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SYMPOSIUM

Linear Quadratic Gaussian-Based Closed-Loop Control of Type 1 Diabetes

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Abstract

Background:

We investigated the applicability of linear quadratic Gaussian (LQG) methodology to the subcutaneous blood glucose regulation problem. We designed an LQG-based feedback control algorithm using linearization of a previously published metabolic model of type 1 diabetes. A key feature of the controller is a Kalman filter used to estimate metabolic states of the patient based on continuous glucose monitoring. Insulin infusion is computed from linear quadratic regulator feedback gains applied to these estimates, generally seeking to minimize squared deviations from a target glucose concentration and basal insulin rate. We evaluated *in silico* subject-specific LQG control and compared it to preexisting proportional-integral-derivative control.

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Abbreviations: (AMM) augmented meal model, (BG) blood glucose, (CGM) continuous glucose monitors, (IP) intraperitoneal, (IV) intravenous, (LBGI) low BG index, (LQ) linear quadratic, (LQG) linear quadratic Gaussian, (LQR) linear quadratic regulator, (Min_BG) minimum glucose concentration, (PERCH) percent-time BG >180 mg/dl, (PERCVL) percent-time BG <70 mg/dl, (PID) proportional-integral-derivative, (RMM) reduced meal model, (SC) subcutaneous, (SMBG) self-monitoring of blood glucose, (T1DM) type 1 diabetes mellitus

Keywords: artificial pancreas, diabetes, LQG control, simulation

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