

Anomaly Detection in Multivariate Temporal Time-Series Application to Smart-Buildings



NICOLAS BAUDIN
INTERNSHIPS IN FRANCE INITIATIVE

Université Toulouse III - Paul Sabatier

Name of the hosting institution in France	Université Toulouse III - Paul Sabatier
Name of the host laboratory / research team	IRIT / SMAC
Address	UPS - 118 route de Narbonne - 31062 Toulouse Cedex 9 - France
Web site	www.irit.fr
Name of the supervisor	Jean-Pierre Georgé
Function	Associate Professor
Email	Jean-Pierre.George@irit.fr
Phone number	33(0)5 61 55 61 82

Internship offer

Topic of the internship (title)	Anomaly Detection in Multivariate Temporal Time-Series Application to Smart-Buildings		
--	---	--	--

Proposed dates of the internship	Start: 2019-09-02	End: 2020-02-29
---	--------------------------	------------------------

Scientific and academic objectives of the internship (detailed description of the internship content, work expected from the intern and expected outcomes):

Context: With the increasing availability of sensors in buildings due to the Internet of Things (IoT), sensors data are readily available for use. These data are measured by a wide variety of sensors that usually differ in type, from temperature, to water consumption, to CO2 concentration, etc. Hundreds or thousands of sensors can be set up in an area in different buildings and we can't guarantee that meta data such as sensors placement or the physical unit in use is available: only origin (sensor id), timestamp, and value are known for sure for each measure. These sensors data are available in real-time and constitute multivariate temporal time-series when put together. In the context of the SANDMAN project (Supervised ANomaly Detection with Multi-AgeNt systems), our goal is to detect anomalies in real time from multivariate temporal time-series. We define anomalies not as uncommon or unexpected values in the data, but rather as undesirable events observed by a human expert in real life or directly from a set of sensors. We are developing a novel approach to detect these anomalies using supervised classification techniques, implemented with a Cooperating Multi-Agent Systems. Our main goals for our anomaly detection system are:

- Real-time detection,
- Scalability: using thousands of sensors,
- Genericity: being able to function for data from many buildings sub-systems or not building related,
- Raw data use: not doing any kind of data pre-treatment,
- Openness: being able to add new sensors data on the fly.

In order to detect anomalies considering our goals we developed a system of systems composed of three main interdependent modules (as of now) with the following tasks:

- M1: Learns expected sensor values for each sensors
- M2: Learns context and importance of each and every sensor for anomaly detection
- M3: Raises alerts and communicates with the human expert

Goals: The main goal of this internship would be to assist in designing, implementing and validating the different modules. In particular, the candidate is expected to use optimization techniques and libraries to implement simple anomaly detection systems in order to validate and compare to the novel anomaly detection method. Furthermore, in the context of the team's AMAS4BigData toolkit, the integration of an adaptive multi-agent system for dynamic big data analytics and correlation detection as a new module would be studied.

Name of industrial partner	Berger-Levrault
Role of the industrial partner in the internship project	The industrial partner is working with the research team in a joint project in Ambient Intelligence, and is providing the main tests cases in Smart Buildings for this work.
Main contact at the French industrial partner	BORTOLASO Christophe
Name of the Australian partner institution	University of Wollongong
Name of lab/department/team involved in the collaboration at the Australian partner institution	Smart Infrastructure Facility
Main contact in the Australian partner institution	Pascal Perez
Function of the main contact in the Australian partner institution	Director - Senior Professor

Email address of the main contact in the Australian partner institution	pascal@uow.edu.au
Outside of this ongoing collaboration, will applications coming from students of other eligible Australian universities be considered by the hosting institution in France?	No

Expected profile of applicant

Level of study	Master
Discipline	Computer Science
Required qualities, knowledge and skills	<ul style="list-style-type: none"> • Academic degree in Computer Science • Java programming language • Knowledge in Artificial Intelligence appreciated • Knowledge of operational research and optimization techniques, experience with a linear equations solver appreciated
Other information	<ul style="list-style-type: none"> • Hosting lab : www.irit.fr • Hosting team : www.irit.fr/smac/ • City of Toulouse, France : www.toulouse-visit.com