

PhD Position in Computer Science for

Analysis of ECGs and Clinical Data to Predict At-Risk Patients

Background and Motivation

Heart failure (HF) affects more than one million people and is responsible for more than 160,000 hospitalizations and 70,000 deaths per year in France. It constitutes a public health problem due to its increasing prevalence due to the aging population.

In clinical practice, the cardiac electrical signal is analyzed using a 12-lead electrocardiogram (ECG). During ECG recording, a large amount of raw data is collected to transform the electrical signal into images that can be used by clinicians. However, the raw data could be used in its entirety to detect variabilities not visible on the image and that predict the onset of future clinical symptoms. In addition, extensive clinical patient data can be extracted using natural language processing methods.

Subject

In this project, we aim to design a short-term prediction model for patients at risk of death or hospitalization for Heart failure that would allow us to implement targeted prevention strategies. More specifically, in this thesis, clinical characteristics and ECG signals will be used and analyzed to identify the most relevant ECG features and clinical parameters associated with the risk of hospitalization for Heart failure and the following aspects will be addressed:

- The proposed methods must be capable not only of automatically classifying unbalanced multiclass ECG signals but also of possessing a high degree of interpretability to meet the needs of clinicians.
- The spatio-temporal relations and intra-patient memory of events will be studied.
- Hybrid approaches combining graphs and deep learning will be considered, in particular to learn multiscale, locally organized and globally connected features.
- Multimodal learning aspects will also be considered for image information integration together with the signal data.
- Data augmentation and imbalanced classes will be also part of the questions to study.

Desired skills and profile

- Master's degree in signal processing, computer science, artificial intelligence, data processing, deep learning, etc.
- Strong algorithmic and programming skills (Python, R, and Linux shell scripting)
- Data analysis and statistics
- Prior experience in machine learning
- Writing and oral skills in English
- Interpersonal skills and ability to work in multidisciplinary team
- Autonomy and proactivity

Localization

- The main thesis site is the CHU of Poitiers and the University of Poitiers, the student will also spend some time with the supervisors in Poland, Gdansk

Remuneration

Around 1800 euros per month during 3 years.

Advisors

- PhD Olena Tankyevych: research engineer at CHU de Poitiers, CIC-1402
- PU-PH Rodrigue Garcia: CHU de Poitiers, CIC-1402
- Pr Philippe Carré: University of Poitiers, Xlim
- Associate Pr Anne-Sophie Capelle; University of Poitiers, Xlim
- Associate Pr Anna Wesierska: Department of Biomedical Engineering, Gdansk University of Technology, Poland