Personalized Model Predictive Control for Artificial Pancreas

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Research

Keywords: artificial pancreas, personalized modeling, model predictive control

Posted Date: July 1st, 2021

DOI: https://doi.org/10.21203/rs.3.rs-634533/v1

Abstract

This paper proposes a personalized model predictive control strategy for the artificial pancreas to guide insulin injection in diabetic therapy. To overcome the parameter uncertainty induced by inter and intra-individual variability, a new observable glucose-insulin dynamic model is established to describe the integrated metabolism of glucose and insulin, under which all model parameters can be extended to observable state variables. Subsequently, a particle filtering estimator is developed to identify not only the personalized parameters, but also the plasma glucose concentration. Concerning the time delay of glucose metabolism, model predictive control is employed to regulate the glucose concentration in plasma, instead of glucose concentration measured in interstitial tissue using continuous glucose monitor. For validation, the experiments are carried out on the 30 in-silico subjects produced by UVa/Padova simulator. The proposed algorithm shows promising performances on personalized identification and plasma glucose control (mean value of 6.64 mmol/L) without meal announcement. It shows that the proposed method has the potential for artificial pancreas in clinical treatment.

Full Text

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