A survey of intelligent driver machine interfaces in transportation cockpits

Alstom

Select one (or more) categories to which this degree project corresponds the best

- ☐ Traffic Planning, market and Simulation
- ☒ Signalling and Traffic control systems
- ☐ Vehicles for Rail and Public transport
- ☐ Rail track, Geotechnics and Constructions
- ☐ Properties and Land use
- ☐ Electrical engineering and Power supply
- ☐ Digitalization, AI and Data Analytics
- ☐ Business Management
- ☐ Sustainability and Environment
- ☐ Other

Background

Being Europe's largest train manufacturer and railway system provider, Alstom always explores cutting-edge technologies to provide safer and more efficient interactions between the driver and the train. One of the most important interfaces is the driver desk including various controls and displays in the train's cockpit. We work on the next generation "smarter" Human/Driver Machine Interfaces (HMI/DMI), with the help of artificial intelligence.

Problem description, tasks, and goals

Recent years have witnessed a booming application of artificial intelligence in the cockpits of all transportation modes, especially automotive. Various AI-based features have been developed and deployed in rich application scenarios with benefits demonstrated, not only to the safe and efficient driving tasks, but also reliability, availability and maintainability of the HMI devices. This thesis aims to investigate the application of AI technology in the driver's cab focusing on the interaction through the human machine interface. The goal is to understand the benefits and limitations of various AI-based solutions in the different transportation modes, and explore the applicabilities to railway.
The student is expected to:
1. Perform a comprehensive survey on the AI based solutions for driver machine interfaces of the following sectors: railway, automotive (including heavy vehicles), aviation, maritime.
2. Categorize the technologies used behind the solutions, and explain the strengths, limitations and benefits.
3. Applicability study of the surveyed solutions and technologies to railway. This may involve interviews with railway HMI experts and/or train drivers.The student will be introduced to the driver machine interface of the trains.The thesis can be either a bachelor or a master thesis, which differ in depth and scope.Prerequisites: Background in software engineering, embedded systems, computer science, human computer interaction, or another related field. Knowledge of artificial intelligence is mandatory. Well-organized, good at reading and writing, good communication skills.

Type of degree project (can be both)

- ☒ Master (20 weeks)
- ☒ Bachelor/Högskoleingenjör (10 weeks)

Language for the thesis

☐ Swedish and/or ☒ English

Is Swedish a language requirement?
☐ Yes ☒ No ☐ No, but Swedish is a requirement for future employment

Possibility to work from our office
☒ Yes ☐ No

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Automated analysis of free text fault and repair reports

Alstom

Select one (or more) categories to which this degree project corresponds the best

- ☐ Traffic Planning, market and Simulation
- ☒ Signalling and Traffic control systems
- ☐ Vehicles for Rail and Public transport
- ☐ Rail track, Geotechnics and Constructions
- ☐ Properties and Land use
- ☐ Electrical engineering and Power supply
- ☐ Digitalization, AI and Data Analytics
- ☐ Business Management
- ☐ Sustainability and Environment
- ☐ Other

Background
Alstom's Train Control and Communication (TC&C) Platform includes hundreds of products that are used in several train platforms. We provide products in all categories from drivers displays to control computers and networking to connect these in a real time onboard network. These products can fail both from the point of hardware but also in terms of software. In both cases, these products may be either managed internally or provided by suppliers external to Alstom. What we see is that we have two cases where we could automate an understanding of the impact on the product and what to focus on in terms of making our products more reliable, the fault report and the repair report.

Problem description, tasks, and goals
The thesis project will focus on exploring and assessing different state-of-the-art strategies such as different LLM models, to better connect fault reports to the resulting repair reports, along with enough data to understand what areas should be addressed to increase the overall reliability and availability of the product. These reports, change requests and other documentation are mostly free text. Selected strategies will then be developed on a conceptual level for the data available in the TC&C Platform, analyzed and evaluated providing recommendations on a process and architecture for such an automated system. Overall, the goal can be described as:
1. Introduction to train control and communication platform, including relevant products for the scope.
2. Introduction to Alstom's processes including fault reports, repair reports, change requests, and configuration management.
3. Survey of state-of-the-art research in automated text analysis.
4. Definition of assessment criteria.
5. Assessment and selection of preferred solutions and strategies.
6. Concept development.
7. Evaluation.
8. Analysis, conclusions, and reporting.

The scope of the project can be adapted to suit one or two thesis students.
Prerequisites: Background in software engineering, artificial intelligence / machine learning state of the art including LLM. A familiarity with hardware and mechanical and electrical engineering is beneficial. Good analytical skills and systems thinking mindset.

Type of degree project (can be both)
☒ Master (20 weeks)
☐ Bachelor/Högskoleingenjör (10 weeks)

Language for the thesis
☒ Swedish and/or ☒ English

Is Swedish a language requirement?
☐ Yes ☒ No ☐ No, but Swedish is a requirement for future employment

Possibility to work from our office
☒ Yes ☐ No

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CFD based methods to generate thermal digital twins railway traction converters

Alstom

Select one (or more) categories to which this degree project corresponds the best

- ☐ Traffic Planning, market and Simulation
- ☐ Signalling and Traffic control systems
- ☐ Vehicles for Rail and Public transport
- ☒ Rail track, Geotechnics and Constructions
- ☐ Properties and Land use
- ☐ Electrical engineering and Power supply
- ☐ Digitalization, AI and Data Analytics
- ☐ Business Management
- ☐ Sustainability and Environment
- ☐ Other

Background

Alstom's latest traction platform is designed to deliver very high performance density. This is accomplished by the effective utilization of the latest generation of power semiconductor devices in a new standardized and scalable packaging for railway traction. Simulations are used to effectively utilize this performance potential, where accurate thermal models are critical. However the models need to combine high fidelity with light computational loads and short processing time.

Problem description, tasks, and goals

The thesis project will focus on developing and validating procedures to derive Reduced Order Models from CFD simulations for a given product design from which machine learning based digital twins can be generated for use in performance simulations. The following steps are foreseen:

1. Introduction to electric railway traction design
2. Introduction to Alstom's modular traction platform thermal design and mission profiles
3. Introduction to Alstom CFD tools
4. Survey of state of the art research and tools in CFD modeling methods for digital twins
5. Model development for Alstom product
6. Evaluation of model accuracy
7. Development and evaluation of an optimum workflow
8. Analysis, conclusions and reporting

The scope of the project can be adapted to suit one or two thesis students.

Prerequisites: Background in thermo- / aerodynamics including a proficiency in CFD tools along with an understanding of electrical and mechanical engineering. Good analytical skills and systems thinking mindset.

Type of degree project (can be both)

- ☒ Master (20 weeks)
- ☐ Bachelor/Högskoleingenjör (10 weeks)

Language for the thesis

☒ Swedish and/or ☒ English

Is Swedish a language requirement?

☐ Yes ☒ No ☐ No, but Swedish is a requirement for future employment

Possibility to work from our office
☒ Yes ☐ No

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Compact digital twin virtual sensor for edge computing in railway traction controller

Alstom

Select one (or more) categories to which this degree project corresponds the best

☐ Traffic Planning, market and Simulation
☐ Signalling and Traffic control systems
☐ Vehicles for Rail and Public transport
☐ Rail track, Geotechnics and Constructions
☐ Properties and Land use
☒ Electrical engineering and Power supply
☐ Digitalization, AI and Data Analytics
☐ Business Management
☐ Sustainability and Environment
☐ Other

Background
Alstom's latest traction platform is based on high performance converters operated with advanced control methods in Alstom's indigenous control platform. The control platform uses several sophisticated control algorithms that require high fidelity real time monitoring while limiting the need for discrete hardware sensors

Problem description, tasks, and goals
The thesis project will focus on developing, implementing and validating a virtual thermal sensor for a railway traction converter created from a machine learning based digital twin. The model needs to be compact, provide high accuracy with low processor loads. The following steps are foreseen:
1. Introduction to electric railway traction design
2. Introduction to Alstom's traction control platform
3. Survey of state of the art research on virtual sensors and compact digital twins
4. Digital twin development for Alstom product based on data from reduced order CFD models
5. Implementation on target device
6. Evaluation of model accuracy and processor performance including risk assessments
7. Development and evaluation of an optimum workflow
8. Analysis, conclusions and reporting

The scope of the project can be adapted to suit one or two thesis students.
Prerequisites: Background in data science, machine learning and AI with an understanding of electrical and control engineering. Good analytical skills and systems thinking mindset.

Type of degree project (can be both)
☒ Master (20 weeks)
☐ Bachelor/Högskoleingenjör (10 weeks)

Language for the thesis
☒ Swedish and/or ☒ English

Is Swedish a language requirement?
☐ Yes ☒ No ☐ No, but Swedish is a requirement for future employment

Possibility to work from our office
☒ Yes ☐ No

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Condition monitoring and fault detection by GDU based smart sensor functions

Alstom

Select one (or more) categories to which this degree project corresponds the best

☐ Traffic Planning, market and Simulation
☐ Signalling and Traffic control systems
☐ Vehicles for Rail and Public transport
☐ Rail track, Geotechnics and Constructions
☐ Properties and Land use
☒ Electrical engineering and Power supply
☐ Digitalization, AI and Data Analytics
☐ Business Management
☐ Sustainability and Environment
☐ Other

Background
Alstom's new traction platform is designed to deliver high performance and energy density. This is accomplished by the effective utilization of the latest generation of power semiconductor devices (Si / SiC) in a new standardized and scalable packaging for railway traction. Alstom's state of the art Gate Drive Unit (GDU) - technology is developed for controlling the semiconductor modules optimally based on different operating conditions. The GDU FPGA is integrated with advanced sensing capabilities which can not only sense base parameters like voltage, current, temperature but can also incorporate new features for condition monitoring and fault detection.

Problem description, tasks, and goals
In the real-world traction application, semiconductor failures are not uncommon, even though the new generation of power semiconductor devices are designed to last for several years of hard operation. Understanding and mitigating these failure scenarios is critical for a successful traction converter business. The thesis project will focus on exploring different failure modes in new generations of IGBTs / MOSFETs, especially in Alstom field applications and develop suitable detection & mitigation functions in the GDU FPGA for minimizing the impact of these failures. Moreover, the work includes a survey of typical failures modes and semiconductor condition monitoring in general so that the best strategies can be adapted for Alstom applications. An assessment will be made based on the literature survey and field experience on order to short list the most critical failure modes to be mitigated first. A corresponding detection and mitigation strategy will be selected for implementation after careful review by the expert team. Selected strategies will then be developed in the GDU FPGA firmware and will be tested and evaluated in the IGBT lab. Successfully evaluated functionalities will become part of the future GDU product upgrade.

The work includes (but not limited to)

- Introduction to Alstom's IGBT/GDU team and way of working in Västerås
- Introduction to electric railway traction converter and gate drive techniques

- Survey of semiconductor failure modes in traction applications and strategies for detection and mitigation
- Study Return of Experience (REX) from Alstrom applications
- Assessment and selection of failure modes and mitigation strategies to work on
- Concept development
- FW development, test and evaluation with the help from the team
- Analysis, conclusions and reporting

Prerequisites: Background in electrical, electronics and/or computer engineering, basic understanding of power electronics and semiconductor switches. Knowledge VHDL is a plus but not mandatory. Good analytical skills.

Type of degree project (can be both)
☒ Master (20 weeks)
☐ Bachelor/Högskoleingenjör (10 weeks)

Language for the thesis
☐ Swedish and/or ☒ English

Is Swedish a language requirement?
☐ Yes ☒ No ☐ No, but Swedish is a requirement for future employment

Possibility to work from our office
☒ Yes ☐ No

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Characterization of inductors for sound prediction on trains

Alstom

Select one (or more) categories to which this degree project corresponds the best

☐ Traffic Planning, market and Simulation
☐ Signalling and Traffic control systems
☒ Vehicles for Rail and Public transport
☐ Rail track, Geotechnics and Constructions
☐ Properties and Land use
☐ Electrical engineering and Power supply
☐ Digitalization, AI and Data Analytics
☐ Business Management
☐ Sustainability and Environment
☐ Other

Background
Alstom has identified a need to improve the sound environment on trains by predicting the sound from inductors and transformers in converters. It has proven difficult to obtain useful results through the simulation of electromagnetism - structure and airborne sound. Therefore, a thesis is proposed to characterize inductors and find significant common denominators that affect sound radiation.

Problem description, tasks, and goals
The goal of the thesis is to develop a method for predicting sound from inductors on trains. To achieve this, a number of inductors will be measured and analyzed through modal analysis and sound measurement. The results will be used to identify factors that affect the sound and propose a method for sound prediction

Type of degree project (can be both)
☒ Master (20 weeks)
☐ Bachelor/Högskoleingenjör (10 weeks)

Language for the thesis
☐ Swedish and/or ☒ English

Is Swedish a language requirement?
☐ Yes ☒ No ☐ No, but Swedish is a requirement for future employment

Possibility to work from our office
☒ Yes ☐ No

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Ethernet receiver for measurement data

Alstom

Select one (or more) categories to which this degree project corresponds the best

☐ Traffic Planning, market and Simulation
☐ Signalling and Traffic control systems
☐ Vehicles for Rail and Public transport
☐ Rail track, Geotechnics and Constructions
☐ Properties and Land use
☐ Electrical engineering and Power supply
☐ Digitalization, AI and Data Analytics
☐ Business Management
☐ Sustainability and Environment
☒ Other

Background

In power lab and in train testing we are using DCUtermplugin. This is used to stream data from all of our control systems in the trains through DCUterm and present/record this data in Dewesoft.

Problem description, tasks, and goals

The DCUterm plugin has a slow sample rate and limited interface flexibility as well as no possibility for time synchronization. Goal is to use the standard Ethernet receiver function in dewesoft

Goals:

Prio 1

•Define target IP address (PC with interface to DCUterm or preferable direct to the control computer.

•Select signals

•Define signals quantities from a lock up table

•Record data at 4 ms task time

•Mitrac tools source systems

Prio 2

•Record DSP data at 100 us task time

•Time synchronization

•AC4 source systems

Prerequisites: Skilled in IP communication areas.

Type of degree project (can be both)
☒ Master (20 weeks)
☒ Bachelor/Högskoleingenjör (10 weeks)

Language for the thesis
☐ Swedish and/or ☒ English

Is Swedish a language requirement?
☐ Yes ☒ No ☐ No, but Swedish is a requirement for future employment

Possibility to work from our office
☒ Yes ☐ No

Contact persons

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Instrument register

Alstom

Select one (or more) categories to which this degree project corresponds the best

☐ Traffic Planning, market and Simulation
☐ Signalling and Traffic control systems
☐ Vehicles for Rail and Public transport
☐ Rail track, Geotechnics and Constructions
☐ Properties and Land use
☐ Electrical engineering and Power supply
☐ Digitalization, AI and Data Analytics
☐ Business Management
☐ Sustainability and Environment
☒ Other

Background

In power lab we have a large number of instruments and other test components. This is manually handled in terms of booking, in/out, repairs and calibration . The interface needs to interact with an external database in a company based in Västerås called Intertek.

Problem description, tasks, and goals

Define a database with the possibility to use the bar codes for all above steps.

Goals:

Prio 1

- Instrumentation In/out of storage area with information on responsible person and location as well as time
- Booking system of instruments

Prio 2

- Components in warehouse , for example fans, magnetical components, motors shall also be defined with Bar codes and be handled in a similar way but only in an local Alstom database

Prerequisites: Skilled in IP communication areas.

Type of degree project (can be both)

☐ Master (20 weeks)
☒ Bachelor/Högskoleingenjör (10 weeks)

Language for the thesis

☐ Swedish and/or ☒ English

Is Swedish a language requirement?

☐ Yes ☒ No ☐ No, but Swedish is a requirement for future employment

Possibility to work from our office

☒ Yes ☐ No

Contact persons

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Resp. manager: Patrik Ericsson
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Wear particle emissions from mechanical brakes on freight trains

Green Cargo AB

Select one (or more) categories to which this degree project corresponds the best

☐ Traffic Planning, market and Simulation
☐ Signalling and Traffic control systems
☒ Vehicles for Rail and Public transport
☐ Rail track, Geotechnics and Constructions
☐ Properties and Land use
☐ Electrical engineering and Power supply
☐ Digitalization, AI and Data Analytics
☐ Business Management
☒ Sustainability and Environment
☐ Other

Background
Emission of airborne particles during the braking is significant aspect of the railway brake system. The particles emitted by train are found to contain a substantial proportion of metals such as Fe, Cu and Mn. These redox active metals make the train emitted particles eight times more genotoxic than ambient particles. Unlike the brake wear emissions from automotive vehicles, which are recently regulated in the newest European emission standard Euro 7. Brake particle emissions from railway vehicles have been very poorly researched, and the exact contribution of the train brake system to the total particle emissions from railway vehicles remains unclear.

About the company
Green Cargo is a sustainable logistics partner and an important part of Scandinavian business life. Almost 98 percent of our transport work takes place with electric trains with a very low climate impact. Every weekday, we run 400 freight trains and replace around 9,000 truck transports on the road network every day. In our network, we serve nearly 300 locations in Sweden, Norway and Denmark, and with partners we reach the whole of Europe. We have 1,800 employees, transport approximately 20 million tonnes of goods and have an annual turnover of SEK 4.2 billion (2023).

Problem description, tasks, and goals
Braking materials will be evaluated by lab experiments for normal and emergency braking. Goals: 1) To study the friction, wear and particle emission (number and mass concentration and size distribution) from various brake block and brake disc materials used on freight trains. 2) To characterize the chemical composition and microstructure of the emitted particles and estimate its environmental and health impacts

Type of degree project (can be both)
☒ Master (20 weeks)
☒ Bachelor/Högskoleingenjör (10 weeks)

Language for the thesis
☒ Swedish and/or ☒ English

Is Swedish a language requirement?
☐ Yes ☐ No ☒ No, but Swedish is a requirement for future employment

Possibility to work from our office
☒ Yes ☐ No

Contact person

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Performance comparison between disc brakes and tread brakes for railway wagons

Green Cargo AB

Select one (or more) categories to which this degree project corresponds the best

- ☐ Traffic Planning, market and Simulation
- ☐ Signalling and Traffic control systems
- ☒ Vehicles for Rail and Public transport
- ☐ Rail track, Geotechnics and Constructions
- ☐ Properties and Land use
- ☐ Electrical engineering and Power supply
- ☐ Digitalization, AI and Data Analytics
- ☐ Business Management
- ☐ Sustainability and Environment
- ☐ Other

Background
Tread brakes is most commonly used braking system on wagons. Further, a variety of brake block materials can be used on these wagons depending on the operating conditions. These material are: cast iron, organic composite and sinter material. In heavy haul or high-speed freight trains, use of wagons with disc brakes is increasing. In addition, winter conditions might reduce the life of wheels in tread braking even further. There are trainsets that use wagons with tread brakes and wagons with disc brakes. Such trainsets can be utilized to make a direct comparison on performance between tread brakes and disc brakes.

About the company
Green Cargo is a sustainable logistics partner and an important part of Scandinavian business life. Almost 98 percent of our transport work takes place with electric trains with a very low climate impact. Every weekday, we run 400 freight trains and replace around 9,000 truck transports on the road network every day. In our network, we serve nearly 300 locations in Sweden, Norway and Denmark, and with partners we reach the whole of Europe. We have 1,800 employees, transport approximately 20 million tonnes of goods and have an annual turnover of SEK 4.2 billion (2023).

Problem description, tasks, and goals
Life cycle costs for wagons are influenced by wheels and brake discs. This study can provide strong basis for deciding the utilization of wagons with optimal braking system to be used in trainsets. Goals: 1) To compare the wear data for wheels and discs 2) To study the types of damage that reduces the life of wheels and discs

Type of degree project (can be both)
- ☒ Master (20 weeks)
- ☒ Bachelor/Högskoleingenjör (10 weeks)

Language for the thesis
☒ Swedish and/or ☒ English

Is Swedish a language requirement?
☐ Yes ☐ No ☒ No, but Swedish is a requirement for future employment

Possibility to work from our office
☒ Yes ☐ No

Contact person

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Develop a Door Computer for Train Coaches

SJ AB

Select one (or more) categories to which this degree project corresponds the best

☐ Traffic Planning, market and Simulation
☐ Signalling and Traffic control systems
☒ Vehicles for Rail and Public transport
☐ Rail track, Geotechnics and Constructions
☐ Properties and Land use
☒ Electrical engineering and Power supply
☐ Digitalization, AI and Data Analytics
☐ Business Management
☐ Sustainability and Environment
☒ Other

Background
As vehicles are getting older the technology used is slowly outdated and spare parts are not any longer possible to buy or produce. An example of this is the PLC computer containing all the intelligence and functionality for steering of the doors in the passenger coaches. SJ needs a new computer to be able to keep the coaches in traffic in the future.

Problem description, tasks, and goals
Pre-study: Analyse the current computer technology and the functionalities that it provides. Technical solution: Find an existing PLC computer that is railway compatible according to all regulations with safety integrity level 3 or above. Write code for the new PLC computer that fulfils today's railway requirements and adds the possibility to communicate with new train monitoring system for passenger coaches. The aim of monitoring the signals is to increase reliability, availability, and maintainability of the door systems. The doors are crucial for passenger safety and therefor much effort must be put on safety matters. A new computer with code must be able to replace the old computer to full extent. Final report: A written technical report and a presentation of the findings to involved roles and functions at SJ. The report should describe the technical solution and a recommendation on how to implement it.

Type of degree project (can be both)
☒ Master (20 weeks)
☒ Bachelor/Högskoleingenjör (10 weeks)

Language for the thesis
☒ Swedish and/or ☒ English

Is Swedish a language requirement?
☐ Yes ☐ No ☒ No, but Swedish is a requirement for future employment

Possibility to work from our office
☒ Yes ☐ No

Contact person
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Image Recognition in Material Management

SJ AB

Select one (or more) categories to which this degree project corresponds the best

☐ Traffic Planning, market and Simulation
☐ Signalling and Traffic control systems
☒ Vehicles for Rail and Public transport
☐ Rail track, Geotechnics and Constructions
☐ Properties and Land use
☐ Electrical engineering and Power supply
☒ Digitalization, AI and Data Analytics
☐ Business Management
☐ Sustainability and Environment
☐ Other

Background
In the railway industry, traceability requirements are high, and it is critical that the correct material is installed on the trains and that this is correctly reported in the system. Each type of material has an individual number of 6-8 digits, which is also used to check inventory balance. There are over 5000 items in the inventory. Today, it is difficult to easily and efficiently search for materials in the maintenance system. There are many similar items, and a train technician may need to spend a lot of time identifying and retrieving replacement materials. There is also a risk for retrieving the wrong material or that the material withdrawal is incorrectly reported. A possible aid that could simplify handling is image recognition of different components and spare parts.

Problem description, tasks, and goals
The tasks may include all or parts of the following: Identify techniques and develop methods for image recognition of components and spare parts; develop hardware and software to identify which material and material numbers are removed from the vehicle through image recognition; write a well-structured report describing the method and results, enabling further work. The final scope and problem formulation will be developed jointly between SJ, the student, and the supervisor at the university.

Type of degree project (can be both)
☒ Master (20 weeks)
☒ Bachelor/Högskoleingenjör (10 weeks)

Language for the thesis
☒ Swedish and/or ☒ English

Is Swedish a language requirement?
☐ Yes ☐ No ☒ No, but Swedish is a requirement for future employment

Possibility to work from our office
☒ Yes ☐ No

Contact person
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Method for Noise Mapping in Train Depots

SJ AB

Select one (or more) categories to which this degree project corresponds the best

☐ Traffic Planning, market and Simulation
☐ Signalling and Traffic control systems
☒ Vehicles for Rail and Public transport
☐ Rail track, Geotechnics and Constructions
☐ Properties and Land use
☐ Electrical engineering and Power supply
☐ Digitalization, AI and Data Analytics
☐ Business Management
☒ Sustainability and Environment
☒ Other

Background
SJ has a need to better describe and understand how our trains and operations contribute to noise levels in and around the depots in use. The focus is on our largest depot in Hagalund, Solna. Residents around the Hagalund depot complain about noise, but it is difficult to identify which part of the operation and which trains are contributing to the noise levels. SJ wants to be able to map the noise with the aim of describing how its own operations and the various vehicles contribute to the noise levels - both in Hagalund and in other places where the need may arise. The goal is to both quantify the noise contribution from the vehicles and operations and also identify effective noise-reducing measures that can be implemented without negatively affecting the rest of the depot operations.

Problem description, tasks, and goals
The tasks may include all or parts of the following: Literature study and review of previously performed work; developing of a method to measure and map noise in Hagalund depot and other places; perform measurements of noise in Hagalund depot; identify how SJ's trains and operations contribute to the noise in Hagalund; develop a general model for noise analysis; identification of effective noise-reducing measures; well-written report describing the method and results, enabling further work. Proficiency in Swedish is necessary to read SJ documentation.

Type of degree project (can be both)
☒ Master (20 weeks)
☒ Bachelor/Högskoleingenjör (10 weeks)

Language for the thesis
☒ Swedish and/or ☐ English

Is Swedish a language requirement?
☒ Yes ☐ No ☐ No, but Swedish is a requirement for future employment

Possibility to work from our office
☒ Yes ☐ No

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Assignments in rail

SL Region Stockholm

Select one (or more) categories to which this degree project corresponds the best

☐ Traffic Planning, market and Simulation
☒ Signalling and Traffic control systems
☐ Vehicles for Rail and Public transport
☒ Rail track, Geotechnics and Constructions
☐ Properties and Land use
☒ Electrical engineering and Power supply
☒ Digitalization, AI and Data Analytics
☐ Business Management
☐ Sustainability and Environment
☐ Other

Background
The assignments for rail traffic are in the following areas: Traffic, Operation and maintenance, Organization and processes, Technology in traffic control and signalling.

Problem description, tasks, and goals
The purpose of all different master thesis that deal with orientation and choice of technology for systems and working methods for rail traffic is to contribute to and ensure that both asset management and development perspectives are considered currently in this moment and in the future.

Type of degree project (can be both)
☒ Master (20 weeks)
☒ Bachelor/Högskoleingenjör (10 weeks)

Language for the thesis
☒ Swedish and/or ☒ English

Is Swedish a language requirement?
☐ Yes ☐ No ☒ No, but Swedish is a requirement for future employment

Possibility to work from our office
☒ Yes ☐ No

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Team Student about practical things like application and assignment as well as guidance into the organization to discuss mutual interest in different areas and work ideas.

Thesis proposals will also be published here: https://www.regionstockholm.se/jobb/for-dig-som-letar-jobb/lediga-jobb/?query=exjobb&orderBy=Relevance&categories=&organizations=Trafikf%C3%B6rvaltningen&placements=&employmentScopes=&skip=0&take=20

JBS JÄRNVÄGSBRANSCHENS SAMVERKANSFORUM

Effective risk management in the design phase of railway projects

SWECO – Transport, Railway

Background

Sweco plans and designs the sustainable communities and cities of the future. Together with our clients, our team of 18,000 architects, engineers, and other specialists develops solutions to address urbanization, leverage the opportunities of digitalization, and make future societies more sustainable. Sweco is the leading consulting firm in technology and architecture in Europe, with a revenue of approximately 22 billion SEK. The company is listed on Nasdaq Stockholm. For further information, please visit www.sweco.se. Within the Transport Infrastructure division, we work on everything from small-scale initiatives to mega-projects in infrastructure. Admittedly, and with a hint of bias, we believe our projects—particularly due to their multifaceted nature—are among the most enjoyable, challenging, and stimulating endeavors at Sweco. However, we recognize that aspects of our project management processes can always be developed and improved, which is where this thesis comes into play. The purpose of the thesis is to develop and enhance our methodologies.

Question

How can risk management in the design phase be improved to minimize cost increases and delays in large railway projects? This question can explore how risk management is identified, assessed, and managed in the early phases to avoid problems later in the project

Type of degree project (can be both)

Master (20 weeks):☒
Bachelor/Högskoleingenjör (10 weeks): ☐

Language for the thesis

Swedish:☒ and/or English:☒

Is Swedish a language requirement?

Yes:☐
No: ☐
No, but Swedish is a requirement for future employment:☒

Possibility to work from our office

Yes:☒
No:☐

Contact person

Agneta Innergård — Group Manager, Project Management, Transport Infrastructure
agneta.innergard@sweco.se

Martin Hjort — Group Manager, Project Management, Transport Infrastructure
martin.hjort@sweco.se

Are you two proactive and engaged students eager to contribute to the development and optimization of our project organizations? Are you interested in large-scale projects and intrigued by the possibility of investigating how we can refine our working methods? If so, you have the opportunity to do so with us!

Writing your thesis at Sweco allows you to experience what it is like to work here and become part of Sweco's culture. For us, your thesis represents an excellent opportunity to begin getting to know you and to learn more about your ideas, skills, and perspectives. A well-executed thesis may lead to an employment offer.Sweco engages in innovative projects that are often incredibly exciting from multiple perspectives. We are not confined to a specific issue but are keen to collaboratively identify this with you.

JBS JÄRNVÄGSBRANSCHENS SAMVERKANSFORUM

Coordination and communication between different disciplines in complex infrastructure projects

SWECO – Transport, Railway

Background

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Question

How can coordination and communication between different technical disciplines (e.g., signaling technology, geotechnics, and architecture) be improved to reduce the number of design conflicts in the design phase of large railway projects?

Type of degree project (can be both)

Master (20 weeks):☒
Bachelor/Högskoleingenjör (10 weeks): ☐

Language for the thesis

Swedish:☒ and/or English:☒

Is Swedish a language requirement?

Yes:☐
No: ☐
No, but Swedish is a requirement for future employment:☒

Possibility to work from our office

Yes:☒
No:☐

Contact person

Agneta Innergård
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Group Manager, Project Management, Transport Infrastructure

Martin Hjort
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Group Manager, Project Management, Transport Infrastructure

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Cost control in large infrastructure projects during the design phase

SWECO – Transport, Railway

Background

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Question

What methods and tools can be used to improve cost control during the design phase in large railway and subway projects?

Type of degree project (can be both)

Master (20 weeks):☒
Bachelor/Högskoleingenjör (10 weeks): ☐

Language for the thesis

Swedish:☒ and/or English:☒

Is Swedish a language requirement?

Yes:☐
No: ☐
No, but Swedish is a requirement for future employment:☒

Possibility to work from our office

Yes:☒
No:☐

Contact person

Agneta Innergård
agneta.innergard@sweco.se
Group Manager, Project Management, Transport Infrastructure

Martin Hjort
martin.hjort@sweco.se
Group Manager, Project Management, Transport Infrastructure

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JBS JÄRNVÄGSBRANSCHENS SAMVERKANSFORUM

Improved scheduling and time tracking during the design phase

SWECO – Transport, Railway

Background

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Question

How can time tracking and scheduling be improved during the design phase in large infrastructure projects to ensure that the projects adhere to their timelines?

Type of degree project (can be both)

Master (20 weeks): ☒
Bachelor/Högskoleingenjör (10 weeks): ☐

Language for the thesis

Swedish: ☒ and/or English: ☒

Is Swedish a language requirement?

Yes: ☐
No: ☐
No, but Swedish is a requirement for future employment: ☒

Possibility to work from our office

Yes: ☒
No: ☐

Contact person

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Martin Hjort
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The importance of leadership for the performance of the project team during the design phase

SWECO – Transport, Railway

Background

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Question

How do different leadership styles affect the performance and collaboration of the team during the design phase of complex subway and railway projects?

Type of degree project (can be both)

Master (20 weeks):☒
Bachelor/Högskoleingenjör (10 weeks): ☐

Language for the thesis

Swedish:☒ and/or English:☒

Is Swedish a language requirement?

Yes:☐
No: ☐
No, but Swedish is a requirement for future employment:☒

Possibility to work from our office

Yes:☒
No:☐

Contact person

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JBS JÄRNVÄGSBRANSCHENS SAMVERKANSFORUM

Use of agile project management in the design phase of large railway projects

SWECO – Transport, Railway

Background

Sweco plans and designs the sustainable communities and cities of the future. Together with our clients, our team of 18,000 architects, engineers, and other specialists develops solutions to address urbanization, leverage the opportunities of digitalization, and make future societies more sustainable. Sweco is the leading consulting firm in technology and architecture in Europe, with a revenue of approximately 22 billion SEK. The company is listed on Nasdaq Stockholm. For further information, please visit www.sweco.se. Within the Transport Infrastructure division, we work on everything from small-scale initiatives to mega-projects in infrastructure. Admittedly, and with a hint of bias, we believe our projects—particularly due to their multifaceted nature—are among the most enjoyable, challenging, and stimulating endeavors at Sweco. However, we recognize that aspects of our project management processes can always be developed and improved, which is where this thesis comes into play. The purpose of the thesis is to develop and enhance our methodologies.

Question

Can agile methods be applied during the design phase of large railway and subway projects, and if so, how does it affect the project's flexibility and adaptability?

Type of degree project (can be both)

Master (20 weeks):☒
Bachelor/Högskoleingenjör (10 weeks): ☐

Language for the thesis

Swedish:☒ and/or English:☒

Is Swedish a language requirement?

Yes:☐
No: ☐
No, but Swedish is a requirement for future employment:☒

Possibility to work from our office

Yes:☒
No:☐

Contact person

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Group Manager, Project Management, Transport Infrastructure

Martin Hjort
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Group Manager, Project Management, Transport Infrastructure

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Factors affecting Dynamic Pricing Models for Railway Operators

Sweco Sverige AB – Tågtrafik & Logistik (Railway traffic & Logistics)

Select one (or more) categories to which this degree project corresponds the best

☒ Traffic Planning, market and Simulation
☐ Signalling and Traffic control systems
☐ Vehicles for Rail and Public transport
☐ Rail track, Geotechnics and Constructions
☐ Properties and Land use
☐ Electrical engineering and Power supply
☒ Digitalization, AI and Data Analytics
☐ Business Management
☐ Sustainability and Environment
☐ Other

Background

Dynamic pricing is a crucial strategy for optimizing railway operations by adjusting ticket prices based on demand fluctuations. With advancements in AI, machine learning, and real-time data processing, there is an opportunity to explore more sophisticated approaches to dynamic pricing. This project invites students to investigate how these technologies can be applied to enhance pricing models in the railway industry.

Problem description, tasks, and goals

Current dynamic pricing systems may not fully account for real-time factors such as local events, weather conditions, or customer preferences. Additionally, the potential for dynamic pricing to support sustainability goals, such as promoting off-peak travel or reducing carbon emissions, is not always explored. The challenge is to identify significant variables and patterns in data that can improve pricing strategies while aligning with both business and environmental objectives. The aim of this project is to develop and test an enhanced dynamic pricing model for railways. Students will explore advanced AI techniques, integrate data, and assess the impact of various factors on pricing decisions. To deepen their understanding, students are encouraged to conduct interviews or meetings with industry operators or customers to gather insights on key variables and perspectives. This research will help in identifying patterns and developing a more responsive and effective pricing model.

Type of degree project (can be both)

☒ Master (20 weeks)
☐ Bachelor/Högskoleingenjör (10 weeks)

Language for the thesis

☒ Swedish and/or ☒ English

Is Swedish a language requirement?

☐ Yes ☐ No ☒ No, but Swedish is a requirement for future employment

Possibility to work from our office

☒ Yes ☐ No

Contact person

Albin Kvarnefalk
Capacity analysist within railway
albin.kvarnefalk@sweco.se

Enhancing Collaboration through Contract Design in Swedish Rolling Stock Maintenance

Sweco Sverige

Select one (or more) categories to which this degree project corresponds the best

☐ Traffic Planning, market and Simulation
☐ Signalling and Traffic control systems
☒ Vehicles for Rail and Public transport
☐ Rail track, Geotechnics and Constructions
☐ Properties and Land use
☐ Electrical engineering and Power supply
☐ Digitalization, AI and Data Analytics
☒ Business Management
☐ Sustainability and Environment
☐ Other

Background
The Swedish railway system is among the most deregulated in Europe, if not the most. While this promotes competition, it also heightens the need for collaboration. Public procurement contracts are typically awarded to the lowest bidder, which often results in suboptimal outcomes as each participant concentrates solely on reducing their own costs.

Problem description, tasks, and goals
How can contracts be designed to foster collaboration in Swedish rolling stock maintenance? This project will involve reviewing current contracts, identifying essential elements that promote beneficial collaboration, and creating guidelines to enhance these aspects in future contracts. The study should discuss the potential benefits of enhanced collaboration from the perspectives of, but not limited to, innovation, cost-effectiveness, and asset management. Additionally, it will include standard research procedures, such as reviewing existing literature on the topic.

Type of degree project (can be both)
☒ Master (20 weeks)
☐ Bachelor/Högskoleingenjör (10 weeks)

Language for the thesis
☒ Swedish and/or ☒ English

Is Swedish a language requirement?
☐ Yes ☐ No ☒ No, but Swedish is a requirement for future employment

Possibility to work from our office
☒ Yes ☐ No

Contact person
Fredrik Strandberg Consultant Rolling Stock
fredrik.strandberg@sweco.se

External Power Supply for non-electrified Railways

Sweco Sverige

Select one (or more) categories to which this degree project corresponds the best

☐ Traffic Planning, market and Simulation
☐ Signalling and Traffic control systems
☒ Vehicles for Rail and Public transport
☐ Rail track, Geotechnics and Constructions
☐ Properties and Land use
☒ Electrical engineering and Power supply
☐ Digitalization, AI and Data Analytics
☐ Business Management
☐ Sustainability and Environment
☐ Other

Background
In Sweden 75% of the railway is electrified. Today the non-electrified railways are operated by locomotives with internal combustion engines running on fossil fuel. On the market today there are alternatives. However these locomotives both electrical with batteries or internal combustion engines, are not suited to supply power for other applications than propulsion itself when in combustion mode. When power supply is needed for other applications, the most common method is to use an external power pack such as an external diesel generator with a fuel tank. This is used to supply power for example construction equipment and emergency heating for passenger coaches.

Problem description, tasks, and goals
The problem is that current locomotives running on internal combustion engines is not suitable to supply external functions beyond propelling the vehicle. The task is to create a reliable energy source concept for construction and emergency operations. The concept should not be dependent on a specific locomotive or construction equipment.

Type of degree project (can be both)
☒ Master (20 weeks)
☐ Bachelor/Högskoleingenjör (10 weeks)

Language for the thesis
☒ Swedish and/or ☒ English

Is Swedish a language requirement?
☐ Yes ☐ No ☒ No, but Swedish is a requirement for future employment

Possibility to work from our office
☒ Yes ☐ No

Contact person
Karl Ståhlberg Consultant Rolling Stock
karl.stahlberg@sweco.se

Utilizing AI to Optimize Rolling Stock Maintenance Scheduling

Sweco Sverige AB

Select one (or more) categories to which this degree project corresponds the best

☐ Traffic Planning, market and Simulation
☐ Signalling and Traffic control systems
☒ Vehicles for Rail and Public transport
☐ Rail track, Geotechnics and Constructions
☐ Properties and Land use
☐ Electrical engineering and Power supply
☒ Digitalization, AI and Data Analytics
☐ Business Management
☐ Sustainability and Environment
☐ Other

Background

Railways have long been a cornerstone of Swedish transportation infrastructure, providing an efficient and sustainable means of travel and freight movement. As the demand for rail services increases, so does the need for maintenance of rolling stock—locomotives, passenger cars, and freight wagons. Effective maintenance is crucial not only for safety and reliability but also for cost efficiency and operational performance.
Traditionally, rolling stock maintenance has been scheduled based on predefined intervals, often leading to either over-maintenance or unexpected failures. This approach can be both costly and inefficient. In recent years, there has been a growing interest in leveraging advanced technologies to optimize these maintenance schedules. Artificial Intelligence (AI) presents a promising avenue for revolutionizing maintenance strategies.

Problem description, tasks, and goals

This thesis aims to explore how artificial intelligence (AI) can be leveraged to optimize maintenance schedules for rolling stock, thereby enhancing operational efficiency, and reducing costs. The thesis should aim to understand the stakeholders involved in the maintenance process and examine how alterations to a maintenance schedule affect, and are affected by, these actors. Additionally, the thesis will involve developing an AI model for optimization of maintenance schedules.

Type of degree project (can be both)
☒ Master (20 weeks)
☐ Bachelor/Högskoleingenjör (10 weeks)

Language for the thesis
☒ Swedish and/or ☒ English

Is Swedish a language requirement?
☐ Yes ☒ No ☒ No, but Swedish is a requirement for future employment

Possibility to work from our office
☒ Yes ☐ No

Contact person
Fredrik Strandberg
Consultant Rolling Stock
fredrik.strandberg@sweco.se

Image recognition of rolling stock components during inspection

SYSTRA AB

Select one (or more) categories to which this degree project corresponds the best

☐ Traffic Planning, market and Simulation
☐ Signalling and Traffic control systems
☐ Vehicles for Rail and Public transport
☐ Rail track, Geotechnics and Constructions
☐ Properties and Land use
☐ Electrical engineering and Power supply
☒ Digitalization, AI and Data Analytics
☐ Business Management
☐ Sustainability and Environment
☐ Other

Background
One of the main problems faced by the Swedish railway industry is breakdown of rolling stock operations due to various reasons such as faulty components, changing regulations and legacy methods for asset register, and maintenance crunch amongst others. In Systra we consult for various stakeholders in the Swedish railway industry on asset management of rolling stock with an increasing push towards digitalization. Our experience places us at a unique position to cater to the future needs of the rolling stock operators to realise the maximum value from their assets

Problem description, tasks, and goals

At Systra we are exploring digital solutions to help us with predictive maintenance of rolling stock and reduce time in identifying and resolving faults in the asset. In this we envision a connected digital eco-system encompassing rolling stock-focussed activities such as inspection at different stages of asset lifecycle, operation, safety assessment, inventory management, etc. An important step in this initiative is building a robust digital inspection tool. In this you will help us with the development of one of the key product features, i.e. **image recognition of components**.

Your activities include (but not limited to)

- Develop a functioning image recognition algorithm tailored to rolling stock subsystems preferably in Python using external libraries, i.e. you are not expected to write it from scratch
- Starting from the analysis of static images, extendable to dynamic image processing
- Perform a literature survey of similar tools/technologies in use in other capital-intensive industries, e.g. energy, ports, buildings, etc
- Follow product development principles in setting requirements and defining basline scope of the product feature

Skills we look for:

- Experience in writing code in Python/MATLAB.
- Willingness to learn

- Knowledge of the rolling stock system
- First principles of systems engineering
- Meritorious to have an understanding of underlying principles such as CNN, feature extraction, object detection algorithms, etc.
- Independent & collaborative: You will need to take the initiative to engage with various people during the assignment

Type of degree project (can be both)
☒ Master (20 weeks)
☒ Bachelor/Högskoleingenjör (10 weeks)

Language for the thesis
☒ Swedish and/or ☒ English

Is Swedish a language requirement?
☐ Yes ☐ No ☒ No, but Swedish is a requirement for future employment

Possibility to work from our office
☒ Yes ☐ No

Contact person
Visakh V Krishna, PhD. Consultant – Asset management
vkrishna@systra.com

ERTMS Level 1

SYSTRA AB

Select one (or more) categories to which this degree project corresponds the best

☐ Traffic Planning, market and Simulation
☒ Signalling and Traffic control systems
☐ Vehicles for Rail and Public transport
☐ Rail track, Geotechnics and Constructions
☐ Properties and Land use
☐ Electrical engineering and Power supply
☐ Digitalization, AI and Data Analytics
☐ Business Management
☐ Sustainability and Environment
☐ Other

Background
Sverige har haft en inriktning på att välja ERTMS Level 2 när man ska byta ut sitt ATC-system till ERTMS. I andra länder har man valt en annan inriktning.

Problem description, tasks, and goals
Vad krävs för att kunna behålla befintliga signalställverk och införa ERTMS Level 1 i Sverige? Vilka skillnader finns i kapacitet mellan ERTMS Level 1 och ERTMS Level 2?

Type of degree project (can be both)
☐ Master (20 weeks)
☒ Bachelor/Högskoleingenjör (10 weeks)

Language for the thesis
☒ Swedish and/or ☐ English

Is Swedish a language requirement?
☐ Yes ☐ No ☒ No, but Swedish is a requirement for future employment

Possibility to work from our office
☒ Yes ☐ No

Contact person
Mikael Cederlund Utredare Signalteknik
mcederlund@systra.com

ERTMS Level 1

SYSTRA AB

Select one (or more) categories to which this degree project corresponds the best

☐ Traffic Planning, market and Simulation
☒ Signalling and Traffic control systems
☐ Vehicles for Rail and Public transport
☐ Rail track, Geotechnics and Constructions
☐ Properties and Land use
☐ Electrical engineering and Power supply
☐ Digitalization, AI and Data Analytics
☐ Business Management
☐ Sustainability and Environment
☐ Other

Background
Sweden have chosen to use ERTMS Level 2 when replacing their old ATP-system to ERTMS. Other countries have chosen other levels of ERTMS.

Problem description, tasks, and goals
What is needed to keep the existing interlockings and use ERTMS Level 1 in Sweden? Is the capacity reduced in an ERTMS Level 1 compared to an ERTMS Level 2-system? Are there any benefits with choosing an ERTMS Level 1-system compared to a Level 2-system?

Type of degree project (can be both)
☒ Master (20 weeks)
☒ Bachelor/Högskoleingenjör (10 weeks)

Language for the thesis
☒ Swedish and/or ☒ English

Is Swedish a language requirement?
☐ Yes ☐ No ☒ No, but Swedish is a requirement for future employment

Possibility to work from our office
☒ Yes ☐ No

Contact person
Mikael Cederlund
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Signalling Safety Reviewer

Examensarbete inom elkraftsområdet

Vill du vara med och utveckla ett av Sveriges största och mest avancerade elkraftsystem och dessutom göra avtryck på framtidens infrastruktur? Skriv exjobb inom elkraft och bidra till hållbara transporter.

Detta är en generell annons för dig som redan har en specificerad frågeställning för examensarbetet och vill se om vi inom Elkraft är intresserade att realisera den tillsammans. Trafikverket Elkraft annonserar också specificerade examensarbeten utifrån våra egna frågeställningar. Dessa publiceras två gånger per år, tidig höst och tidig vår.

Uppdragsgivare
Trafikverket ansvarar för långsiktig planering av transportsystemet för vägtrafik, järnvägstrafik, sjöfart och luftfart samt för byggande, drift och underhåll av de statliga vägarna och järnvägarna. Trafikverket prövar också frågor om statligt bidrag till svensk sjöfartsnäring och verkar för tillgänglighet i den kollektiva persontrafiken genom bland annat upphandling av avtal.

Järnvägar
Trafikverket är infrastrukturförvaltare för cirka 14 200 spårkilometer av Sveriges järnvägsnät. Den allra största delen, över 80 procent, är elektrifierad järnväg. Utöver det statliga järnvägsnätet finns industrispår till exempel hos industrier, terminaler och hamnar, spårvägar och tunnelbanor.

Bakgrund:
Trafikverket arbetar med elkraft inom ett flertal områden. Mest känt är att vi har ett avancerat kraftsystem för att försörja elektriska tåg samt järnvägens kringutrustning. Det är ett av Sveriges största kraftnät och den sammanlagda effekten är ca 2 000 MVA.

Tågen på järnvägen matas i Sverige via ett 1-fas system med en frekvens på 16,7 Hz. Lasterna (tågen) i detta system är i ständig rörelse med varierat effektuttag. Hos Trafikverket finns omformarstationer för att omvandla elenergi med en frekvens på 50 Hz till 16,7 Hz. Detta sker både med avancerade omriktare med den senaste halvledartekniken samt med roterande omformare bestående av synkronmotorer och synkrongeneratorer. Energin förs ut till fordonen via ett nät av kontaktledningar, matarledningar, kopplingscentraler och transformatorstationer. Kontaktledningarna står i förbindelse med en strömavtagare på fordonet som via elmotorer driver tågen. För att försörja lasterna utmed järnvägen med elenergi, som t.ex. signalanläggningar, teleanläggningar, belysning på bangårdar och för att värma spårväxlar har Trafikverkets ett högspänt 50 Hz hjälpkraftssystem samt lokala kraftanslutningar med lägre spänning. Hela kraftsystemet övervakas och styrs via driftcentraler samt anläggningens egna styr- och övervakningssystem med reläskydd, regulatorer, etc.

Förutom arbete med järnväg utvecklar och förvaltar Trafikverket även vägnätets kraftförsörjning, exempelvis belysningen och kraftförsörjning av tunnlar. Dessutom arbetar vi med elektrifiering av vägar samt elektrifiering av vägfärjor och därtill kopplade system. Totalt sett spänner trafikverkets kraftsystem över ett stort antal teknikområden där vi besitter specialistkompetens.**Frågeställning**

- Hur kan kvarstående livslängd för befintliga kontaktledningsfundament i Trafikverkets anläggning bedömas på ett tillförlitligt sätt?
- Har de designförändringar som genomförts, t.ex. övergången till ihåliga fundament, haft en positiv eller negativ inverkan på fundamentens livslängd?
- Vilka åtgärder kan vidtas för att förlänga livslängden hos befintliga fundament så att de klarar Trafikverkets mål om en livslängd på uppemot 100 år, och kan förbättringar i utformningen minska riskerna för exempelvis korrosion och stående vatten i ihåliga fundament?

Om examensarbetet
Det här är en möjlighet för dig som har ett stort intresse för teknik, att tillsammans med våra tekniska specialister, fördjupa dig inom elkraftsområdet.

Arbetet utförs individuellt eller i par om två studenter. Studenterna själva driver arbetet framåt och har löpande avstämningar med personal från Trafikverket samt högskolan eller universitetet.

Examensarbetet bygger på en av studenten framtagen frågeställning som sedan planeras och utformats tillsammans mellan Trafikverket och lärosätet utifrån behov, kunskap och intresseområde. Det är också

viktigt att säkerställa att kravet kring arbetets formella utformning uppfylls. Ofta inleds arbetet med en litteraturstudie med tillhörande inläsningsfas innan själva uppgiften eller forskningsområdet angrips. Resultatet redovisas i en rapport samt tillhörande presentation.

Exempel på forskningsområden

- Utformning av låg- eller högspänningsanläggningar
- Högspänningsteknik eller mekanik för kontaktledning, kraftledning, kabelteknik eller liknande
- Simulering av kraftsystem
- Drift och optimering av kraftsystem
- Analys av inhämtad information från kraftsystemet (Dataanalys/Big data/AI)
- Fördjupning kring en eller flera komponenter inom kraftsystemet
- Energieffektivisering och effektoptimering
- Samspelet mellan trafik, fordon och kraftsystemet
- Elkvalitet
- Jordning
- Underhållsteknik
- Livscykelanalys
- Belysning

Kvalifikationer

Du har förmåga att självständigt strukturera ditt arbete/angreppssätt i frågor och driver dessa processer vidare. Du har förmågan att göra analyser av dina resultat och kan se vilken påverkan dessa har ur ett helhetsperspektiv.

Du har lätt för att samarbeta, du är nyfiken och har viljan att driva arbetet framåt. Du har en god kommunikationsförmåga som innebär att du förmedlar budskap på ett enkelt sätt samt är lyhörd och anpassar din kommunikation till mottagaren.

Vi söker dig som:

- är driven och vill utveckla Trafikverkets kraftsystem
- håller på att avsluta en högskoleutbildning inom elkraft, maskinteknik, energiteknik, underhållsteknik eller annan för examensarbetet relevant utbildning.
- har mycket goda kunskaper i svenska i tal och skrift.

Övrig information

Koncernspråk inom Trafikverket är svenska och alla våra styrande dokument och de flesta rapporter är skrivna på svenska. Examensuppsatsen kan skrivas på engelska.

Som sökande till Trafikverket kan du eventuellt behöva gå igenom en säkerhetsprövning. Den innehåller säkerhetsprövningssamtal och registerkontroll innan anställning, om tjänsten är placerad i säkerhetsklass. I vissa fall krävs svenskt medborgarskap för säkerhetsklassade tjänster.

Ansökan

Trafikverket tar inom elkraftsområdet emot öppna ansökningar om examensarbeten där du som student har en idé till frågeställning som du vill arbeta utifrån. Vi erbjuder sedan examensarbeten utifrån att det matchar våra behov och möjligheter samt att det matchar dina behov och kunskaper.

För att hinna hantera er ansökan önskar vi att den skickas till oss senast tre månader innan önskat startdatum för examensarbetet. Antalet examensarbeten per år är begränsat inom elkraft, så ansök gärna i god tid.

Skicka in din ansökan till oss via e-post till: elkraft@trafikverket.se

Din ansökan ska innehålla:

- En kort specifikation för examensarbetet där följande framgår:
  - Bakgrund
  - Syfte
  - Frågeställning
  - Mål
- Ett personligt brev per student med:
  - En presentation av dig själv.
  - En beskrivning av din utbildning och kompetenser.

    - Ett förslag till examensarbete alternativt en beskrivning av det område inom elkraft som ni önskar att fördjupa er inom.
- CV inklusive utdrag över relevanta kurser för examensarbetet.
- Information om på vilken ort ni önskar genomföra examensarbetet, arbetets omfattning (15/30 hp), samt när i tid det ska genomföras.

Kontaktledningsfundament:
Livslängdsanalys och förslag på hållbarhetsåtgärder

Uppdragsgivare
Trafikverket ansvarar för långsiktig planering av transportsystemet för vägtrafik, järnvägstrafik, sjöfart och luftfart samt för byggande, drift och underhåll av de statliga vägarna och järnvägarna. Trafikverket prövar också frågor om statligt bidrag till svensk sjöfartsnäring och verkar för tillgänglighet i den kollektiva persontrafiken genom bland annat upphandling av avtal.

Järnvägar
Trafikverket är infrastrukturförvaltare för cirka 14 200 spårkilometer av Sveriges järnvägsnät. Den allra största delen, över 80 procent, är elektrifierad järnväg. Utöver det statliga järnvägsnätet finns industrispår till exempel hos industrier, terminaler och hamnar, spårvägar och tunnelbanor.

Syfte
Syftet med detta examensarbete är att undersöka och utveckla metoder för tillståndsbedömning av Trafikverkets befintliga kontaktledningsfundament. Arbetet ska också inkludera förslag på förbättringar av fundamentens utformning som kan bidra till en ökad livslängd och bättre möta framtida krav.

Bakgrund:
Trafikverket har under årens lopp använt flera olika typer av kontaktledningsfundament, vilket har resulterat i en stor variation av fundament i järnvägsanläggning. Fram till 1990-talet var det vanligt att kontaktledningsstolparna gjöts direkt in i fundamenten, vilket skapade en stadig men korrosionskänslig konstruktion. Under 1990-talet infördes en ny design där stolparna istället monterades med bultförband i fundamentet, vilket underlättade underhåll och kontaktledningsbyten. Ytterligare förändringar, som införandet av ihåliga fundament för att minska materialåtgången, har också implementerats.

Idag råder det osäkerhet kring om det till exempel är risk för stående vatten inuti fundamenten, och det saknas en metod för att bedöma om detta påverkar livslängden negativt. Trafikverket har heller ingen metod för att inspektera fundamenten invändigt. Denna variation i fundamenttyper och osäkerheter kring vissa utformningar har lett till att behovet av tillståndsbedömning har blivit allt viktigare, särskilt då man strävar efter att öka livslängdskraven till uppemot 100 år.

Frågeställning
- Hur kan kvarstående livslängd för befintliga kontaktledningsfundament i Trafikverkets anläggning bedömas på ett tillförlitligt sätt?
- Har de designförändringar som genomförts, t.ex. övergången till ihåliga fundament, haft en positiv eller negativ inverkan på fundamentens livslängd?
- Vilka åtgärder kan vidtas för att förlänga livslängden hos befintliga fundament så att de klarar Trafikverkets mål om en livslängd på uppemot 100 år, och kan förbättringar i utformningen minska riskerna för exempelvis korrosion och stående vatten i ihåliga fundament?

Arbetets innehåll
- Kartläggning av Trafikverkets fundament som fortfarande är i bruk i anläggningen.
- Genomföra mätningar och tester, i fält och/eller i lab, t ex med hjälp av titthålskamera eller korrosionsmätningar.
- Att utveckla en metod för att på ett tillförlitligt sätt bedöma den kvarstående livslängden för kontaktledningsfundament i Trafikverkets anläggningar, som kan användas som beslutsunderlag inom verksamhetsplaneringen.
- Föreslå ändringar i regelverk eller förbättringar i fundamentens design för att förlänga deras livslängd och säkerställa att de möter framtida krav på hållbarhet och livslängd.

Kvalifikationer
- Civilingenjörsutbildning inom Väg- och Vattenbyggnad/Samhällsteknik eller motsvarande
- Kunskaper inom hållfasthetslära, konstruktionsteknik samt betong

- Inom Trafikverket används i första hand svenska i kommunikation och i skrivna dokument. Goda kunskaper i svenska är därför meriterande men inget krav om studenten besitter goda kunskaper i engelska.
- Med fördel har sökande även kunskaper inom korrosion

Placeringsort
Arbetet bedrivs vid lärosätet alternativt vid Trafikverkets kontor i Malmö.
Handledning finns i Lund/Malmö.

Övrigt
Arbetet utförs med fördel under VT25.

Ansökan
Vi önskar att ni skickar in er ansökan till elkraft@trafikverket.se och märker mailet med ”Examensarbete kontaktledningsfundament”

Ansökan ska innehålla följande:
Personligt brev
CV inkl betygsutdrag av relevanta kurser
Önskad placeringsort
Ungefärlig tidsperiod när exjobbet kan genomföras

Urvalsprocessen sker löpande med en sista ansökningsdag 2024-11-30.

Kontakt
Hanna Närhi
E-post: hanna.a.narhi@trafikverket.se

Nyttjandegrad banarbeten

Uppdragsgivare
Trafikverket ansvarar för långsiktig planering av transportsystemet för vägtrafik, järnvägstrafik, sjöfart och luftfart samt för byggande, drift och underhåll av de statliga vägarna och järnvägarna. Trafikverket prövar också frågor om statligt bidrag till svensk sjöfartsnäring och verkar för tillgänglighet i den kollektiva persontrafiken genom bland annat upphandling av avtal.

Järnvägar
Trafikverket är infrastrukturförvaltare för cirka 14 200 spårkilometer av Sveriges järnvägsnät. Den allra största delen, över 80 procent, är elektrifierad järnväg. Utöver det statliga järnvägsnätet finns industrispår till exempel hos industrier, terminaler och hamnar, spårvägar och tunnelbanor.

Beskrivning av ämnet
Nyttjandegraden av banarbeten behöver öka och vi behöver ta fram en metod för effektiv uppföljning av utnyttjade banarbetstider i spår.

Dokumentationen av banarbeten sker genom manuella rutiner.
Trafikverket saknar möjlighet att följa upp banarbeten och utförandet av dessa för att upptäcka och eliminera slöseri samt kunna adressera problem och utmaningar dit de hör hemma (projekt/entreprenör/kontraktsskrivningar etc). En digital hantering av detta system är nyckeln för att kunna få till det.

Etablera en applikation för digital hantering av banarbeten i det operativa skedat. Utfallsdata för planerade banarbeten ska kunna exporteras för att kunna följa upp nyttjandegrad, kunna följa volymen av direktplanerade skydd osv.

Omfattning
Vi ser gärna ett arbete som görs av två personer.
I dialog med handledarna kan omfattning, upplägg och leveranser diskuteras.

Kontakt
Anders Viklund Trafikverket
E-post: anders.viklund@trafikverket.se

Arne Cronvall, Trafikverket
E-post: arne.cronvall@trafikverket.se

Simulering av transienta förlopp vid kopplingar i Trafikverkets kraftsystem för banmatning

Uppdragsgivare
Trafikverket ansvarar för långsiktig planering av transportsystemet för vägtrafik, järnvägstrafik, sjöfart och luftfart samt för byggande, drift och underhåll av de statliga vägarna och järnvägarna. Trafikverket prövar också frågor om statligt bidrag till svensk sjöfartsnäring och verkar för tillgänglighet i den kollektiva persontrafiken genom bland annat upphandling av avtal.

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Syfte
Syftet med examensarbetet är att skapa en fördjupad förståelse kring transienta fenomen som uppträder i delar av Trafikverkets kraftsystem vid t.ex. omkopplingar eller andra händelser. Främst där det finns kablar och/eller elektriska maskiner med stor kapacitans eller induktans.

Bakgrund:
Trafikverket arbetar med elkraft inom ett flertal områden. Mest känt är att vi har ett avancerat kraftsystem för att försörja elektriska tåg samt järnvägens kringutrustning. Det är ett av Sveriges största kraftnät och den sammanlagda effekten är ca 2 000 MVA.

Tågen på järnvägen matas i Sverige via ett 1-fas system med en frekvens på 16,7 Hz. Lasterna (tågen) i detta system är i ständig rörelse med varierat effektuttag. Hos Trafikverket finns omformarstationer för att omvandla elenergi med en frekvens på 50 Hz till 16,7 Hz. Detta sker både med avancerade omriktare med den senaste halvledartekniken samt med roterande omformare bestående av synkronmotorer och synkrongeneratorer. Energin förs ut till fordonen via ett nät av kontaktledningar, matarledningar, kopplingscentraler och transformatorstationer. Kontaktledningarna står i förbindelse med en strömavtagare på fordonet som via elmotorer driver tågen.

I kraftsystemet finns flera brytare och frånskiljare som används för att kunna ansluta eller koppla från olika delar av nätet. Vid omkopplingar, i förloppet mellan en driftsituation till en annan, kan transienta spänningar och strömmar uppstå. För att kunna studera sådana transienta förlopp används snabba mätsystem och simuleringsmodeller med kapacitet att hantera med korta tidssteg.

Trafikverket har med hjälp av ABB Corporate Research genomfört mätningar i delar av Trafikverkets kraftsystem för att studera transienta strömmar och spänningar vid omkopplingar i delar av 15 kV (16 Hz) systemet. Både strömmar och spänningar har registrerats och analyserats.

Nästa steg i arbetet, som detta examensarbete syftar till, är att utveckla en simuleringsmodell som representerar den del av nätet där mätningar genomförts samt genomföra analyser. Detta med syfte att fördjupa förståelsen kring de uppmätta fenomen som uppstår samt se hur förändringar i nätets uppbyggnad påverkar de transienta förloppen.

Genomförande
Examensarbetet innehåller följande arbetsmoment:

- Informationsinhämtning kring Trafikverket kraftsystem för att skapa en förståelse om dess uppbyggnad och funktion.
- Framtagning av en simuleringsmodell (i t.ex. PSCAD) som representerar den del av kraftsystemet där genomförda mätningar har genomförts.
- Analysera och förklara de fenomen som uppträder i kraftsystemet vid mätning och simulering.
- Analysera hur olika förändringar i modellen påverkar simuleringsresultaten, t.ex:

- Placering av filter samt val av filterparametrar för att minska transienter.
- Val av olika kabeltyper samt längder på kablar.
- Dokumentera och sammanställa genomföra arbete i en rapport skriven på engelska.

Krav

- Student på masternivå med kunskap inom elkraftsystem.
- Analytisk och strukturerad
- God kommunikationsförmåga på engelska, både muntlig och skriftlig.
- Utöver kraven är det meriterande om du har:

- Erfarenhet av simulering av transienta förlopp i elkraftsystem.
- Kunskap i mjukvaran PSCAD
- God kommunikationsförmåga på svenska, både muntlig och skriftlig.

Övrigt

- Examensarbetet sker i ett nära samarbete mellan Trafikverket och ABB. Handledning och simuleringar kommer att genomföras hos ABB Corporate Research i Västerås.
- Examensarbetet avser 30 hp.

Ansökan

Ansökningar för examensarbetet hanteras av ABB via den annons som du hittar här:

Master Thesis in Transient Power System Simulations representing part of the Swedish railway network in Västerås, Vaestmanland County, Sverige | Forskning & utveckling at ABB (careers.abb)

Översyn Teknisk Säkerhetsstyrning Signal (TSS)

Uppdragsgivare
Trafikverket ansvarar för långsiktig planering av transportsystemet för vägtrafik, järnvägstrafik, sjöfart och luftfart samt för byggande, drift och underhåll av de statliga vägarna och järnvägarna. Trafikverket prövar också frågor om statligt bidrag till svensk sjöfartsnäring och verkar för tillgänglighet i den kollektiva persontrafiken genom bland annat upphandling av avtal.

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Syfte
Trafikverkets har en process för Teknisk Säkerhetsstyrning Signal som är Trafikverkets tolkning och anpassning av kraven enligt CENELEC 50126, 50128, 50129. Examensarbetet syftar till att utreda hur väl Trafikverkets anpassning följer kraven enligt senaste utgåvor av CENELEC.

Bakgrund
Trafikverket har under snart 22 års tid använt sig av en egen process, Teknisk Säkerhetsstyrning Signal, för att bevisa säkerheten i signalanläggningen. Anledningen till att processen är framtagen är att den ska vara en anpassning till Trafikverkets verksamhet av de CENELEC krav som finns. Trafikverket vill dock tydliggöra mappningen mellan processen och CENELEC och undersöka förbättringsmöjligheter.

Arbetets innehåll

- Utreda hur väl Trafikverkets anpassning följer kraven enligt CENELEC 50126, 50128, 50129
- Komma med förbättringsförslag, förenkling eller komplettering, på Trafikverkets process för Teknisk Säkerhetsstyrning Signal
- Dokumentera utfört arbete och resultatet i form av en slurapport.

Metod
Först och främst läsa in sig på gällande regelverk. Både Trafikverkets regelverk och CENELEC. Intervjuer med personer som är berörda eller arbetar med processen. Undersöka hur andra infrastrukturförvaltare arbetar med Teknisk Säkerhetsstyrning Signal. Både i Sverige och om möjligt andra europeiska förvaltare.

Ort
Valfri, arbete utförs i huvudsak på distans utanför Trafikverkets lokaler. Handledaren placerad i Borlänge.

Datum
Examensarbetet planeras att genomföras vårterminen 2025.

Kontakt
Mattias Karlsson, Trafikverket
E-post: mattias.a.karlsson@trafikverket.se