SCIENCES & BIOENGINEERING SCIENCES

The Research Group
Artificial Intelligence Lab

has the honor to invite you to the public defence of the PhD thesis of

Xavier Chesterman

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:

Condition monitoring and failure diagnosis for wind turbines in the context of rare failing and slowly progressing damage

Promotors:
Prof. dr. Ann Nowé
Prof. dr. Jan Helsen

The defence will take place on

Friday, November 28 2024 at 3 p.m. in auditorium D.2.01

The defence can also be followed through a live stream: **Join the meeting now**

Members of the jury

Prof. dr. Coen De Roover (VUB, chair)
Prof. dr. Pieter Libin (VUB, secretary)
Dr. Cédric Peeters (VUB)
Prof. dr. Bart Goethals (UAntwerpen)
Prof. dr. Donatella Zappalá (TU Delft, NL)
Prof. dr. Amir Nejad (NTNU, NO)

Curriculum vitae

Opleiding

- PhD Computer Science, Vrije Universiteit Brussel, Brussels, Belgium
- Master of Science in Statistical Data Analysis , Ghent University, Ghent, Belgium
- Master of Science in Economics, Ghent University, Ghent, Belgium
- Master of Arts in History, Ghent University, Ghent, Belgium

Employment

- Vrije Universiteit Brussel, Brussels, Belgium, Sep 2021-now
- Picanol NV, Ieper, Belgium, July 2018-Aug 2021

Abstract of the PhD research

It is a well-known fact that the current generations of operational wind turbines suffer from premature component failures. These failures result often in long downtimes. If it were possible to identify them sufficiently in advance, the failing components could be replaced during regular maintenance. This would result in significantly lower maintenance costs and shorter downtimes.
Failure prediction and diagnosis for wind turbines is currently an unsolved question. A useful system should be able to detect many different failure types well in advance. This means it should not just be able to identify the moment a component starts behaving out of the ordinary, but it should also be able to interpret the abnormal behavior.
The improved availability of data has been a blessing and a curse. On the one hand, it has made it possible to analyze the behavior of the wind turbines thoroughly. On the other hand, the large quantity of data has made the task of analyzing and understanding it a challenging task for experts. An automated approach would solve this problem. Developing such a methodology is currently the topic of state-of-the-art research.
The main goal of the research presented in this thesis is the development of an automated failure detection and diagnosis framework for wind turbine drivetrains. This is done using data that is readily available from wind farms, e.g. 10-minute Supervisory Control And Data Acquisition (SCADA) and status log data. The framework should be able to identify or predict failures of wind turbine drivetrains well in advance by analyzing component temperatures. Furthermore, it should also be able to determine the failure mode accurately by analyzing the patterns in the identified abnormal behavior.
The framework is a pipeline consisting of several artificial intelligence (AI) techniques, i.e. machine learning and data mining. The developed framework is validated on data from three operational wind farms. Several techniques are tested. The validation shows that the best failure prediction methodology can detect failures accurately and well in advance. The best failure diagnosis methodology succeeds in identifying patterns that are related to certain failure modes. These patterns can be used to make an accurate failure diagnosis.