2022-05359 - Sniffer: machine learning for monitoring and signature analysis of mains-operated electrical equipment

Renewable contract : Oui
Level of qualifications required : Graduate degree or equivalent
Other valued qualifications : PhD
Fonction : Temporary scientific engineer

About the research centre or Inria department

Le centre Inria Rennes - Bretagne Atlantique est un des huit centres d'Inria et compte plus d'une trentaine d'équipes de recherche. Le centre Inria est un acteur majeur et reconnu dans le domaine des sciences numériques. Il est au cœur d'un riche écosystème de R&D et d'innovation : PME fortement innovantes, grands groupes industriels, pôles de compétitivité, acteurs de la recherche et de l'enseignement supérieur, laboratoires d'excellence, institut de recherche technologique

Context

The objectives of Sniffer are the detection and identification of IT equipment based on its electrical signature. A global measurement (on a building or a floor for example) of the electrical consumption is carried out by a measuring equipment. From this global signal representing the instantaneous power consumption measured at the switchboard, it is a matter of detecting the type of equipment and their number, then identifying each piece of equipment, in particular individual computers (PCs), and determining whether or not they are authorised to be connected to the electrical network. The main objective of this research and development engineer position is to build a prototype to demonstrate our electrical network compromise analysis methods able to detect in real time an intruder connected to the mains. This includes the hardware specification and development of the demonstrator based on already existing devices, as well as the software development of related machine learning and signal processing algorithms, mainly in Python and C++.

Assignment

Context

Developing smarter and greener buildings has been an expanding field of research over the last decades. One of the essential requirements for energy utilities is the knowledge of power consumption patterns at the single-appliance level. To estimate these patterns without using an individual power meter for each appliance, Non-Intrusive Load Monitoring (NILM) consists in disaggregating electrical loads by examining the appliance specific power consumption signature within the aggregated load single measurement. Therefore, the method is considered non-intrusive since the data are collected from a single electrical panel outside of the monitored building. Thus, NILM has been a very active field of research with renewed interest over the last years. Knowing the plug-level power consumption of each appliance in a building can lead to drastic savings in energy consumption and NILM can thus play an important role in energy management and reduction in buildings and homes.

Another application to electrical appliance monitoring is related to security. In certain contexts, it is important to recognize the electrical signature of authorized IT equipment, and to be able to detect if unauthorized ones, especially computers, are connected to the mains. Based on the SmartSense platform and on traces of the power consumption of individual electrical appliances and building-level power monitoring, the aim of this work funded by the Sniffer project is the detection and surveillance of equipment connected to the mains supply using advanced machine learning techniques.

SmartSense: a sensor network platform for smart building research

With 150 nodes deployed at INRIA/IRISA (Lannion and Rennes), the SmartSense platform collects many different data related to energy consumed and uses in buildings. These data pave the way for a large number of applications, in particular in data mining, electrical load disaggregation or in sensor processing. Each node comprises approximately 20 sensors: camera, infra-red, audio, radio spectrum sensing, 9-axis inertial, humidity, atmospheric pressure, temperature, light (red, green, blue, white, UVA, UVB), centimeter precision distance ranging, CO2+VOC. Each node collect these data and fill a terabyte-capacity database accessible through local computing and storage servers.

Objectives

This position is mainly within the context of electrical network compromise analysis. The first step consists in identifying equipment connected to the mains of an installation (e.g., building, factory) relying on machine learning techniques. The identification extracts equipment characteristics (such as PC, monitor, charging mobile phones, coffee machine, printer, etc.) when they are connected to the mains. Then, these electrical signatures are processed to perform in-depth learning and detect the presence or absence of specific equipment on that network. We also my want to combine the electrical signals with data obtained from sensors and from electromagnetic signals which are closely related to the current and power consumed by an electrical device. We also want to evaluate if a specific software running on a PC and launched as a daemon (a background process) can generate some unique signatures on the electrical network. For validation, we will mainly rely on the SmartSense platform that provides real-time (but low-frequency) electrical power traces of our Laboratory, together with many sensor data.

We already demonstrated through signal processing and machine learning (in particular deep learning) that it is possible to detect (i) a computer generating a unique signature on the electrical network (i.e., an authorized computer), (ii) a computer which is active and connected to the main but which does not emit a signature (i.e., an intruder), and (iii) other electrical equipment (e.g., printer, coffee machine, light). The main objective of this research and development engineer position is to build a prototype to demonstrate the previously mentioned techniques electrical network compromise analysis able to detect in real time an intruder connected to the mains. This includes the

General Information

- **Theme/Domain :** Architecture, Languages and Compilation
  Instrumentation et expérimentation (BAP C)
- **Town/city :** Rennes
- **Inria Center :** Centre Inria de l'Université de Rennes
- **Starting date :** 2022-10-01
- **Duration of contract :** 12 months
- **Deadline to apply :** 2022-12-31

Contacts

- **Inria Team :** TARAN
- **Recruiter :**
  Sentieys Olivier / Olivier.Sentieys@irisa.fr

About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

Instruction to apply

Merci de déposer en ligne CV, lettre de motivation et éventuelles recommandations

Pour plus d'information, contactez olivier.sentieys@inria.fr

Defence Security :
This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST).Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

Recruitment Policy :
As part of its diversity policy, all Inria positions are accessible to people with disabilities.

Warning : you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

hardware specification and development of the demonstrator based on already existing devices, as well as the software development of the related machine learning and signal processing algorithms, mainly in Python and C++.

Skills

Expected Profile

- PhD or Master in Computer Science, Electrical or Computer Engineering

- Background in machine learning and/or signal processing.

- Programming experience, e.g., in C/C++ and Python.

- Good knowledge in some of these fields would be a plus: computer architecture, hardware design, embedded software development, embedded systems.

What is valued the most is autonomy. We expect the research engineer to be motivated and capable of composing short and mid-term objectives themselves.

Benefits package

- Prise en charge à 50 % des frais de transport en commun sur le trajet domicile-travail ou FMD.
- Restauration subventionnée
- Prise en charge partielle des frais de mutuelle
- Possibilité de télétravail (à hauteur de 90 jours annuels) et d'aménagement du temps de travail

Remuneration

rémunération mensuelle brute à partir de 2655 euros selon diplôme et expérience