögnvaldsson, T., Norrman, H., Byttner, S. & Järpe, E. (2014). Estimating p-Values for Deviation Detection. SASO 2014 - Eighth IEEE International Conference on Self-Adaptive and Self-Organizing Systems, Imperial College, London, United Kingdom, September 8-12, 2014 (pp. 100-109).

Sant'Anna, A. (2014). Activity monitoring as a tool for person-centered care: preliminary report. 2014 IEEE International Conference on Bioinformatics and Biomedicine, Belfast, United Kingdom, 2-5 November, 2014 (pp. 48-51).

Sant'Anna, A. & Bass, R. (2014). A New Two-Degree-of-Freedom Space Heating Model for Demand Response. 3rd International Conference on Smart Grids and Green IT Systems - SMARTGREENS 2014, Barcelona, Spain, 3-4 April, 2014 (pp. 5-13).

Taheri, T. & Sant'Anna, A. (2014). Non-Invasive Breathing Rate Detection Using a Very Low Power Ultra-wide-band Radar. 2014 IEEE International Conference on Bioinformatics and Biomedicine, Belfast, United Kingdom, 2-5 November, 2014 (pp. 78-83).

Weman-Josefsson, K. A., Halila, F., Johnson, U., Lindwall, M., Wickström, N. & Wärnestål, P. (2014). Digital innovations and self-determined exercise motivation: a person-centred perspective. Vitalis - Nordens ledande eHälsomöte 2014, Göteborg, Sverige, 8-10 april, 2014 (pp. 22-25).

Zhang, M., Liu, J., Sun, Z., Tan, T., Su, W., Alonso-Fernandez, F., Joshi, A. (2014). The First ICB Competition on Iris Recognition. IJCB-2014, IEEE/IAPR International Joint Conference on Biometrics, Clearwater (Tampa), FL, 29 Sept – 2 Oct, 2014.

2013

Alonso-Fernandez, F. & Bigun, J. (2013). Quality Factors Affecting Iris Segmentation and Matching. ICB-2013, The 6th IAPR International Conference on Biometrics, Madrid, Spain, June 4-7, 2013 (pp. Article number 6613016).

Aue, J., Schmid, M.R., Graf, T., Effertz, J., and Muehlfellner, P. (2013). Object Tracking from Medium Level Stereo Camera Data Providing Detailed Shape Estimation Using Local Grid Maps. IEEE Intelligent Vehicles Symposium, June 23-26, 2013, Gold Cost, Australia (pp. 57-62).

Byttner, S., Nowaczyk, S., Prytz, R. & Rögnvaldsson, T. (2013). A field test with self-organized modeling for knowledge discovery in a fleet of city buses. 10th IEEE International Conference on Mechatronics and Automation, IEEE ICMA 2013, Takamatsu, Japan, 4-7 August, 2013 (pp. 896-901).

Furgale, P., Schwesinger, U., Rufli, M., Derendarz, W., Grimmett, H., Mühlfellner, P. (2013). Toward automated driving in cities using close-to-market sensors: An overview of the v-charge project. IEEE Intelligent Vehicles Symposium, June 23-26, 2013, Gold Cost, Australia (pp. 57-62).

Gelzinis, A., Verikas, A., Bacauskiene, M. & Vaiciukynas, E. (2013). Learning Accurate Active Contours. 14th International Conference, EANN 2013, Halkidiki, Greece, September 13-16 (pp. 396-405).

Kalsyte, Z., Verikas, A., Bacauskiene, M. & Gelzinis, A. (2013). A Novel Technique to Design an Adaptive Committee of Models Applied to Predicting Company's Future Performance. 5th International Conference on Computer Research and Development (ICCRD 2013), Ho Chi Minh City, Vietnam, February 23-24, 2013 (pp. 65-70).

Khandelwal, S. & Chevallereau, C. (2013). Estimation of the Trunk Attitude of a Humanoid by Data Fusion of Inertial Sensors and Joint Encoders. The 16th International Conference on Climbing and Walking Robots and the Support Technologies for Mobile Machines (CLAWAR 2013), Sydney, Australia, 14-17 July, 2013 (pp. 822-830).

Mikaelyan, A. & Bigun, J. (2013). Frequency and ridge estimation using structure tensor. Biometric Technologies in Forensic Science (BTFS 2013), Nijmegen, Netherlands, October 14-15, 2013 (pp. 58-59).

Muehlfellner, P., Furgale, P. T., Derendarz, W. & Philippsen, R. (2013). Evaluation of Fisheye-Camera Based Visual Multi-Session Localization in a Real-World Scenario. IEEE Intelligent Vehicles Symposium, June 23-26, 2013, Gold Cost, Australia (pp. 57-62).

Nowaczyk, S., Prytz, R., Rögnvaldsson, T. & Byttner, S. (2013). Towards a Machine Learning Algorithm for Predicting Truck Compressor Failures Using Logged Vehicle Data. 12th Scandinavian Conference on Artificial Intelligence, Aalborg, Denmark, November 20–22, 2013 (pp. 205-214).

Ourique de Morais, W. & Wickström, N. (2013). A "Smart Bedroom" as an Active Database System. 9th International Conference on Intelligent Environments, IE 2013, Athens, Greece, 18-19 July, 2013 (pp. 250-253).

Prytz, R., Nowaczyk, S., Rögnvaldsson, T. & Byttner, S. (2013). Analysis of Truck Compressor Failures Based on Logged Vehicle Data. 9th International Conference on Data Mining, Las Vegas, Nevada, USA, July 22–25, 2013.

Taha, W., Cartwright, R., Philippsen, R. & Zeng, Y. (2013). A First Course on Cyber Physical Systems. 2013 Workshop on Embedded and Cyber-Physical Systems Education (WESE), Montreal, Canada, October 3, 2013.

Vaiciukynas, E., Verikas, A., Gelzinis, A., Bacauskiene, M., Sulcius, S., Paskauskas, R. & Olenina, I. (2013). Prototype-Based Contour Detection Applied to Segmentation of Phytoplankton Images. 3rd World Conference on Information Technology (WCIT-2012), 14-16 November 2012, University of Barcelon, Barcelona, Spain (pp. 1285-1292).

Zeng, Y., Rose, C., Brauner, P., Taha, W., Masood, J., Philippsen, R., Cartwright, R. (2013). Modeling Basic Aspects of Cyber-Physical Systems, Part II. DSLRob 2013: 4th International Workshop on Domain-Specific Languages and models for ROBotic systems (DSLRob-13).

2012

Alonso-Fernandez, F. & Bigun, J. (2012). Iris Boundaries Segmentation Using the Generalized Structure Tensor: A Study on the Effects of Image Degradation. The IEEE Fifth International Conference on Biometrics: Theory, Applications and Systems (BTAS 2012), Washington DC, September 23-26, 2012 (pp. 426-431).

Alonso-Fernandez, F. & Bigun, J. (2012). Periocular Recognition Using Retinotopic Sampling and Gabor Decomposition. International Workshop "What's in a Face?" WIAF, in conjunction with the 12th European Conference on Computer Vision, ECCV 2012, Florence, Italy, 7-13 October, 2012 (pp. 309-318).

Andreasson, H., Bouguerra, A., Åstrand, B. & Rögnvaldsson, T. (2012). Gold-fish SLAM: An application of SLAM to localize AGVs. The 8th International Conference on Field and Service Robotics, Matsushima, Miyagi, Japan, July 16-19, 2012 (pp. 585-598).

Brorsson, S., Gelzinis, A., Tonkonogi, M. & Verikas, A. (2012). Differences in the muscle activities in the forearm muscles in healthy men and women. XIXth Congress of the International Society of Electrophysiology & Kinesiology, Brisbane, Australia, 19-21 July 2012 (pp. 437-437).

Gelzinis, A., Vaiciukynas, E., Bacauskiene, M., Verikas, A., Sulcius, S., Paskauskas, R. & Oleninaz, I. (2012). Boosting performance of the edge-based active contour model applied to phytoplankton images. 13th IEEE International Symposium on Computational Intelligence and Informatics (CINTI2012), November 20-22, Budapest, Hungary (pp. 273-277).

Kalsyte, Z., Verikas, A. & Vasiliauskaite, A. (2012). Predicting trends of financial attributes by an adaptive committee of models. The 7th International Conference on Electrical and Control Technologies, ECT-2012, Kaunas, Lithuania, May 3-4, 2012 (pp. 48-53).

Karginova, N., Byttner, S. & Svensson, M. (2012). Data-driven methods for classification of driving styles in buses. SAE 2012 World Congress & Exhibition, Cobo Center, Detroit, Michigan, USA, April 24-26, 2012. Warrendale, PA:.

Karlsson, S. M. & Bigun, J. (2012). Lip-motion events analysis and lip segmentation using optical flow. 2012 IEEE Computer Society Conference on Computer Vision and Pattern Recognition Workshops, CVPRW 2012, 16-21 June, 2012, Rhode Island, USA (pp. 138-145).

Mikaelyan, A. & Bigun, J. (2012). Ground truth and evaluation for latent fingerprint matching. IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR), Providence, Rhode Island, June 16-21, 2012 (pp. 83-88).

Nowaczyk, S., Byttner, S. & Prytz, R. (2012). Ideas for Fault Detection Using Relation Discovery. The 27th annual workshop of the Swedish Artificial Intelligence Society (SAIS), 14–15 May 2012, Örebro, Sweden (pp. 1-6).

Sant'Anna, A., Wickström, N., Eklund, H. & Tranberg, R. (2012). A wearable gait analysis system using inertial sensors Part II: Evaluation in a clinical setting. International Conference on Bio-inspired Systems and Signal Processing, BIOSIGNALS 2012, Vilamoura, Algarve, 1-4 February, 2012 (pp. 5-14).

Sant'Anna, A., Wickström, N., Zügner, R. & Tranberg, R. (2012). A wearable gait analysis system using inertial sensors Part I: Evaluation of measures of gait symmetry and normality against 3D kinematic data. International Conference on Bio-inspired Systems and Signal Processing, BIOSIGNALS 2012, Vilamoura, Algarve, 1-4 February, 2012 (pp. 180-188).

Sentis, L., Petersen, J. G. & Philippsen, R. (2012). Experiments with Balancing on Irregular Terrains using the Dreamer Mobile Humanoid Robot. Robotics: Science and Systems VIII, University of Sydney, Sydney, NSW, Australia, July 09-13, 2012.

Taha, W. & Philippsen, R. (2012). Modeling Basic Aspects of Cyber-Physical Systems. In: 3rd International Workshop on Domain-Specific Languages and models for ROBotic systems (DSLRob-12): 3rd International Conference on Simulation, Modeling, and Programming for Autonomous Robots (SIMPAR-2012), Tsukuba, Japan, November 5-8, 2012.

Vachkov, G., Byttner, S. & Svensson, M. (2012). Battery aging detection based on sequential clustering and similarity analysis. 6th IEEE International Conference Intelligent Systems, IS 2012, Sofia, Bulgaria, 6-8 September 2012, Category number: CFP12802-PRT, Code: 94030 (pp. 42-47).

OTHER CONFERENCE PAPERS

Chen, L., Englund, C. (2018), Future autonomous airports: a system-of-systems approach. Proceedings of the Third Swedish Workshop on the Engineering of Systems-of-Systems (SWESoS2018), Linköping, Sweden, RISE, pp. 11–13

Cooney, M., Pashami, S., and Lilienthal, A. J. (2017). Breath-Sensing Robots: Looking Toward a Person using a Gas Sensor. 5th Swedish Workshop on Data Science (SweDS 2017), December 12.

Cooney, M., Pashami, S., Fan, Y., Sant'Anna, A., Ma, Y., Zhang, T., Zhao, Y., Hotze, W., Heyne, J., Englund, C., Lilienthal, A.J., and Ziemke, T. (2017) Exploring interactive capabilities for home robots via medium fidelity prototyping. arXiv:1710.01541

Alonso-Fernandez, F., Mikaelyan, A, and Bigun, J. (2017), Compact Multi-scale Periocular Recognition Using SAFE Features, Swedish Symposium on Image Analysis, SSBA (Linköping, Sweden), March 13-15 2017

Nemati, H., Fan, Y., and Alonso-Fernandez, F. (2016), Hand Detection and Gesture Recognition Using Symmetric Patterns, Swedish Symposium on Image Analysis, SSBA (Uppsala, Sweden), March 14-16 2016 (Oral)

Alonso-Fernandez, F. and Bigun, J. (2016), Periocular Biometrics: Databases, Algorithms and Directions, Swedish Symposium on Image Analysis, SSBA (Uppsala, Sweden), March 14-16 2016.

Hedenberg, K. & Åstrand, B. (2015). 3D Sensors on Driver-less Trucks for Detection of Overhanging Objects in the Pathway. ICRA 2015 Workshop on Autonomous Industrial Vehicles: From the Laboratory to the Factory Floor, Seattle, WA, USA, 30 May, 2015.

Alonso-Fernandez, F. & Bigun, J. (2013). Biometric Recognition Using Periocular Images. Swedish Symposium on Image Analysis 2013 (SSBA 2013), Gothenburg, 14-15 March.

Eriksson, H., Isaksson, A. & Lundström, J. (2013). Technology and trust: Social and technical innovation in elderly care. Equality, Growth and Innovation - In Theory and Practice, Luleå University of Technology, Luleå, Sweden, 9-10 October, 2013 (pp. 17-18).

Weman-Josefsson, K. A., Wärnestål, P., Johnson, U., Halila, F. & Wickström, N. (2013). An interdisciplinary project plan on Digital Innovations and Self-determined Exercise Motivation. CVHI Research School "Entrepreneurship and Health", 2nd Open Seminar, "Entrepreneurship, Health, and Innovation", Halmstad University, Halmstad, Sweden, November 12th, 2013.

Alonso-Fernandez, F. & Bigun, J. (2012). Iris Segmentation Using the Generalized Structure Tensor. SSBA Symposium 2012 (SSBA2012), Stockholm, Sweden, 8-9 mars, 2012.

BOOK CHAPTERS

Fanaee Tork, H., Bouguelia, M.-R., & Rahat, M. (2020). CycleFootprint: A Fully Automated Method for Extracting Operation Cycles from Historical Raw Data of Multiple Sensors. In IoT Streams for Data-Driven Predictive Maintenance and IoT, Edge, and Mobile for Embedded Machine Learning : Second International Workshop, IoT Streams 2020, and First International Workshop, ITEM 2020, Co-located with ECML/PKDD 2020, Ghent, Belgium, September 14-18, 2020, Revised Selected Papers. Switzerland: Springer Publishing Company.

Nowaczyk, S., Rögnvaldsson, T., Fan, Y., & Calikus, E. (2020). Towards Autonomous Knowledge Creation from Big Data in Smart Cities. In Handbook of Smart Cities (pp. 1–35). Cham: Springer.

Alonso-Fernandez, F., Farrugia, R. A., Fierrez, J., & Bigun, J. (2019). Super-resolution for selfie biometrics: Introduction and application to face and iris. In Selfie Biometrics (pp. 105-128). Springer, Cham.

Alonso-Fernandez, F., and Bigun, J. (2017) An Overview of Periocular Biometrics, in Iris and Periocular Biometric Recognition, (C. Busch, C. Rathgeb, Eds.), pp. 29-54, IET 2017,

Hedenberg, K. and Åstrand, B., (2016) 3D Sensors on Driverless Trucks for Detection of Overhanging Objects in the Pathway, Autonomous Industrial Vehicles: From the Laboratory to the Factory Floor, ASTM STP1594, R. Bostelman and E. Messina, Eds., ASTM International, West Conshohocken, PA, pp. 41–56.

Alonso-Fernandez F., Fierrez J., Bigun J. (2015) Quality Measures in Biometric Systems. In: Li S.Z., Jain A.K. (eds) Encyclopedia of Biometrics. Springer, Boston, MA.

Alonso-Fernandez F., Fierrez J. (2015) Fingerprint Databases and Evaluation. In: Li S.Z., Jain A.K. (eds) Encyclopedia of Biometrics. Springer, Boston, MA.

Andreasson, H., Bouguerra, A., Åstrand, B. & Rögnvaldsson, T. (2014). Gold-Fish SLAM: An Application of SLAM to Localize AGVs. In: Yoshida, Kazuya; Tadokoro, Satoshi (Ed.), Field and Service Robotics: Results of the 8th International Conference (pp. 585-598). Heidelberg, Germany: Springer Berlin/Heidelberg, 92.

Ourique de Morais, W., Lundström, J. & Wickström, N. (2013). A Database-Centric Architecture for Home-Based Health Monitoring. In: Christopher Nugent, Antonio Coronato, José Bravo (Ed.), Ambient Assisted Living and Active Aging: 5th International Work-Conference, IWAAL 2013, Carrillo, Costa Rica, December 2-6, 2013, Proceedings (pp. 26-34). Heidelberg, Germany: Springer, 8277.

Sant'Anna, A. & Wickström, N. (2013). Symbolic Approach to Motion Analysis: Framework and Gait Analysis Case Studies (1ed.). In: Fei Hu (Ed.), Telehealthcare Computing and Engineering: Principles and Design (pp. 561-606). Boca Raton: CRC Press.

Sant'Anna, A., Wickström, N., Eklund, H., Zügner, R. & Tranberg, R. (2013). Assessment of Gait Symmetry and Gait Normality Using Inertial Sensors: In-Lab and In-Situ Evaluation. In: Joaquim Gabriel et al. (Ed.), Biomedical Engineering Systems and Technologies: 5th International Joint Conference, BIOSTEC 2012, Vilamoura, Portugal, February 1-4, 2012, Revised Selected Papers (pp. 239-254). Heidelberg: Springer Berlin/Heidelberg.

PATENTS

Derendarz, W.W, Mühlfellner, P., Grysczyk, S., Junge, L., Waldmann, R., Wonneberger, S., Holleis, T., Brüning, S., Horstmann, S., Brummer, C., Bartholomaeus, M., Stellmacher, M., Nicklas, M., Pucks, F., Last, C. (2018). Method for the automated driving of a vehicle, in particular of a motor vehicle, in order to approach a parking position. US Patent Application 2018/0281859 A1 (priority date 2015 in Germany - partly a result of Peter Mühlfellner's work as industrial PhD student at VW 2012-2015)

Derendarz, W.W., Mühlfellner, P., Grysczyk, S., Junge, L., Waldmann, R., Wonneberger, S., Holleis, T., Brüning, S., Horstmann, S., Brummer, C., Bartholomaeus, M., Stellmacher, M., Nicklas, M., Pucks, F., Last, C. (2018) Method and Device for Carrying Out an Automatic Drive of a Vehicle. US Patent Application 2018/0265130 A1 (priority date 2015 in Germany - partly a result of Peter Mühlfellner's work as industrial PhD student at VW 2012-2015)

Karlsson, N., Svensson, M., Prytz, R., Nowaczyk, S., Byttner, S., Rögnvaldsson, T. (2018). Method for monitoring the operation of a sensor. US Patent 10,109,118 B2

Teferi Lemma, D. & Bigun, J. (2014). Method and apparatus for encoding and reading optical machine-readable data codes. US patent 8,757,490 B2.

Verikas, A., Viberg, P., Razanskas, P. (2014). A method for detection of muscle fatigue during dynamic work in EMG signals and means for obtaining and processing said signal. Swedish national patent application number 92562 20141204.

Holmberg, U., Petersson, D., Salomonson, T., Johansson, J. (2014). Power assisting system and method. EP2248501 (B1).

Hansson, J., Svensson, M., Rögnvaldsson, T. & Byttner, S. (2013). Remote diagnosis modelling. US patent 8,543,282 B2.

PhD theses

Fan, Y. (2020). Wisdom of the Crowd for Fault Detection and Prognosis (PhD dissertation).

Mashad Nemati, H. (2019). Data Analytics for Weak Spot Detection in Power Distribution Grids. Doctoral thesis.

Khandelwal, S. (2018). Gait Event Detection in the Real World. Doctoral thesis.

Gholami Shahbandi, S. (2018). Interpretation and Alignment of 2D Indoor Maps: Towards a Heterogeneous Map Representation. Doctoral thesis.

Mühlfellner, P. (2015). Lifelong visual localization for automated vehicles. Doctoral thesis.

Mikaelyan, A. (2015). Compact orientation and frequency estimation with applications in biometrics: Biometrics on the orientation express. Doctoral thesis.

Ourique de Morais, W. (2015). Architecting Smart Home Environments for Healthcare: A Database-Centric Approach. Doctoral thesis.

Lundström, J. (2014). Situation Awareness in Colour Printing and Beyond. Doctoral thesis.

Sant'Anna, A. (2012). A Symbolic Approach to Human Motion Analysis Using Inertial Sensors: Framework and Gait Analysis Study. Doctoral thesis.

Licentiate theses

Calikus, E. (2020). Self-Monitoring using Joint Human-Machine Learning : Algorithms and Applications (Licentiate dissertation).

Farouq, S. (2019). Towards large-scale monitoring of operationally diverse thermal energy systems with data-driven techniques. Licentiate thesis.

Ashfaq, A. (2019). Using AI to Individualise Care for Heart Patients in Halland. Licentiate thesis.

Mashad Nemati, H. (2017). Data-Driven Methods for Reliability Evaluation of Power Cables in Smart Distribution Grids. Licentiate thesis

Carpatorea, I. (2017). Methods to quantify and qualify truck driver performance. Licentiate thesis

Fan, Y. (2016). A Self-Organized Fault Detection Method for Vehicle Fleets. Licentiate thesis.

Gholami Shahbandi, S. (2016). Semantic Mapping in Warehouses. Licentiate thesis.

Hedenberg, K. (2014). Obstacle Detection for Driverless Trucks in Industrial Environments. Licentiate thesis.

Prytz, R. (2014). Machine learning methods for vehicle predictive maintenance using off-board and on-board data. Licentiate thesis.

Lundström, J. (2012). Understanding Offset Print Quality: A Computational Intelligence-based Approach. Studies from the School of Science and Technology 26, Örebro University. Licentiate thesis

Thanks to:

Our main funder

The Knowledge Foundation

CAISR partners

Affecto Sweden
AI Innovation of Sweden
Alfa Laval
CGI
EasyServ Sweden
European DLB Consortium
FacePhi Biometria Ltd.
Getinge
Halmstad municipality
HEM - Halmstad Energi och Miljö
High Five
HMS Industrial Networks
HotSwap Norden
Karolinska Institute
Kollmorgen Automation
Linköping University Hospital
Lund University
NEAT Electronics
Novartis
Region Halland
Region Skåne
RISE (Research Institutes of Sweden)
SKR (Swedish Association of Local Authorities and Regions)
Stena Recycling
Swedish Adrenaline
Sydpumpen
Tappa Service
Toyota Material Handling Europe
Viscando
Volvo Group Connected Solutions
Volvo Technology / Volvo Group Trucks Technology
Volvo Bus Corporation
Volvo Trucks
Zenuity
Zenseact
Öresundskraft

Knowledge Foundation

The Knowledge Foundation funds research and competence development at Sweden's new universities. The Foundation was established by the Swedish government in 1994, and the Foundation's overall mission is to strengthen Sweden's competitiveness.

The Knowledge Foundation has the following objectives:

- to support the exchange of knowledge and skills between the business sector on one hand, and universities, higher education institutions (HEIs), and research institutes on the other.
- to fund research at smaller and mid-sized HEIs and Sweden's new universities (founded after the foundation was formed) in special profile areas.
- to promote information technology.

The Knowledge Foundation achieves these objectives by helping young universities build internationally competitive research environments, work long-term on strategic profiling and increase the cooperation between academia, industry and institutes. The Foundation funding programs are all characterized by a long-term perspective and requirements for co-production with industrial partners.

CAISR

CAISR, the Center for Applied Intelligent Systems Research, is a long-term research program on intelligent systems established by Halmstad University. The program is funded by the University and the Knowledge Foundation with support from Swedish Industry.

The subject expertize in the center is in signal analysis, machine learning and mechatronics. Several industrial partners are collaborating with researchers from the University in joint projects, and take an active part in the development of CAISR. The key application areas that the center does research in are intelligent vehicles and health technology. The industrial partners include multinational companies as well as research-based growing companies.

The mission of CAISR is to serve and promote the development of industry and society. It is a center for industrially motivated research on the future technologies for and application opportunities with aware intelligent systems. CAISR will serve as a partner for industry´s own research and development, as a recruitment base for those who seek staff with state-of-the-art knowledge in intelligent systems technologies, and as a competence resource for industry and society. All research is conducted within different research projects.

HALMSTAD UNIVERSITY

Visiting Address: Kristian IV:s väg 3
P O Box 823, SE 301 18 Halmstad
Telephone: +46 35 16 71 00
E-mail: registrator@hh.se
www.hh.se

Halmstad University, School of Information Technology, March 2021