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Abstract

Closed-loop control of blood glucose, also called an artificial pancreas (AP), can free people with type 1 diabetes from the burden of managing their insulin therapy. In addition, it has the potential to provide tighter blood glucose control while reducing the risk of short- and long-term diabetes complications. Currently, linear model predictive control (MPC) algorithms are being tested for the AP and show promising results. However, the insulin-glucose dynamics are highly nonlinear, and would require advanced techniques for more accurate state and parameter estimation.

Here, we apply MPC to an AP for people with type 1 diabetes. We use a minimal identifiable physiological model for simulation. In particular, we estimate the model states and parameters using a continuous-discrete extended Kalman filter (EKF). The filter should be able handle uncertainties associated with meal intake and changes in insulin sensitivity. We describe the key aspects of the numerical implementation and provide quantitative insights into the factors limiting the achievement of acceptable AP performance.

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