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ORIGINAL ARTICLES

Proposed Clinical Application for Tuning Fuzzy Logic Controller of Artificial Pancreas Utilizing a Personalization Factor

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Abstract

Background:

Physicians tailor insulin dosing based on blood glucose goals, response to insulin, compliance, lifestyle, eating habits, daily schedule, and fear of and ability to detect hypoglycemia.

Method:

We introduce a method that allows a physician to tune a fuzzy logic controller (FLC) artificial pancreas (AP) for a particular patient. It utilizes the physician's judgment and weighing of various factors. The personalization factor (PF) is a scaling of the dose produced by the FLC and is used to customize the dosing. The PF has discrete values of 1 through 5. The proposed method was developed using a database of results from 30 University of Virginia/Padova Metabolic Simulator *in silico* subjects (10 adults, 10 adolescents, and 10 children). Various meal sizes and timing were used to provide the physician information on which to base an initial dosing regimen and PF. Future decisions on dosing aggressiveness using the PF would be based on the patient's data at follow-up.

Results:

Three examples of a wide variation in diabetes situations are given to illustrate the physician's thought process when initially configuring the AP system for a specific patient.

Conclusions:

Fuzzy logic controllers are developed by encoding human expertise into the design of the controller. The FLC methodology allows for the real-time scaling of doses without compromising the integrity of the dosing rules matrix. The use of the PF to individualize the AP system is enabled by the fuzzy logic development methodology.

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Abbreviations: (AP) artificial pancreas, (BG) blood glucose, (FL) fuzzy logic, (FLC) fuzzy logic controller, (HbA1c) hemoglobin A1c, (HBGI) high blood glucose index, (LBGI) low blood glucose index, (PF) personalization factor, (TDD) total daily dose, (UVa) University of Virginia

Keywords: artificial pancreas, diabetes, fuzzy logic, personalization, physician method

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