Robustness Properties of Optimal Insulin Bolus Administrations for Type 1 Diabetes

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***Abstract*— Type 1 diabetic patients compensate the lack of endogenous insulin by basal delivery and bolus injections at meal-times. Exact dosage of the bolus amount is critical to keep the blood glucose both below the maximum limits and above the hypoglycaemia critical values. Determination of the optimal dosage would require information which in general is not available to the patient, who uses empirical rules of thumb to choose the dosage. Although closed loop control obtained by linking insulin delivery from insulin pumps and continuous glucose monitoring systems may be considered as the ultimate solution, multiple daily insulin injections and finger stick glucose measurements remain the current mode of therapy. This paper is concerned with this conventional insulin treatment and is based on the use of model predictive techniques extended to approximate continuous control output signal by single control moves in time. The paper shows that substituting continuous measurement and insulin delivery with discrete values leads to a suboptimal control performance, but that this residual defect is not essential if compared with estimation errors of model parameters, patient inputs and/or measurements. Furthermore, the approach proposed shows in simulation sufficient robustness margins. Computations are done with an extended Bergman model tuned on available data of Type 1 diabetic patients.**

Manuscript received September 22, 2008. The research leading to these results has received funding from the European Community´s Seventh Framework Programme FP7/2007-2011 under grant agreement n° 216592.

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