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Improved Blood Glucose-Insulin Monitoring with Dual-Layer Predictive Control Design

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Abstract : In response to widely used wearable medical devices equipped with a continuous glucose monitor (CGM) and insulin pump, the advanced control methods are still demanding to get the full benefit of these devices. Unlike costly clinical trials, implementing effective insulin-glucose control strategies can provide significant contributions to the patients suffering from chronic diseases such as diabetes. This study deals with a key role of two-layer insulin-glucose regulator based on model-predictive-control (MPC) scheme so that the patient’s predicted glucose profile is in compliance with the insulin level injected through insulin pump automatically. It is achieved by iterative optimization algorithm which is called an integrated perturbation analysis and sequential quadratic programming (IPA-SQP) solver for handling uncertainties due to unexpected variations in glucose-insulin values and body’s characteristics. The feasibility evaluation of the discussed control approach is also studied by means of numerical simulations of two case scenarios via measured data. The obtained results are presented to verify the superior and reliable performance of the proposed control scheme with no negative impact on patient safety.

Keywords : blood glucose monitoring, insulin pump, predictive control, optimization
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