Abstract

• Patients with Type-1 diabetes suffer from lack of insulin due to autoimmune destruction of the pancreatic beta cells.
• To solve this issue, patients use an insulin pump to keep proper blood glucose levels.
• Complications arise when blood glucose levels are too high, too low, or unstable.

Background

• Artificial Pancreas: This is a device that automatically supplies insulin based on blood glucose levels. It consists of 3 components: a glucose sensor, and infusion pump, and a controller.
• AP Controller: Takes in signals from glucose sensor and outputs the necessary insulin. The controller consists of a feed forward network for preemptive external changes and feedback network from insulin output.
• Blood-Glucose System: Refers to the anatomical system that deals with insulin and blood glucose levels. This system is broken down into the block diagram shown on the right.

Research Challenges

• Achieving proper differential equation solutions for each stage of the controller.
• Creating the feedforward controller.
• Implementing controller into Simulink consisting of block diagrams as well as Matlab functions.
• Tuning the PID controller to achieve desired output.

Methodology

• First step is to find and solve differential equations needed for the controller.

\[ \dot{G}_s(t) = -k_s G_s(t) + k_g G(t), \]

Diff Eq. for sensor information

• Next is to map out order of system. This is seen through the block diagram.
• Final step is to map it to Simulink in order to simulate the response.

Results/Future Work

• After running the simulation we see that the Blood Glucose stayed fairly close to our set value of 80 mg/dl.
• The important thing to note is that the blood glucose did not drop below 60 mg/dl, which could cause severe hypoglycemia.

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References