Programme de la réunion du GT S3 du jeudi 5 Mars 2020
Arts et Métiers Paris, 151 Boulevard de l'Hôpital

10h-10H15 Introduction de la journée

10h15-10H55 A new predictive maintenance model considering Log-diffusion stochastic cost process
Hai Canh VU, Antoine GRALL (UTT, Troyes), Mitra FOULADIRAD (UTT, Troyes)

Abstract: With the dynamic of technological innovation and economic growth today, the price of assets/services as well as maintenance strongly varies over both short-term and long-term horizons. The paper aims at introducing the cost variation/fluctuation into the maintenance optimization framework. The consideration of the cost variation makes the maintenance model become more complex but it offers at the same time the opportunity of doing the maintenance at lower costs. For more details, the maintenance cost is firstly modeled by use of a Log-Diffusion stochastic process (LD process) to cover its variation/ fluctuation over time. A new predicted maintenance model is then developed. In the developed model, the maintenance decisions are made based on both the system's conditional reliability and the preventive replacement (PR) cost-saving probability (the probability that the PR cost will be reduced at the next decision epoch). Long-term expected maintenance cost rate, a performance measure of the proposed model, is evaluated by taking advantage of the semi-regenerative properties of the maintained system. Finally, different theoretical and numerical studies confirm that the consideration of the stochastic maintenance cost is necessary. The effectiveness of the proposed maintenance model is also verified by comparing to the other existing models.

10H55-11H35 Quelques résultats sur les observateurs à entrées inconnues pour le diagnostic
Dalil Ichalal et Saïd Mammar (IBISC-Lab, Univ. Evry - Paris Saclay)

Résumé : L'objectif de cet exposé est de présenter quelques résultats récents sur les observateurs à entrées inconnues pour des systèmes LTI et LPV. Concernant les systèmes LTI, la notion de découplage asymptotique est introduite. Elle permet d'améliorer le taux de convergence de l'erreur d'estimation d'état en présence de dynamiques internes stables mais lentes. Pour les systèmes LPV, nous présentons un observateur à entrées inconnues flexible dans le sens où les matrices de l'observateur ne sont pas forcément sous la même forme polytopique que le système initiale. La notion de découplage asymptotique est également étendue à cette classe de systèmes. Une validation réelle à la dynamique moto est également exposée.

11H35-12h15 An observer design for Singular Nonlinear Parameter-varying System
Manh-Hung Do (1), Damien Koenig(1), and Didier Theilliol (3) ((1) Gipsa-Lab, Grenoble, (2) CRAN, Université de Lorraine, Nancy)

Abstract: A generalized observer design for a class of descriptor linear parameter-varying system with the Lipschitz condition is proposed. In which, based on the satisfaction for unknown input (UI) decoupling condition, H∞ and UI observer-based approaches are developped and the parameter-dependent stability are established for both cases which allows widening the solution space. Finally, a numerical example with gridding solution is illustrated to highlight the proposed design.

14H-14H40 A Hybrid system-level Prognostics Approach for Electronics-rich Systems
Ahmad Al-Mohamad (1,2), Ghaleb Hoblos (1) and Vicenc¸ Puig (2), ((1) Univ. Rouen, ESIGELEC, IRSEEM ; (2) Univ. Polytècnica Catalunya (UPC), ACSG, Barcelone)

Abstract: This work outlines the contribution of the system level prognostics of power electronics systems with slow degradation process. We are dealing with a model-based multivariable dynamical system identifying a degraded DC-DC converter. Thus, the study has established the failure mechanisms of MOSFETs and electrolytic capacitors. Moreover, based on prior tests and publications, the Adaptive Joint Extended Kalman Filter (AJEKF) technique has been modified and utilized for the estimation process of the aforementioned components. However, an online and an offline algorithms have been created for the Remaining Useful Life (RUL) prediction highlighting its importance in the reliability assessment of the Prognostics and Health Management (PHM). Therefore, a hybridization has merged the Data-driven methodologies based on Accelerated aGing Experiments (AGE) with the model based analysis to validate the effectiveness of the presented PHM algorithms for RUL forecasting of the case-study. The aforementioned modeling, analysis and estimation techniques are demonstrated in simulation.

14H40-15H20 Functionability Analysis of Redundant Mechatronic Systems
Pushpendra Kumar, Ismail Bensekrane, Blaise Conrard, Armand Toguyeni, Rochdi Merzouki (CRISTAL CNRS UMR 9189, Lille)

Abstract: A redundant system can continue to perform its intended function in a faulty condition using its multiple configurations. However, the performance may be degraded due to varying functional performance of each configuration. Thus, redundancy improves the reliability of a system. We present a method to analyze the level of functional performance of a redundant system with faults. A new indicator, called functionability, is proposed for a class of redundant systems, namely engineering mechatronic systems. A methodology for the functionability analysis of redundant systems is developed. This is applied on the steering function of a heavy redundant mobile robot called Robutainer. Due to redundancy, Robutainer shows multiple steering configurations, namely front, rear, and dual. The approach is validated through experiments and real-time co-simulation of Robutainer for trajectory tracking in a port environment and considering different components faults in its multidomain hybrid steering system.

15h20-16H Elaboration of an economic model for decision aid optimizing the maintenance strategy of transport systems
Rim LOUHICHI, Mohamed SALLAK (UTC, Compiègne), Jacques PELLETAN (Université Paris 8 and Institut Louis Bachelier)

Abstract : In a competitive environment, predictive maintenance gets a major attention from industrials because predictive maintenance prevents the system from failure while allowing an optimal exploitation of the system. Predictive maintenance consists in making a failure prognosis to anticipate the obsolescence of the system on the basis of interpreting real data coming from industrial connected objects. These data are processed by computer to assess the health state of the system. One of the measures to assess the health state of the system is the remaining useful life. However, it remains a challenging task for experts to predict the best time for predictive maintenance that minimizes the total cost of maintenance. In our work, we propose a maintenance cost optimization approach that allows to evaluate approximately the threshold of remaining useful life under which the system should be predictively replaced and the regularity with which the system must undergo inspections. We

first apply this methodology on a mechanical bearing system of a train motor. This component is critical for the operation of the train motor as it enables rotation movement of the motor shaft while reducing friction and handling stress born by the motor shaft. We then study and analyze the influence of variations of input parameters and their implications on the optimization results. We finally compare our optimization approach with the reliability-centered predictive maintenance optimization, an approach extracted from literature and which has already proven it ability to schedule maintenance effectively.

16h16H30 Informations et discussions sur le GT