

Sujet de recherche Master MSIAM 2019-2020

Titre : Optimization of hyperparameter of deep learning network : application to chemical process

Encadrement :

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Subject :

The development of fault detection and diagnosis (FDD) tools for the chemical industrial process still need further developments to improve their effectiveness and development cost. Using supervised deep learning learning (DL) techniques have been demonstrated to be effective to respond to these needs but the effort needed for data labelling remains important and costly. Unsupervised DL methods such as Auto-Encoder, Restricted Boltzmann Machines, Variational Auto-Encoder and Generative Adversarial Networks, can help lower the FDD tools development cost while improving their effectiveness. These artificial intelligence techniques have not yet been sufficiently explored within this field and we believe that they can deal with structured and unstructured data and where training samples with known faults are limited.. However, the performance of deep learning methods is highly related to the choice of the hyperparameters and layers that define the structure of the unsupervised deep learning network.

Subsequently, the goal of the project is to develop a method to automate the training and the construction of the unsupervised DL methods. The candidate will use blackbox optimization for this purpose, and more specifically the Mesh Adaptive Direct Search algorithm to optimize the hyperparameters of supervised deep neural network.

Previous research work led to a software package called HYPERNOMAD. The results showed that HYPERNOMAD is able to build high-performance DL neural networks to classify images. The candidate will use adapt HYPERNOMAD to optimize the hyperparameters of unsupervised DL methods, and then provide easily accessible models to process engineer with limited machine learning background for diagnosing abnormal events in the large-scale industrial process.

Skills

- Must have followed an introduction course both on continuous optimization and artificial intelligence
- Must have knowledge in one high programming language (C++, Java, Python, C++ is preferred)

Internship location :

The internship will take place part of time at G-SCOP (France) and part of time at GERAD Lab (Montreal).

Depending of the academic level and investment during the internship a phd could be considered.

Références :

- https://www.gerad.ca/Sebastien.Le.Digabel/talks/2019_CORS_20mins.pdf
- <https://en.wikipedia.org/wiki/Autoencoder>
- [https://en.wikipedia.org/wiki/Restricted Boltzmann machine](https://en.wikipedia.org/wiki/Restricted_Boltzmann_machine)
- [https://en.wikipedia.org/wiki/Generative adversarial network](https://en.wikipedia.org/wiki/Generative_adversarial_network)