SUMMARY

Project Title: Development of a Circuit Based Model for the Analysis of Glucose Regulation System

The significant contributions and highlights of the project work can be summarized as:

- *Development of gradient free approach for the estimation of insulin sensitivity and pancreatic insulin responsitivity*:

  The avoidance of gradient calculation in the proposed technique, makes the estimated physiological parameters (circuit elements) independent of the initial parameterization. The same is reflected in the low standard deviation of the parameters obtained for successive runs of the algorithm. A low standard deviation relates to higher confidence in estimating the model parameters from experimental data.

- *Development of a circuit for simulating the subject specific dynamics of glucose-insulin interactions*:

  The correlation achieved between the circuit elements and the physiological process of glucose metabolism is in correspondence with the similar studies being carried out in literature for respiratory system. The simulation of the circuit for different inputs can be used for meal management and determining the optimal dose and instant of insulin infusion. The conventional approaches involving pre-defined insulin dosage based on the meal intake do not take into consideration the nonlinear and time varying dynamics of glucose metabolism. The glucose-insulin profile obtained from simulation are able to track the possible changes in the processes involved in glucose metabolism by continuous estimation of model parameters and can thus provide a better management.

- *Analysis to isolate the different components of glucose utilization i.e. insulin dependent and insulin independent utilization*:

  In the Bergman Minimal Model, the intermediate variable $X(t)$ replicates the insulin dependent glucose utilization component. Similarly the insulin independent glucose utilization is represented by the parameter p_2, which is approximated by R_1 in the equivalent circuit model. The low deviation between the glucose-insulin profile obtained by the simulation of the mathematical model, electrical circuit and IVGTT data reflects the appropriateness of using the model/circuit parameters for pathological purpose.

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