

LABORATOIRE DES SIGNAUX ET SYSTÈMES

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Master internship offer at L2S within the RTE Chair

Title :	Learning and abnormal behavior detection of high dimensional Boolean networks
Place :	Laboratoire des Signaux et Systèmes (L2S), Gif-sur-Yvette (Paris suburbia)
Duration :	5 months to 7 months (in 2018)
Supervisor :	Michel KIEFFER - Collaboration with Antoine GIRARD and Samson LASAULCE.
Net salary :	920 E / month
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Description

The proposed project is sponsored by RTE which is the French transmission operator (TSO). The outcomes of the internship intend to be used as strong insights into the design of modern and smart electricity transmission networks. The main tools that will be exploited are learning, channel coding, signal processing classification tools, and to a less extent graph theory.

More precisely, one considers a high dimensional Boolean network whose state components represent the status (open or closed) of the links interconnecting the network nodes. Links may appear or disappear in an asynchronous way by some legitimate control authority. Malicious agents may want to take control of some parts of the network and act on the links either to damage the network or to use it in their own interest.

The aim of the proposed project is to design mechanisms that are able to detect such malicious agents from partial observations of the state of the network links and by monitoring the succession of controlled actions taken by a legitimate control authority.

Working plan

The proposed solutions will be based on a set of available real data provided by RTE, which consists of Boolean temporal sequences describing the transitions of some state components in the network. Partial observations of the network state may also be available at given time instants. These data sets have been collected during the normal behavior of the network over a long time period.

The first part of the work consists in analyzing the statistical properties of the data sequences: time variability (*e.g.*, prevalence of stationary over transient behavior), correlations between variables (*e.g.*, to derive reduced-order local models).

The second part of the work will consist in designing algorithms to learn and detect abnormal behavior of the system. Tools from channel coding will also be exploited to build partial summaries of the state of the Boolean network. From these summaries, the consistency of the sequence of legitimate control actions with the state summaries will have to be detected. The way the summaries may be performed in a distributed way has to be designed. We will also build upon existing approaches for sequence classification [1], logistic principal component analysis [2].

Wanted skills

The candidate should have a strong background in one the following fields: learning, graph theory, channel coding, signal processing. He/she should also be familiar with statistical learning techniques. The internship will be specialized according to the candidate skills.

References

[1] Xing, Zhengzheng, Jian Pei, and Eamonn Keogh. "A brief survey on sequence classification." *ACM SIGKDD Explorations Newsletter* 12.1 (2010): 40-48.

[2] Andrew J. Landgraf, Yoonkyung Lee. *Dimensionality Reduction for Binary Data through the Projection of Natural Parameters*, available at <http://arxiv.org/abs/1510.06112>, 2015.