

PhD position
FEMTO-ST Institute (UBFC - ENSMM/UFC/UTBM)

Title
Decision oriented prognostics approach

Supervisors
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keywords: decision support, decision based prognostics, optimization

1 Context

During the last decade, a lot of works were done in the PHM (rognostics and Health Management) domain (figure 1), [3]. Most of published works are focused on the prognostics step [9], [7]. The main goal of prognostics is to determine the remaining useful life (RUL) of a component or a system. This process is generally based on data coming from the system, observations or environment.

The PHM team of Femto-st institute has developed strong competencies on this important stage. The proposed approaches take various form. They are either based on data or hybrid approaches. Oriented data methods use a training phase to learn degradation phenomenons and are used with online data to predict the RUL evolution. Hybrid approaches embed degradation models of the studied system in addition to the data.

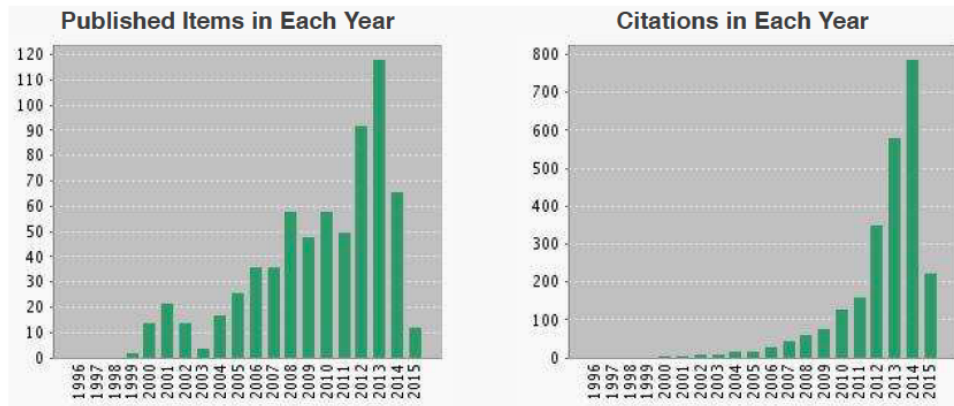


Figure 1: PHM domain publications (Web of Science)

It seems more and more evident that prognostics phase is not an end in itself. It should provides pertinent information in order to decide the best action to perform. This is absolutely necessary to maintain the performance level of a system. Emerging works are published [1], [6], they handle the decision phase for some particular studied cases. Decision approaches depend on several factors such that the horizon of decision, the studied system (component, set of component, etc.) or the criticality of the supervised component.

Consequently, some works propose to adapt the system control to the state of health evolution [8], or to define a new maintenance policy by optimizing the cost of maintenance [2], or to optimize the missions assigned to an equipment in order to keep an acceptable quality of service [1]. The PHM team also worked on this problem with the PhD thessi of N. Herr [5], [4].

2 PhD subject

In the works presented previously, the prognostics and decision steps are always considered as independent. The unique link is that results from prognostic are entries for decision. We prone that those two steps are linked and that they should be considered together.

Indeed, the efficiency and accuracy of prognostics are influenced by future operational conditions of the system are known. Considering coming solicitations is a necessity for the prognostics. In the same time decision can lead to change the operational conditions with the aim of modifying the solicitations. One problem is then how can be manage the communication between prognostics and decision phases.

All those aspects are not really investigated in the international state of the art. The aim of this PhD Thesis is to propose an answer to this issue:

- propose a decision based prognostic approach. Such a method could be similar to exiting ones but should be more proactive by considering possible change in the system control.
- using prognostics information, mean and long term actions (predictive maintenance) should also be impacted by evolving data such as the RUL uncertainties for instance.

To sum up, the objective is to optimize the ‘iterative’ interaction between prognostics and decision steps. One orientation is to use multi criteria optimization approaches.

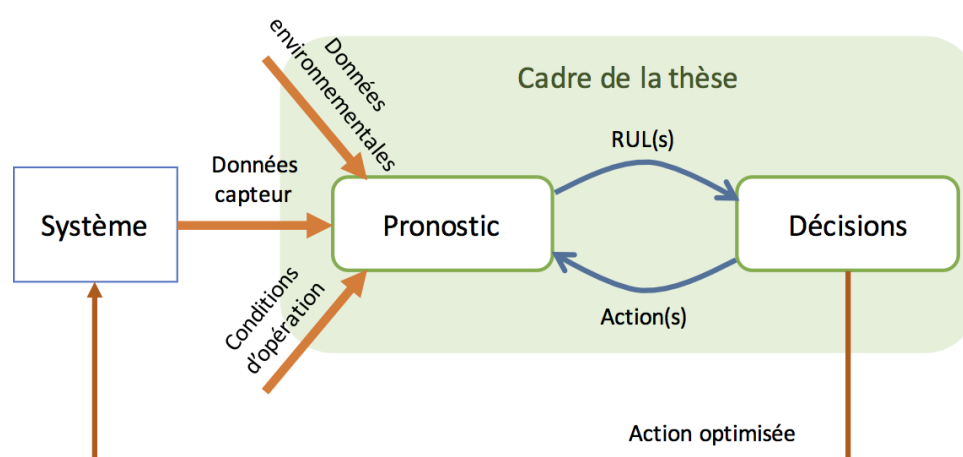


Figure 2: Prognostics-décision interaction

3 Hosting team and working environment

The PhD student will be part of PHM team in AS2M department of FEMTO-ST institute (UBFC-ENSMM/UFC/UTBM) in Besançon (ENSMM). Christophe Varnier et Noureddine Zerhouni will be the co-supervisors of this works.

Contact : Christophe Varnier (christophe.varnier@ens2m.fr).

You can send your application file to:

- detailed CV (with contact details: adress, email, phone)

- cover letter
- transcript of grades
- reference letter(s) or academic advisor contacts.

4 Candidates profile

Required skills for the PhD. student:

- Optimization methods
- Prognostics
- Programming

References

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