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COMMENTARY

Algorithms for a Closed-Loop Artificial Pancreas: The Case for Model Predictive Control

B. Wayne Bequette, Ph.D.

Abstract

The relative merits of model predictive control (MPC) and proportional-integral-derivative (PID) control are discussed, with the end goal of a closed-loop artificial pancreas (AP). It is stressed that neither MPC nor PID are single algorithms, but rather are approaches or strategies that may be implemented very differently by different engineers. The primary advantages to MPC are that (i) constraints on the insulin delivery rate (and/or insulin on board) can be explicitly included in the control calculation; (ii) it is a general framework that makes it relatively easy to include the effect of meals, exercise, and other events that are a function of the time of day; and (iii) it is flexible enough to include many different objectives, from set-point tracking (target) to zone (control to range). In the end, however, it is recognized that the control algorithm, while important, represents only a portion of the effort required to develop a closed-loop AP. Thus, any number of algorithms/approaches can be successful—the engineers involved in the design must have experience with the particular technique, including the important experience of implementing the algorithm in human studies and not simply through simulation studies.

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Author Affiliation: Department of Chemical and Biological Engineering, Rensselaer Polytechnic Institute, Troy, New York

Abbreviation: (AP) artificial pancreas, (ARX) autoregressive moving average, (CGM) continuous glucose monitoring, (CIR) carbohydrate-to-insulin ratio, (DMC) dynamic matrix control, (GPC) generalized predictive control, (MPC) model predictive control, (MMPPC) multiple model probabilistic predictive control, (PID) proportional integral derivative, (TDD) total daily dose

Keywords: algorithms, artificial pancreas, model predictive control, proportional-integral-derivative control

Corresponding Author: B. Wayne Bequette, Ph.D., Department of Chemical and Biological Engineering, Rensselaer Polytechnic Institute, 110 Eighth Street, Troy, NY 12180-3590; email address bequette@rpi.edu