Internship in data science, (Bio)Mathematics and Modelling applied to ‘sport and diabetes’ physiology.

Applications by e-mail to elsa.heyman@univ-lille.fr

Workplace: Université de Lille (EURASPORT, 413 avenue Eugène Avinée, 59120 Loos, FRANCE)

Supervisors : Elsa Heyman (URePSSS, ULR 7369 Univ Lille), Pierre Morel (URePSSS, ULR 7369 Univ Littoral), and Philippe Preux (laboratoire CRISTAL UMR 9189 Univ Lille)
Collaborators : Rémi Rabasa-Lhoret (IRCM, Montréal) ; Joris Heyman (CNRS, Univ Rennes 1)

Context:
In type 1 diabetes (T1D), physical activity is an essential component of the treatment plan because of its recognised beneficial effects on numerous health parameters. Nevertheless, T1D individuals often have a level of physical activity that falls short of international recommendations. The main obstacles to physical activity are fear of hypoglycaemia and diabetes imbalance. Depending on the intensity, duration, method and timing of the last insulin injection, physical activity can have a hypo- or hyperglycaemic effect. Faced with this situation, it is difficult for T1D sports practitioners to anticipate appropriate adaptations to their insulin and/or diet: at present, recommendations as to the adaptations to be made according to the characteristics of the exercise remain very vague due to the lack of studies carried out under real-life conditions (glucose monitoring sensors).

The overall aim of the project is to improve the accuracy of algorithms for predicting variations in blood sugar levels as a function of physical activity, using data recorded by sensors worn in everyday life, taking into account diet, insulin administered (e.g., from insulin pumps), etc.

Objectives of the internship:
The sensors (accelerometer, continuous glucose monitoring systems, insulin pumps, etc) worn by the patients living with T1D generate a large amount of temporal data each day. This data needs to be processed and analysed automatically to produce simple indicators that are useful to patients, and to enable research teams to base their predictive models on it. Codes for calculating indices of glycaemic excursions (e.g., time spent at different thresholds of hypoglycaemia or hyperglycaemia, glycaemic variability, i.e., rapid variations towards high and low glycaemia levels, etc.) have already been developed to process data from glucose sensors. These codes are also designed to create a formatted database for each patient, enabling a number of simple indicators to be displayed and calculated. These codes were then put into an intuitive web interface for researchers and doctors.

The main objective of the internship will be to explore machine learning methods in order to improve the algorithms and statistical models for prediction of hypo and hyperglycaemic risk around physical activity (considering their temporal dynamics).

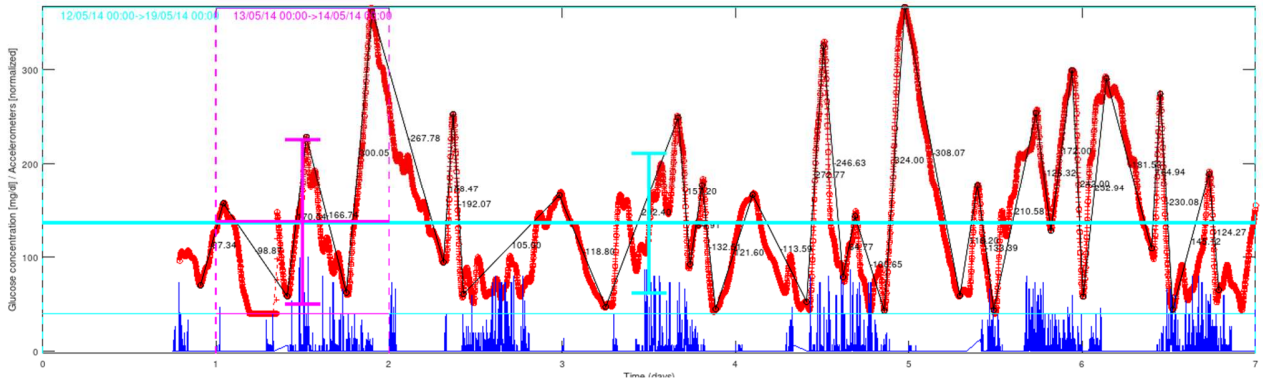

Figure 1: Example of a blood glucose (red) and accelerometry (blue) time series for a patient over a period of one week. Statistical indicators calculated from these data (annotations) are used to qualify the patient's general condition. The aim is to predict variations in blood sugar levels as a function of physical activity, insulin administered, diet and psychological stress.

Working environment:

Data visualizations and models will be based on data collected by URePSSS laboratory over the last few years on hundreds of physically active children and adults living with type 1 diabetes, with recordings over one to two weeks of their everyday life. The URePSSS laboratory continues to collect data on patients, which will enable the student to discover and gain a better understanding of the data collection methods used for modelling.

The internship will be located at the University of Lille, within the URePSSS laboratory (Multidisciplinary Sport, Health and Society Research Unit, ULR 7369) under the supervision of Prof. Elsa Heyman and Dr. Pierre Morel, in close collaboration with Prof. Philippe Preux of the CRISTAL laboratory (UMR 9189, IT, Signal and Automation Research Centre). Regular videoconference meetings will be organised with a collaborator from the University of Rennes (Joris Heyman) and Montreal (Rémi Rabasa-Lhoret).

Expected profile:

- In-depth knowledge of data science
- In-depth knowledge of the main supervised and unsupervised learning models
- Strong skills in R or, failing that, in Python for data science
- Fluent reading of English
- Autonomy, rigor, reliability
- Ability to listen and communicate with the scientific community
- Ability to present work orally and in writing