Glucose Regulation in Type 1 Diabetes Mellitus with Model Reference Adaptive Control and Modified Smith Predictor

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Abstract

Nature of the system, a novel adaptive control structure has been proposed for time-delayed systems, which is a combination of the model reference adaptive control with modified Smith Predictor. Due to extensive variability among patients in metabolism, an in-silico trial consisting of 30 patients with random changes and sinusoidal oscillation in parameters of Dalla Man glucose-insulin model has been used to simulate the personal variability in the glucose control system. Performance of the proposed algorithm has been compared to the PID controller with Smith Predictor, based on the quantitative and qualitative indicators. Simulation results show that the proposed control scheme is effective in fasting conditions, meal disturbance rejection, and robustness against inter-patients variability. Insulin therapy for type 1 diabetes patients often causes high fluctuations in their blood glucose and hypoglycemic/hyperglycemic events. Closed loop control of blood glucose using artificial pancreas can improve life quality of patients. In this paper, physiological behaviour of the system has been modeled inversely using daily patient data acquired GIM simulator. Then, considering the delay.

Keywords: Type 1 diabetes mellitus, Model reference adaptive control, Time delayed system, Smith Predictor