# Post-doctorate in (Bio)Mathematics, Modelling and Data science, applied to 'sport and diabetes' physiology.

**Applications by e-mail to elsa.heyman@univ-lille.fr before the 30th September 2024**

**General information:**
Workplace: Université de Lille (EURASPORT, 413 avenue Eugène Avinée, 59120 Loos, FRANCE)
Publication date: July 2024
Type of contract: Scientific fixed-term contract (post-doctorate)
Duration of contract: 12 months (possibility of renewing for 6 additional months)
Planned start date: from November 2024 or January 2025
Working hours: Full time
Gross salary: between 2480 and 2730 €
Level of studies required: Level 8 - (PhD)
CNU (National University Council) sections: 25, 26, 27, 60, 61

**Scientific 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. The overall aim of the project is to improve the understanding of the many factors influencing glycaemic fluctuations around physical activity in a real-world setting. This will help in improving and personalising guidance to patients on adapting insulin and diet to facilitate physical activity while minimising specific glycaemic fluctuations.

**Objective of the post-doctorate position:**
The main objective of **the post-doctorate position** will be to explore mathematical and biophysical models (*e.g.,* compartment models based on physiological understanding of glycaemia regulation), machine learning methods (*e.g.* repeated measures random forests), mathematical models (*e.g.* coupling between variables for dynamic signals) in order to improve the algorithms for prediction of hypo and hyperglycaemic risk around physical activity while considering their temporal dynamics. These in-depth analyses will allow to better understand the specific glycaemic impacts of physical activity characteristics (e.g., duration, intensity, modality) and of the conditions under which physical activity is performed (e.g., time of day, pre-exercise glycaemia, insulin on board, carbohydrate intake, psychological stress).

**Data that will be analyzed:**
The sensors (continuous glucose monitoring systems, accelerometers, heart rate monitors, diet on-line applications, insulin pumps etc) worn by individuals 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. Code 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.) has already been developed to process data from glucose sensors. This code is also designed to create a formatted database for each patient, enabling a number of simple indicators to be displayed and calculated. An intuitive web interface was also created for researchers and doctors.

Models will be based on data collected by both the URePSSS laboratory and the Montreal Clinical Research Institute 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 post-doctoral student to discover and gain a better understanding of the data collection methods used for modelling.

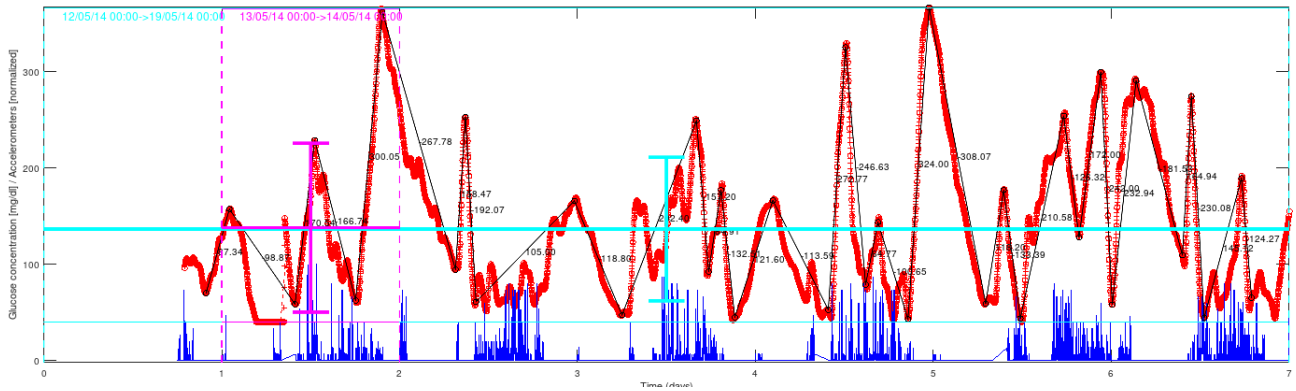


*Figure 1: Example of a blood glucose (red) and accelerometry (blue) time series for a patient over a period of one week. Statistical indicators calculated from these data (annotations) are used to qualify the patient's general condition. The aim is to predict variations in blood sugar levels as a function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

**Working environment:**
The post-doctorate position 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, CS, Signal & Automatic Research Centre).
The work will be carried out as part of an International Associated Laboratory, including the 'Metabolism' team from the URePSSS laboratory in charge of the project with the PROMD team headed by Prof. Rémi Rabasa-Lhoret at the Institute for Clinical Research in Montreal. Regular videoconference meetings will be organised with a collaborator from the University of Rennes (Joris Heyman).

**Person specification:**

- In-depth knowledge and experience in data science and the main supervised and unsupervised learning models
- University education including an extensive training in mathematical and biophysical models, and time series analysis and modelling
- Strong skills in Python or/and in R for data science
- Fluent reading/writing of English
- Autonomy, rigor, reliability
- Ability to listen and communicate with the scientific community
- Ability to present work orally and in writing
- Aptitude for working in interaction with specialists from other disciplines (exercise physiology, medicine)