Development of a Digital Twin approach for Health Monitoring and Predictive Maintenance

Ref. BAP-2020-63

The proposed research track runs at the KU Leuven Noise and Vibration Research Group which currently counts 90 researchers and is part of the Department of Mechanical Engineering, a vibrant environment of more than 300 researchers (www.mech.kuleuven.be). Doctoral training is provided in the framework of the Leuven Arenberg Doctoral School (https://set.kuleuven.be/phd).
The Noise and Vibration Research Group has a longstanding history and internationally highly recognized expertise in the fields of condition monitoring, numerical modeling, engineering dynamics, automotive engineering, vibro-acoustic analysis, identification and robust optimal control of (non-) linear systems, active control and lightweight structure design and analysis. The Noise and Vibration research group is also recognized for its yearly Acoustics (ISAAC) and Modal Analysis (ISMA) courses and for organizing the biennial ISMA Noise and Vibration Engineering Conference (www.isma-isaac.be).
Furthermore, the group contributes the DMMS (Dynamics of Mechanical and Mechatronic Systems) University Core Lab of Flanders Make. Flanders Make is the strategic research centre for the manufacturing industry in Flanders, stimulating open innovation through excellent research.
The research group's international research flavour is illustrated amongst others by the large portfolio of research projects (https://www.mech.kuleuven.be/en/mod/Projects) which includes regional, national and international funded activities through which the group cooperates with leading mechatronic and machine & vehicle-building companies in Flanders and throughout Europe.

https://www.mech.kuleuven.be/en/mod

Project

In the era of Industrial Internetof Things (IIoT) and Industry 4.0, complex electromechanical systems will be equipped with a variety of sensors providing new opportunities for the development of Health Monitoring and Management Systems targeting to the optimum exploitation of available information in order to maximize the performance of machinery. Focusing towards the increase of production reliability and safety as well as on the reduction of cost, there is an ever increasing industrial need not only for accurate, early, on time and online fault detection and diagnosis with minimum/optimum number of false alarms and missed detections but also for a robust, early, accurate and on time estimation of the Remaining Useful Life (RUL) of the defected components, within a confidence interval, independent of the operating conditions. Prognostics and Health Management (PHM) is an emerging engineering discipline, linking the failure mechanisms to the system life cycle management, but is still an Achilles' heel in Condition Based Monitoring being still immature. Prognostics is extremely important for safety critical components and therefore the first prognostics applications are focused on aerospace vehicle applications (NASA,GE, Rolls Royce, Pratt&Whitney etc.), on electronics & battery applications (related mainly to aerospace) and recently on industrial applications such as paper making machines. Moreover the existing Prognosticand Health Monitoring (PHM) techniques have not yet achieved the level of accuracy needed for systems operating under varying operating conditions and have not yet found massively their position in the industrial world. A key technological barrier is the absence of real (mainly vibration) measurement data from the industrial field in sufficient quantities (enough to assure the correct training and validation of Machine Learning algorithms), captured under different operating conditions and presenting different failure modes and abnormalities, as industries seldom allow their machines to run to failure. Additionally the physical degradation tests, even in their accelerated version, present long duration and extremely high cost without reassuring the natural development of different failure modes.

Therefore, to overcome the above mentioned limitations, the core target of the PhD will be the development of a Digital Twin approach for Health Monitoring and Predictive Maintenance of transmissions, consisting of bearings and gears. The major objectives of the PhD will be: a) the development of a Digital Twin of physical component/system inoperation, to support data driven prognostic methodologies by simulations and artificial data generation, trying to solve the classical problem of unavailable, sparse or truncated data and b) the proposal of advanced prognostic techniques for the estimation of Remaining Useful Life of mechanical components/systems based on the combination of the Digital Twin perspectivewith Machine Learning and Parameter Estimation techniques.

Profile

We are looking for a highly motivated, enthusiastic, communicative and eager to learn researcher with a Master of Science in Engineering (preferably in Mechanical or Electrical Engineering). The candidate should have a strong background and interest in signal processing, machine learning, measurements and particularly in vibrationand acoustic condition monitoring, fault detection and diagnosis of complex electro mechanical systems.

The candidate is expected to:

- · Have a very good knowledge of English (spoken and written);
- · Be a team player;
- · Be able to work independently,accurately and methodically;
- · Have the willing to present researchfindings at national and international conferences;
- · Have the willing to publish researchfindings in international journals.

Offer

A remuneration package competitive with industry standards in Belgium, a country with a high quality of life and excellent health care system.

- An opportunity to pursue a PhD in Mechanical Engineering, typically a 4 year trajectory, in a stimulating and ambitious research environment.
- Ample occasions to develop yourself in a scientific and/or an industrial direction. Beside sopportunities offered by the research group, further doctoral training for PhD candidates is provided in the framework of the KU Leuven Arenberg DoctoralSchool (https://set.kuleuven.be/phd), known for its strong focus on both future scientists and scientifically trained professionals who will valorise their doctoral expertise and competences in a non-academic context. More informationon the training opportunities can be found on the following link:https://set.kuleuven.be/phd/dopl/whytraining.
- A stay in a vibrant environment in the hearth of Europe. The university is located in Leuven, a town of approximately 100.000 inhabitants, located close to Brussels (25km), and2 0 minutes by train from Brussels International Airport. This strategic positioning and the strong presence of the university, international research centers, and industry, lead to a safe town with high quality of life, welcome to non-Dutch speaking people and with ample opportunities for social and sportactivities. The mixture of cultures and research fields are some of the ingredients making the university of Leuven the most innovative university in Europe (https://nieuws.kuleuven.be/en/content/2018/ku-leuven-once-again-tops-reuters-ranking-of-europes-most-innovative-universities).

Interested?

For more information please contact Prof. dr. Konstantinos Gryllias, tel.: +32 16 32 30 00, mail: konstantinos.gryllias@kuleuven.be.

You can apply for this job no later than February 29, 2020 via the online application tool :

http://www.kuleuven.be/eapplyingforjobs/light/55546931

KU Leuven seeks to foster an environment where all talents can flourish, regardless of gender, age, cultural background, nationality or impairments. If you have any questions relating to accessibility or support, please contact us at diversiteit.HR@kuleuven.be.