L@BISEN

yncréa

SMART AND AUTONOMOUS SYSTEMS
RESEARCH LABORATORY

INTERNSHIP OPPORTUNITIES
SUMMER 2023

4 CAMPUSES IN WESTERN FRANCE: BREST - CAEN - NANTES - RENNES

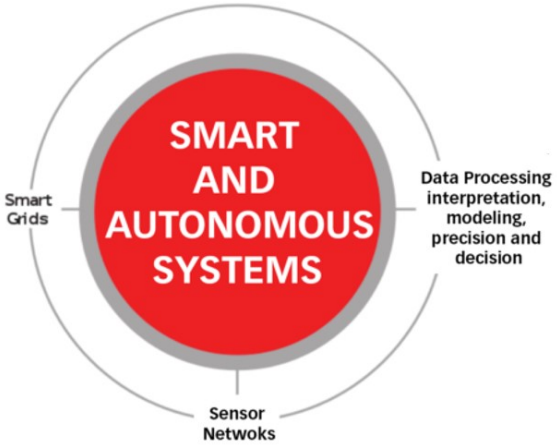
yncréa OUEST

ISEN Engineering School
L@bISEN Research Unit

Our research project

L@bISEN is structured around **Smart and autonomous systems**. **Three main lines of action** define our research activities:

- Environment understanding → **Sensor networks**
- Energy-related issues → **Smart grids**
- Processing/analysis → **Data processing**



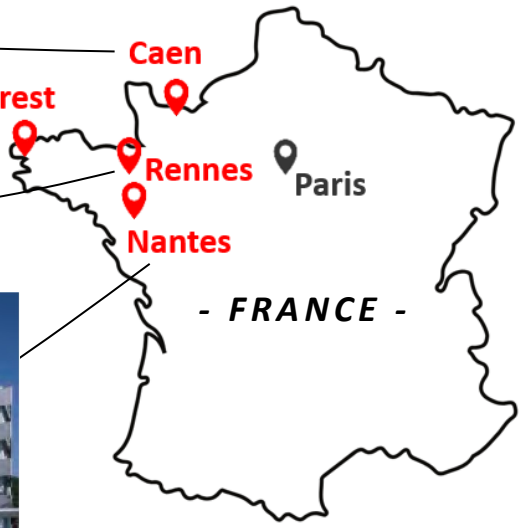
Our common research project allows us to **get a firm grasp of the entire area of expertise** to build smart and autonomous systems in terms of decision and energy.

Our research laboratory

1 research laboratory on **4** campuses

127 members

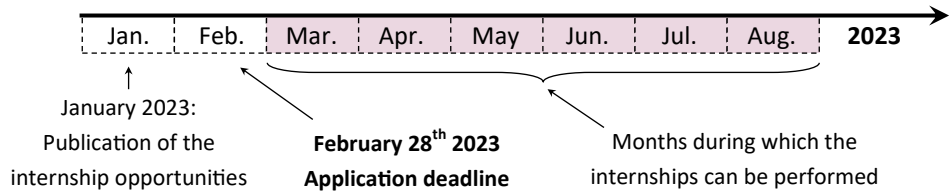
63 associate professors



Summer internships at L@bISEN

The following pages present internship projects across a range of disciplines that L@bISEN is offering for Summer 2023. These projects are accessible to graduate students (students pursuing a Master's degree) and should last between 3 and 6 months.

Timeline:



Benefits:

Internships will be compensated in accordance with French law (567 € per month, full time). An allowance will be made for lunch.

Location:

Please be advised that, while we hope to be able to welcome our 2023 interns in person, it will still depend on the national and international Covid-19 pandemic situation whether on-site internships are possible. In the event that the pandemic situation does not allow us to have interns on campus, we will instead offer the internships as remote when where possible.

How to apply?

If you are interested in an internship with L@bISEN, please send your detailed CV and cover letter to:

Dorian Appéré dorian.appere@isen-ouest.yncrea.fr and to
Dr. Jean-Marie Guyader jean-marie.guyader@isen-ouest.yncrea.fr

by **February 28th 2023**, indicating the reference of the project you are interested in. We will arrange for online interviews with the project supervisors.

Internship project:
Tropical cliques and bicliques in vertex-colored graphs

Project reference: 23-01

Supervisor: Leandro Montero
Contact: leandro.montero@isen-ouest.yncrea.fr
Campus: ISEN Nantes

L@bISEN research team involved in this project:
Knowledge learning and information modelling (KLaIM).

Research question/Problem addressed:
Is it possible to find these structures in polynomial time?

Project abstract:
Graph theory has become a very powerful tool for modeling real-life problems and it has been studied by both mathematicians and computer scientist lately. We present the following two topics on graph theory that we will use.

First, a vertex-colored graph is a graph such that each of its vertices receives a color. They are useful in various situations. For instance, the Web graph may be considered as a vertex-colored graph where the color of a vertex represents the type of content of the corresponding web page. Applications can also be found in bioinformatics, scheduling problems, etc.

Second, a clique in a graph is a complete subgraph while a biclique is a complete bipartite induced subgraph of a graph. Cliques and bicliques in graphs are useful as well, having applications in many different contexts, such as, social networks, bioinformatics, electrical engineering, chemistry, cybersecurity.

A subgraph in a vertex-colored graph is tropical if each color appears at least once in it. In this project we will study the following problem: Given a vertex-colored graph, is it possible to find tropical cliques and bicliques of a fixed size in polynomial time? Uncolored versions of these problems are NP-Complete therefore if this is true also for our case, find classes of graphs where the problem becomes polynomial.

Technologies utilized:
- Algorithms and data structures.
- Graph modeling and theory.
- Complexity theory.

Internship project:
Travel market simulator

Project reference: 23-02

Supervisor: Benoit Lardeux
Contact: benoit.lardeux@isen-ouest.yncrea.fr
Campus: ISEN Nantes

L@bISEN research team involved in this project:
Connected robotics.

Research question/Problem addressed:
Develop first components of a platform which simulates bookings arrivals in a market. Objectives will be to compare new algorithms of revenue optimization for airlines.

Project abstract:
Transportation companies need to model the behavior of their expected customers during the period of bookings for trains or flights; in order to optimize the revenue generated by the sold tickets and to optimize the utilization of the perishable resources (seats). Thanks to these models, transportation companies can simulate the benefits on simulated revenue from running up new pricing algorithms.

Travelers can be classified among different passenger classes which have similar consumer behaviors, like the reservation date, their willingness-to-pay, the expected service level, etc.

The objective of this internship is to model and then implement a prototype of the demand simulation module. Stochastic process (like Poisson, Exponential, etc.), based on algorithms of queuing would be developed. The optimization algorithms based on dynamic programming or linear programming can then be added to assess generated revenue for the transportation companies available on the studied market.

Technologies utilized:
- Python.
- Operations research.
- Revenue management.

Internship project:
Modelling, design, assembling and control of reconfigurable robots (drones)

Project reference: 23-03

Supervisors: Henrique Fagundes Gasparoto and Titouan Verdu
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titouan.verdu@isen-ouest.yncrea.fr
Campus: ISEN Brest

L@bISEN research team involved in this project:
Autonomous Robots (AutoRob).

Research question/Problem addressed:
Determining new mobile robots (drones) architectures (mechanical, electronic, and computational) for complex missions in inhospitable or hybrid environments.

Project abstract:
Nowadays, robots-drones are used in various applications where the tasks to achieve are too risky, too complex even too repetitive for humans. As the complexity of the tasks to carry by the autonomous system evolves, their physical structure becomes more and more complete. Moreover, for complex missions requiring deploying a fleet or a group of robots, it is often necessary to use specific robots made for a particular environment. Thus, this specialization constrains robots to be used only for one environment, such as the sea, the ground, or the air.

Our research objectives are mainly related to developing new drone structures that can evolve in different environments. For example, a drone could achieve tasks on the ground before changing its structure and flying to another location, mainly to gain transition speed between two desired areas. These robots/drones are called reconfigurable robots, as they will change their physical structure from one to another.

This internship aims to work on this particular type of drone. The tasks given to the drone will be defined together with the internship student, and the objectives will be to design, model, or prototype a new reconfigurable structure. On the other hand, once the structure is done, a step of architecture (software and hardware) development and integration will be held to achieve the drone. The internship could eventually finish with several drone tests in real conditions.

Technologies utilized:
- 3D printing prototyping.
- Reconfigurable (podded) thursters.
- Paparazzi UAV Autopilot
- Contactless mechanical transmission.

Internship project:
Unsupervised classification of emotions in speech via functional data

Project reference: 23-04

Supervisor: Matthieu Saumard
Contact: matthieu.saumard@isen-ouest.yncrea.fr
Campus: ISEN Brest

L@bISEN research team involved in this project:
Vision and data analysis (VISION-AD).

Research question/Problem addressed:
Development of an unsupervised classification algorithm for speech emotions recognition with functional data analysis tools.

Project abstract:
Transform the raw data of existing databases to estimate the fundamental frequency curves. Construction of features which relies on the operator of covariance of the fundamental frequency curve. Implementation of a K-means algorithm with an appropriate distance on the features. Evaluation of the performances of the algorithm.

Technologies utilized:
- Librosa (Python package).
- Scikit-fda (Python package).
- Fda.usc (R package).

Internship project:
IsQuantumLab: ISEN Quantum Laboratory

Project reference: 23-05

Supervisor: Marwa El Bouz
Contact: marwa.el-bouz@isen-ouest.yncrea.fr
Campus: ISEN Brest

L@bISEN research team involved in this project:
Light - Scatter - Learning (LSL).

Research question/Problem addressed:
The goal of this project is to set up the first quantum solutions specific to ISEN.

Tasks to perform:

- Provide a state of the art of examples and codes present in the literature (a short list will be provided).
- Perform tests on IBM tools based on Qiskit - https://qiskit.org/ (Quantum Information Science Kit), an opensource environment that allows to code programs in quantum computing and cryptography.
- Work on the required functional specifications: e.g. the necessary computer memory to install Qiskit locally to perform quantum simulations.
- Configuration and installation of such a simulator.
- Further steps:
    - Test the performances of the implemented simulator and compare with those of Google, IBM, Microsoft…
    - Create quantum cryptography games to illustrate the exchange protocols between two people and simulate the consequences of the presence of a spy.

Technologies utilized:

- Computer science.
- Quantum physics.

Internship project:
Energy management of unmanned underwater vehicles with multi-sources for environmental inspection missions

Project reference: 23-06

Supervisor: Zhibin Zhou
Contact: zhibin.zhou@isen-ouest.yncrea.fr
Campus: ISEN Brest

L@bISEN research team involved in this project:
Energy and electromechanical systems (ESE).

Research question/Problem addressed:
For hybrid underwater vehicles, how to optimize the control strategies of the multi-source power supply sources to increase the energy efficiency and the autonomy range?

Project abstract:
Unmanned Underwater Vehicles (UUV), also called underwater robots, have generated increasing interests due to their potential applications in environmental and scientific domains. Recently, electric propulsion systems become popular for small or mini UUVs. The main drawback of this solution, however, is the limited operational range of the underwater robots. A lot of efforts have been dedicated to the estimation and optimization of the underwater routing range in electrical UUVs. The actual solutions (i.e. increasing the battery size.) are somewhat suffering from a number of drawbacks and therefore still need some further developments. One option to increase a UUVs cruising range is the use of fuel-cell based power supply source. In this case, once the power is defined according to the needed features of the UUV, the only limit of the operating range is the amount of fuel that the device can carry. In this context, if a storage battery is used, the UUV could be considered as a micro---grid, where the main issue is the energy optimal control and management to increase the underwater cruising range to achieve a UUV of high –performance. This project is therefore expected to deal with this issue, where the main steps should be modeling, simulation, emulation, and experimental validation for a given mission profile.

Technologies utilized:
- Matlab/Simulink.
- DSP.
- Microcontroller.

Internship project:
Underwater fish detection using tiny deep learning network

Project reference: 23-07

Supervisor: Ayoub Karine
Contact: ayoub.karine@isen-ouest.yncrea.fr
Campus: ISEN Nantes

L@bISEN research team involved in this project:
Vision and data analysis (VISION-AD).

Research question/Problem addressed:
How to detect the types of fish in the underwater images using a tiny deep learning network?

Project abstract:
The detection of the fishes in the underwater images is of paramount importance for different applications such as marine ecological monitoring and management. This is a challenge task due to the poor quality of this kind of images especially its noisy background. To overcome this limitation, the first goal of this project is to study the different deep learning methods used to enhance the quality of underwater images. The second goal consists of reducing (compressing) the size of the deep learning methods often used on the detection of land images. These two goals can be incorporated in the same framework using the distillation knowledge principle with a neural network supervised by a teacher and its student. In this way, we can propose neural architectures networks that can be embedded in the edge devices. Depending on the progress of the work, the developed tiny detector models can then be integrated into the Jetson Nano.

To achieve the two goals of the project, the proposed methods will be conducted on Brackish dataset[1].

Technologies utilized:
- GPU server.
- Deep learning.
- Object-oriented programming.
- Python.
- Jetson Nano.

[1] Pedersen, M., Bruslund Haurum, J., Gade, R., & Moeslund, T. B. (2019). Detection of marine animals in a new underwater dataset with varying visibility. In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops (pp. 18-26).

Internship project:
Explainable AI methods for agent-based models

Project reference: 23-08

Supervisor: Cédric Buron
Contact: cedric.buron@isen-ouest.yncrea.fr
Campus: ISEN Nantes

L@bISEN research team involved in this project:
Knowledge learning and information modeling (KLaIM).

Research question/Problem addressed:
Is the Shapley value a good way to measure sensitivity in agent-based models?

Project abstract:
Explainability is a rising topic in artificial intelligence. It aims at providing understanding regarding the output of black box models. Two main approaches have been proposed to meet this challenge: local methods allow to explain a specific output of an algorithm, while global methods provide an understanding of the model as a whole.

One of the most common ways to achieve global explainability is to use global sensitivity analysis (GSA), and more specifically analysis of variance (ANOVA). These methods come from statistics and provide elements to measure how the output of an artificial intelligence method varies when the input varies. It allows to determine to which extent the output of the method is linked and sensible to the input features, separated or combined.

ANOVA has been used to evaluate the sensitivity of machine learning techniques, but also agent-based models (ABMs), which can be used to model societies and draw conclusions regarding possible changes in the systems they model. The most widely used methods for ABMs are classical ANOVA ones, such as Sobol indexes. However they have limitations, and with the rise of explainable AI (XAI), many new methods have been discovered in GSA to address them. In particular recent works in statistics have proposed to use other indexes such as the Shapley values to provide simpler analysis of the sensitivity, including when the input features are correlated. The objective of this project is to test them on various ABMs, modeling maritime traffic, interactions in a company, or students in a school.

Technologies utilized:
- Multi-agent systems.
- Statistics.
- Analysis of variance.
- Algorithms.

Internship project:
Massive IoT deployment

Project reference: 23-09

Supervisor: Maher Jridi
Contact: maher.jridi@isen-ouest.yncrea.fr
Campus: ISEN Nantes

L@bISEN research team involved in this project:
Vision and data analysis (VISION-AD).

Research question/Problem addressed:
How to measure packet loss in massive IoT LoRa communications.

Project abstract:
The goal of the project is to participate to the global project about the implementation of connected campus at ISEN Nantes. We are looking for digital solutions to control the environment (parking, classrooms, around campus). Theses IoT based solutions uses environmental sensors, microcontroller to acquire date from the environment, transceiver for radio emission and reception and cloud platform for data storage and monitoring. We propose to use massive LoRa devices for transceiver and we would like to know by practice how communication can be done by maintaining a good quality of service. Indeed, with LoRa there is no implementation of collision avoidance or collision detection protocols. We have no warranty that all transmitted data will be received.

The project aims to respond to this question by implementing massive IoT communications between nodes and Gateway.

Technologies utilized:
- IoT.
- LoRa.
- Embedded systems.
- Python.
- Matlab.

Internship project:
Artificial intelligence and blockchain for decentralized energy management in an energy community of smart buildings

Project reference: 23-10

Supervisor: Yassine Amirat
Contact: yassine.amirat@isen-ouest.yncrea.fr
Campus: ISEN Brest

L@bISEN research team involved in this project:
Energy and electromechanical systems (ESE).

Research question/Problem addressed:
Energy management and artificial intelligence.

Project abstract:
Local energy communities (LECs) consist of prosumers cooperating to meet their energy requirements. Prosumers are members of the community who can create and consume energy. LECs allow the incorporation of renewable energy sources and offer the opportunity to reduce energy expenses. P2P energy trading allows for the direct exchange of energy between members of a local energy community. The surplus of energy from renewable sources is exchanged to satisfy local demand, so retaining costs and income within the community and eliminating transmission losses and grid strain.

This internship intends to use artificial intelligence and blockchain technology to construct a smart peer-to-peer market for local energy communities in which prosumers are rational and self-interested individuals acting selfishly to optimize their transactions. The market design strives to ensure self-consumption of locally produced energy and provides incentives for balancing community supply and demand. Using simulations and theoretical analysis, the suggested design will be evaluated in contrast to existing ones (centralized and decentralized management). The comparison will take into account the environmental impact of the produced digital solutions and the application of AI to reduce that impact.

Technologies utilized:
- Simulation tools.
- Artificial intelligence.

Internship project:
Aging modeling of PEM fuel cells using a hybrid physical/ machine learning approach

Project reference: 23-11

Supervisor: Yassine Amirat
Contact: yassine.amirat@isen-ouest.yncrea.fr
Campus: ISEN Brest

L@bISEN research team involved in this project:
Energy and electromechanical systems (ESE).

Research question/Problem addressed:
Aging modeling.

Project abstract:
The proton exchange membrane fuel cells (PEMFCs) have given rise to many applications, particularly in transportation. Unfortunately, the commercial application of PEMFCs is hampered by the early deterioration and low durability of the cells. In this case, accurate real-time condition monitoring plays an essential role in extending the lifespan of PEMFCs through accurate planning of maintenance tasks. Accordingly, among the widely used modeling tools, such as model-driven and data-driven machine learning, has received much attention and has been extensively studied in the literature.

The proposed internship concerns the aging modeling of PEM Fuel cells using a hybrid physical/machine learning approach. The aim is to provide a global understanding of the aging mechanisms and the main associated failure modes and a criterion for the health of a PEMFC in operation.

The research activity will consist of the following:

- Bibliographic study of analytical or data-based models of PEMFC aging;
- Establishment of behavioral models of PEMFC, integrating the operating conditions and also its aging by a hybrid physical/machine learning approach.

Technologies utilized:

- Behavioral models.
- Machine learning.

Contact us

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