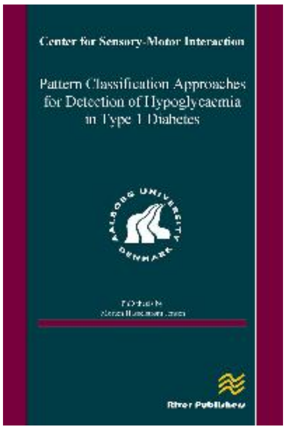

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Pattern Classification Approaches for Detection of Hypoglycaemia in Type 1 Diabetes

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Description:

Diabetes is a chronic disease that affects 347 million people world-wide. The disease is characterised by insufficient or absent insulin production and secretion and/or insulin resistance, and the consequences are acute and late-diabetic complications. Evidence from the Diabetes Control and Complications Trial suggests that intensive insulin therapy delays the onset and slows the progression of late-diabetic complications. This beneficial effect, however, comes at the expense of an increase in the number of acute hypoglycaemic events, which hampers the therapeutic compliance because people with diabetes are afraid of hypoglycaemia. Measures to detect hypoglycaemia, thereby enabling prevention, would be a possible solution to maintain intensive insulin therapy without increasing the number of hypoglycaemic events. Self-monitoring of blood glucose typically results in 3-4 blood glucose measurements pr. day, which is not enough to detect all hypoglycaemic events. On the other hand, a measurement every 5 minutes with continuous glucose monitoring provides a sufficient amount of information to detect hypoglycaemia. Unfortunately, this technology suffers from inaccuracy, especially in the hypoglycaemic range, due to physiological delay and a delay caused by filter routines. Researchers have for decades worked on the problem of inaccuracy of continuous glucose monitoring, and the devices have improved significantly. Nevertheless, the measuring devices have unacceptable inaccuracies resulting in an unacceptable number of false alerts.

The research described in this thesis utilises pattern classification approaches to optimise the hypoglycaemia detection of continuous glucose monitoring. A large number of features from the continuous glucose monitoring signal and insulin injection were systematically extracted, and then the dimension was reduced with SEPCOR and Forward Selection. Using Support Vector Machines, each continuous glucose monitoring reading was classified as hypoglycaemic or non-hypoglycaemic based on concurrent blood glucose readings. This approach was used to develop a retrospective algorithm and a real-time algorithm using both historic and future data and only historic data, respectively. Both algorithms managed to detect 100% of the hypoglycaemic events of the dataset, with only one false positive. By comparison, the continuous glucose monitoring device alone detected only 2/3 of the events, but with zero false positives. These results, while promising, should be generalised through training and testing of the algorithms on several datasets, including datasets with spontaneous hypoglycaemic events.

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