

Thesis proposal

Thesis proposal title	Advanced predictive maintenance decision-making based on Machine learning for Industry 4.0
Research laboratory	<i>Laboratory:</i> Roberval (mechanical, acoustics and material engineering) laboratory, Pierre Guillaumat research center, University of Technology of Compiègne (UTC), France <i>research team:</i> Integrated systems team: Product / Process <i>web site:</i> https://roberval.utc.fr/
Thesis supervisor(s)	Vu Hai Canh, Assistant Professor, Roberval laboratory, UTC (Compiègne, France) Amélie Ponchet Durupt, Assistant Professor, Roberval laboratory, UTC (Compiègne, France)
Scientific domain(s)	Reliability engineering, Data science
Research work	<p>The production processes of the future are intelligent systems composed of several cyber-physical modules (CPMs). From a maintenance point of view, a CPM can be an integration of a machine (physical part) with its intelligent sensors (IoT : Internet of Things) and actuators to enable it to: (a) automatically measure the level of degradation of the machine (crack size, vibration level, etc.); (b) predict the evolution of the system health; (c) calculate the Remaining Useful Life (RUL), i.e. the time remaining before the machine failure; (d) make the predictive maintenance (PdM) decision according to the calculated RUL (e.g. https://www.youtube.com/watch?v=cFIY6L1igKY). The PdM decision-making process has been developed mainly based on historical degradation data to reduce the maintenance and machine failure related costs. In reality, the machine may be in malfunctioning states before its failure. These states lead to various problems concerning the product quality (e.g. the increase of the rate of nonconformity) and bring many difficulties to the customer satisfaction and/or to the production organization. The penalty costs related to these problems can be very high depending on the applications. To reduce the previous impacts and improve the company competitiveness, it is therefore important to consider the product quality in PdM decision-making process. For this purpose, our project focuses on developing advanced predictive maintenance models based on Machine learning methods allowing to improve significantly the product quality. The project contains two main phases:</p> <ul style="list-style-type: none"> • Advanced prognostic approaches based on the machine learning to explore the product/process data (e.g. historical control charts). The developed approaches should consider the computational constraints of the CPMs to enable the artificial intelligence application. • Flexible PdM decision rules based on the prognostic results (e.g. predicted machine health and/or product quality state). These decisions should be optimized with respect to the zero-defect manufacturing concept in industry 4.0. <p>The obtained results of the project will provide a scientific basis for the applications of Predictive maintenance, Artificial intelligence and Zero-defect manufacturing in Industry 4.0.</p>
Key words	Machine learning, Industry 4.0, Internet of Things, zero defect manufacturing, Artificial Intelligence, Predictive maintenance decision-making.
Requirements	<p><i>Skills:</i></p> <ul style="list-style-type: none"> - Scientific background in mechanics engineering, reliability engineering and data science. - Proficiency in English writing and in French if possible - Programming language: Python, R <p><i>Personal Qualities:</i></p> <ul style="list-style-type: none"> - Ability to work collaboratively as part of a team in an interdisciplinary context - Capacity to conduct a project with different tasks and respect deadlines - Flexibility, motivation, pro-activity, commitment to high quality <p><i>Qualification:</i></p> <p>MS degree or equivalent qualification.</p>