FICHE DE POSTE N° - POST-DOC DIAGNOSTIC OS4 MI P5 COMPRAIL-F1

12 months Post-doc position at IFSTTAR (www.ifsttar.fr) – Public Research Institute

Contribution to the diagnosis of railway control systems based on discrete event models

Starting date: May, June or July 2019

Deadline for application: Mars 31st 2019

Context

This post-doc position is related to the Comprail project in the framework of ELSAT2020 program.

Fault diagnosis is a crucial and challenging task in large and complex dynamic systems. This task is all the more essential in critical applications such as, railway control systems, where failures may cause serious consequences such as loss of human lives, severe injuries, and large scale of material and environmental damages or considerable economic penalties. Fault diagnosis problem has been extensively studied by both Artificial Intelligence (AI) and Control Engineering (CE) communities. In particular, an increasing amount of work has been devoted to fault diagnosis of DES over the last two decades [1-3].

One of the main issues in fault diagnosis of DES, is diagnosability analysis [1]. In simple terms, diagnosability refers to the ability to infer accurately, from partially observed executions, about the faulty behavior within a finite delay after a possible occurrence of a fault. Then comes the issue of developing a *diagnoser* which performs the online diagnosis tasks, i.e., to determine, online, whether the behavior of the monitored system is abnormal, and if so to determine the failure, based on observations that may be collected on the system behavior.

In the DES literature, a large part of the existing works considers that faults are permanent, which means once a fault occurs, the system remains indefinitely faulty [1]. However, in many real-life systems, faulty behavior often occurs intermittently, which can be depicted as a failure event followed by its corresponding ”reset” event, followed by new occurrences of failure events, and so forth [4,5]. Indeed, intermittent faults are defined as faults that can automatically recover once they have occurred. Besides, temporal aspects may be crucial in the monitoring context [6,7]; namely different occurrence dates of events may have different means in terms of supervision which requires that the monitoring processes have to consider these aspects carefully, particularly in real-time applications. As a consequence, further variants of diagnosability property can be defined to better cope with real monitoring needs.

Mission

In collaboration with various partners, IFSTTAR-COSYS/ESTAS team has been developing works on the diagnosis of DES since several years [7-15], with several applications in the domain of guided transportation systems [10-14]. In this work, different extensions of the results previously obtained are targeted from three viewpoints: 1) further types of failures will be investigated, while considering different failure occurrence modes (intermittent, periodic, patterns, etc.), 2) different monitoring contexts will be considered (untimed, timed, stochastic), and 3) Further techniques will brought into play to investigate diagnosis issues. In particular, in the past we have investigated using formal methods, namely model-checking, to

deal with diagnosis issues pertaining to permanent/intermittent failures [13,14]. We aim to continue exploring such techniques to deal with new diagnosis issues. Besides, linear programming techniques which have shown interesting features particularly in state estimation of DES [3] will be investigated as well.
The efficiency and the scalability of the developed techniques will be assessed based on some railway control applications.

Required Competencies

- PhD related to some or all of the following topics: monitoring, diagnosis, discrete event systems, formal methods, linear programming, artificial intelligence.
- Knowledge of railway applications would be appreciated
- Good skills in software engineering

Procedure for recruitment

Interview with a jury
If interested, please send a detailed CV, the two most representative publications of your work, and if possible some recommandation letters to: **mohamed.ghazel@ifsttar.fr**
Deadline : Mars 31st 2019

Work location

IFSTTAR Lille
COSYS/ESTAS

Gross salary

~ 2400 euros/month.

Le projet ELSAT2020 est cofinancé par l'Union Européenne avec le Fond européen de développement régional, par l'Etat et la Région Hauts de Franc.

References

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