Master Thesis spring 2023: Fault detection for a hydraulic rock drill through machine learning with domain adaption

Company presentation:
Epiroc is a leading productivity partner for the mining, infrastructure and natural resources industries. With cutting-edge technology, Epiroc develops and produces innovative drill rigs, rock excavation and construction equipment, and provides world-class service and consumables.

As a thesis student you will have the opportunity to work in an open and friendly environment, where we are committed to always find new innovative solutions through collaboration both within the team and externally. Join our journey towards developing future technology within electrification and automation.

Functional area: Rock Drills
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Education background:
Mechanical engineering, Mechatronics, Electrical engineering, Data Science

Level of thesis project:
Master Thesis.

Number of students in the project:
Two students per project.

Target:
The target of this project is to investigate how information from a physics-based model can be utilized in combination with data driven approaches. In particular, we wish to investigate how domain adaptation between a simulation model and reality can be used to extend the usability of data driven methods.

Background:
Hydraulic rock drills are robust hydromechanical systems with extreme performance requirements. As a result, it is complicated to have any sort of sensors on the device, for example with the purpose of condition monitoring. A possible solution is to have pressure sensors in close vicinity, but a downside of this approach is how to interpret results from such a sensor since many possible fault modes and variations can affect the signal. The data also tends to become sensitive to external disturbances. A dataset including induces internal faults is available, which was used in the PHM2022 data challenge. The outcome of this challenge generated a number of proposed data driven methods for fault classification.

Paper on the dataset; https://data.phmsociety.org/wp-content/uploads/sites/9/2022/06/PHM2022_Data_Challenge_Description.pdf
PHM data challenge: https://data.phmsociety.org/2022-phm-conference-data-challenge/

Figure 1. An underground drill rigs, typically used for the target system

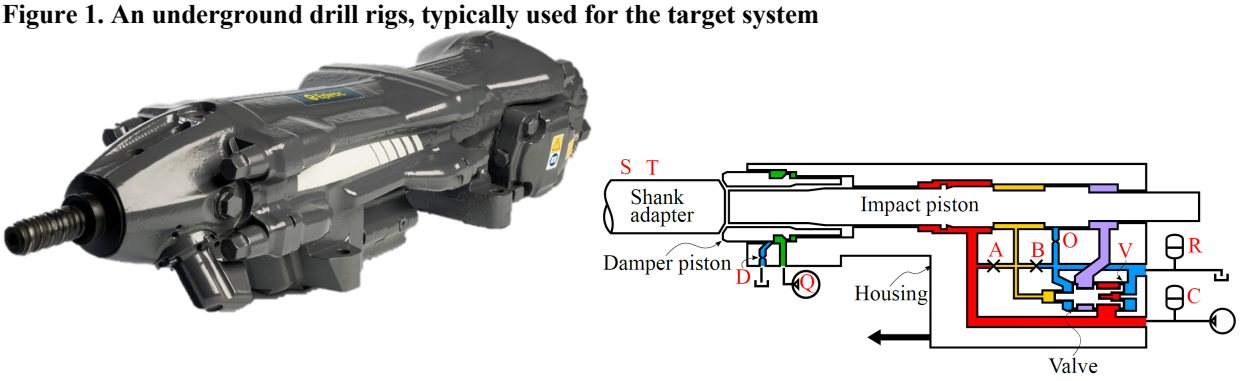

Figure 2. External and schematic view of the hydraulic rock drill.

Mission:
The mission is to evaluate how domain adaptation techniques can be utilized to combine information from existing physics based models, and various machine learning models. The success is measured not as increased accuracy on the test set, but rather an increased usability of the models to new domains.

Qualification:
To be successful in this project, the students need to be curious and thorough in investigating unknown areas. The thesis is not strictly specified and can thus change depending on the outcome of the project. This is a big opportunity for the ambitious student, who can then shape the thesis to his/her will, but also put demands on the students to come with ideas and shape the task in a useful direction together with the supervisors. The students preferably have experience in signal processing, machine learning and simulation of hydraulic/mechanical systems.

How to apply:
Does this sound interesting, and do you feel this is a match? Log in to the recruitment system. If you are new to the system, you need to start by making a profile. Do not forget to attach your CV and a short letter about your-self, describing why you are applying for this thesis. Please note that we **do not** accept applications via email.

Send your application as soon as possible, but **no later than November 12.**