PhD Proposal 2017

School: CentraleSupélec	
Laboratory: LGI	**Web site: http://www.lgi.ecp.fr/**
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Title: Hybrid particle filter life prediction method based on different field data for application to advanced industries, e.g. energy, aeronautics etc.
Scientific field: Fault prognostics and reliability modeling, data analytics
Key words: failure mechanism, performance degradation, life prediction, particle filter, reliability

Details for the subject:

This project focuses on the useful life estimation theory of large commercial components of highly technological industries, like aircraft utility, energy utility etc., based on the combination of failure mechanism analysis, data analytics statistical estimation, lab test data and recorded field data of component degradation states. For example, in the aircraft system considering the micro topography of friction pairs, a mixed lubrication performance degradation law of hydraulic rotary components can be established and used for life prediction. For this, the project aims at developing provides an hybrid particle filter fed by online field data for estimation and prediction updating. Realistic multiple degradation mechanisms will be considered state transition method and cross-check for the correction of state estimation will be implemented to decrease the alarm rate.

Background, Context:

Large components in highly critical commercial industries (e.g. energy and air transportation) require high reliability, long life and high availability. For example, after one hundred years development, the useful life of advanced commercial aircraft systems approaches 60 thousand hours (equivalent to 20-30 service years), and its overhaul can reach 10 years [1]. In the past, the first turning period for military aircraft was provided based on the lab testing and some rough file [2], so that the first turning period of the aircraft onboard equipment independently developed turned out very short (for example the first turning period of an hydraulic pump could very well be just several thousand hours, with various economic and inefficiency problems associated). This certainly does not help meeting the requirements of long life for commercial aircrafts. Then, the need arises of being able to estimate the onboard system useful life accurately. However, there is no reliable and useful life estimation theory based on physics degradation and statistical regression for this type of components. For this reason, this PhD project focuses on the development of a methodology for useful life estimation and prediction.

Research subject, work plan:

The thesis aims at preparing the PhD student to become an international researcher in the field of life prediction and reliability analysis of complex systems for industrial applications (e.g. aircraft utility system).
The study will focus on failure mechanism analysis, performance degradation modelling, life prediction algorithm and reliability evaluation.

References:

[1] W. E. Hammond and W.G. Jones, Vehicle health management, George C. Marshall Space Flight Center Huntsville, Alabama, AIAA 92-1477.
[2] Shaoping Wang, Dault diagnosis and health management, Mechanical Industry Press, 2014.