Sep 26, 2019

Toward Medically Inspired Internet-of-Things Automated Glucose Control Systems for People with Diabetes

Marzia Cescon

Assistant Professor, Department of Mechanical Engineering, University of Houston, TX

ABSTRACT:

Diabetes is a global health problem increasing at an alarming rate worldwide and affecting as many as 33.5 million individuals in the United States alone with associated annual medical cost of $345 billion. Regulation of blood glucose in the acceptable range is imperative in order to avoid the severe complications associated with this chronic condition and is achieved, among other approaches, by exogenous insulin replacement. Automated insulin delivery systems, also known as Artificial Pancreas (AP), are steadily becoming the standard of care in management of type 1 diabetes. However, in spite of the progress made in insulin therapy and the advancements in glucose monitoring devices, the current reach of such closed-loop systems is still limited to a selected population due to insufficient adoption of insulin pumps and continuous glucose monitors (CGMs), inadequate understanding of the underlying pathophysiology and challenges in the management of daily life stressors that impact blood glucose regulation. In the age of connected devices, in which the behavior and habits of patients can be registered on their smartphone and data gathered in cloud-based platforms, there are unprecedented opportunities to collect objective data on a growing number of patients in the free-living setting and design solutions suitable and accessible to a larger population of people with diabetes. In this talk, I will leverage automatic control and machine learning toward the development of medically inspired internet-of-things systems addressing glucose regulation in a larger fraction of people with diabetes. First, I will present iterative algorithms to automate traditional clinical therapies for people that use multiple-daily-injections (MDIs) and a finite number of capillary blood glucose measurements. Second, I will introduce methods to estimate aspects of physical activity and sedentary behavior from three-axis accelerometer data collected with a wrist-worn device, with the goal of incorporating this information in closed-loop systems and hence removing manual feed-forward action.

BIOGRAPHY:

Marzia Cescon is the David C. Zimmerman Assistant Professor in Mechanical Engineering at the University of Houston, Cullen College of Engineering, Houston, TX and an adjunct investigator at Sansum Diabetes Research Institute in Santa Barbara, CA. She earned the BSc degree in Information Engineering and the MSc degree in Automation Engineering from the University of Padua, Italy, in 2005 and 2008, respectively, and received the PhD degree in Controls in 2014 from the Automatic Control Department at Lund University, Sweden, with the supervision of prof. Rolf Johansson. In 2014 she was a research specialist with the biomedical control group lead by prof. Francis Doyle in the Chemical Engineering Department at the University of California, Santa Barbara. She moved to Melbourne, Australia, in January 2015 where she joined the Control and Signal Processing Lab at the Melbourne School of Engineering, University of Melbourne, working with prof. Erik Weyer. After a short stint in 2017 as lead technologist and data scientist at Dianovator AB, a new digital health start-up in diabetes technology, she returned to academia in January 2018, as a postdoctoral fellow at the Harvard John A. Paulson School of Engineering and Applied Sciences in Cambridge, MA, working on automated insulin delivery systems for people with diabetes with Prof. Francis Doyle and Dr. Eyal Dassau.Dr. Cescon's research lies at the intersection of model-based automatic control and machine learning and aims at improving the quality and safety of healthcare.