

Master Thesis Topic

Design and implementation of an energy efficient artificial pancreas using reinforcement learning

Keywords

Machine Learning, Deep Learning, Edge computing, reinforcement learning, Python, Tensorflow, Pytorch

Description

Blood glucose control, for example, in diabetes mellitus or severe illness, requires strict adherence to a protocol of food, insulin administration and exercise personalized to each patient. An artificial pancreas for automated treatment could boost quality of glucose control and patients' independence. The components required for an artificial pancreas are: i) continuous glucose monitoring (CGM), ii) smart controllers and iii) insulin pumps delivering the optimal amount of insulin. In recent years, medical devices for CGM and insulin administration have undergone rapid progression and are now commercially available. Yet, clinically available devices still require regular patients' or caregivers' attention as they operate in open-loop control with frequent user intervention. Dosage-calculating algorithms are currently being studied in intensive care patients, for short overnight control to supplement conventional insulin delivery, and for short periods where patients rest and follow a prescribed food regime. In this thesis, we will review and discuss different reinforcement learning (RL) algorithms, controlling insulin in a closed-loop to provide individual insulin dosing regimens that are reactive to the immediate needs of the patient. The system will be implemented on a small computer chip and will be tested for energy efficiency to ensure the system is suitable for continuous operation.

The tasks are as follows:

- Analyze and understand the different state of the art algorithms in reinforcement learning,
- understand the problem of glucose monitoring and how to react to sudden changes in glucose levels,
- implement a RL system to control insulin,
- implement the system on a micro controller and optimize for energy consumption.

Requirements

- Basic knowledge of algorithms and statistical modelling
- Good knowledge of machine learning models
- Python programming skills
- Basic experience with libraries like Tensorflow and/or Pytorch

Contact

Ahmad Ayad, Room 336 (ICT Cubes), E-mail: ahmad.ayad@isek.rwth-aachen.de