BIOENGINEERING, BIOMEDICAL, COMPUTING FRONTIERS

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Dr. Cescon joined the Cullen College of Engineering (CCOE) in August 2019. She completed her post-doctoral fellowship at Harvard John A. Paulson School of Engineering and Applied Sciences and has worked as an adjunct investigator with the William Sansum Diabetes Center in Santa Barbara, California. Dr. Cescon has also served as the lead data scientist with Dianovator AB, a Swedish startup focused on innovative diabetes technology; as a Research Fellow at the University of Melbourne in Australia; and as a visiting Research Specialist at the University of California, Santa Barbara. At the CCOE, she leads the Advanced Learning and Control Laboratory, a multidisciplinary effort at the intersection of model-based control, data-driven decision making systems and artificial intelligence. Her areas of research interest include machine and reinforcement learning and controls and dynamical system, with applications in diabetes care, neuroscience and robotics.

TOWARD MEDICALLY INSPIRED AUTOMATED GLUCOSE CONTROL SYSTEMS FOR PEOPLE WITH DIABETES

Fig. 1

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. 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 from patients in real time and design automated insulin delivery and decision support systems which learn from data and are capable of improving glycemic outcomes while reducing the burden on patients.

Dr. Cescon's group has leveraged automatic control and machine learning toward the development of medically inspired internet-of-things systems addressing precisely the above unmet need. Specifically, Dr. Cescon has proposed iterative algorithms to automate traditional clinical therapies for people that use multiple-daily-injections (MDIs) and a finite number of capillary blood glucose measurements. Further, she has introduced 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 additional information seamlessly in closed-loop glucose control systems. All these technologies can be implemented in smart-phone applications.

Publications

1. Marzia Cescon, S. Deshpande, R. Nimri, F. J. III Doyle, and E. Dassau. Using iterative learning for insulin dosage optimization in multiple-daily-injections therapy for people with type 1 diabetes. IEEE Trans. Biomed. Eng., 2020. To appear.

2. Divya Choudhary, Marzia Cescon, J.E. Pinsker, V. Dadlani, K. Kumari, C. Reid, C. Andre, M.M. Church, Y.C. Kudva, F.J. Doyle, and E. Dassau. Activity detection and activity level categorization in free-living subjects with type 1 diabetes. Diabetes Technology Society Student Research Award Gold Prize Winner and Selected for oral presentation. In Proc. 18th Diabetes Technology Meeting (DTM2018), Bethesda, MD, 2018.

3. Marzia Cescon, D. DeSalvo, T.T. Ly, D.M. Maahs, L.H. Messer, B.A. Buckingham, F.J. Doyle III, and E. Dassau. Early detection of infusion set failure during pump therapy in type 1 diabetes. Journal of Diabetes Science and Technology, 10:1268–1276, 2016.

Patents

1. Marzia Cescon, E. Dassau, and F. J. III Doyle. Iterative learning control with sparse measurements for long acting insulin injections in people with type 1 diabetes. U.S. Provisional Application No. 62/872,020, July 2019 (pending conversion to a PCT application).