TENSOR PRODUCT-BASED ROBUST CONTROL OF DIABETES

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Introduction

In order to develop a well-functioning artificial pancreas the modern advanced control algorithms have indispensable role. However, there have not been born a general solution until nowadays which is able to deal with the questions of personalization and general usability at the same time. Personalization demands the use of more accurate and complex patient models which are tuned based on the patient's own data. The general (robust) control algorithms are able to handle the complex models but the quality of the control is not as much as it can be beside guaranteeing the safety of the patients due to the complexity of the models. Our aim is the further development of our robust control framework and it's redefinition from quality point of view. To develop a control framework (both on the control and the modeling sides), which is able to provide safe and adequate blood glucose control beside the vary of the parameters of the patients (both from the intra- and inter-variability point of view as well). We have designed a TP-LPV-LMI controller based on difference based qLPV model accompanied with EKF which is able to enforce the original nonlinear system to satisfy the predefined criteria.

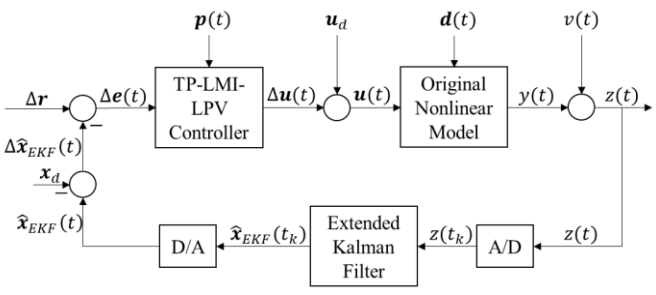

Fig. 1. Control structure

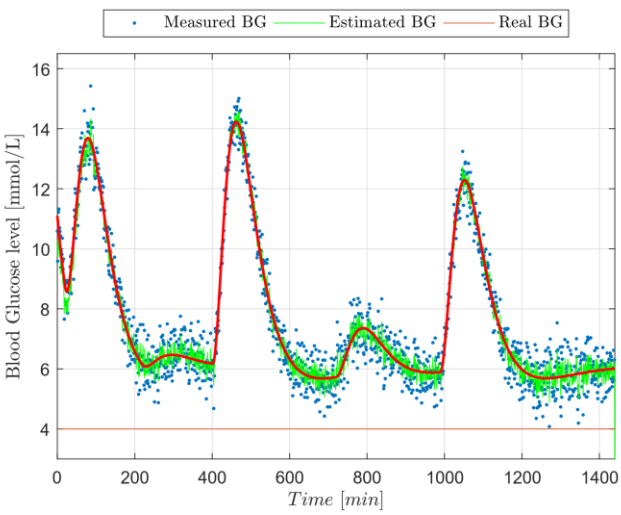

Fig. 2. Measured, Estimated and Real BG levels

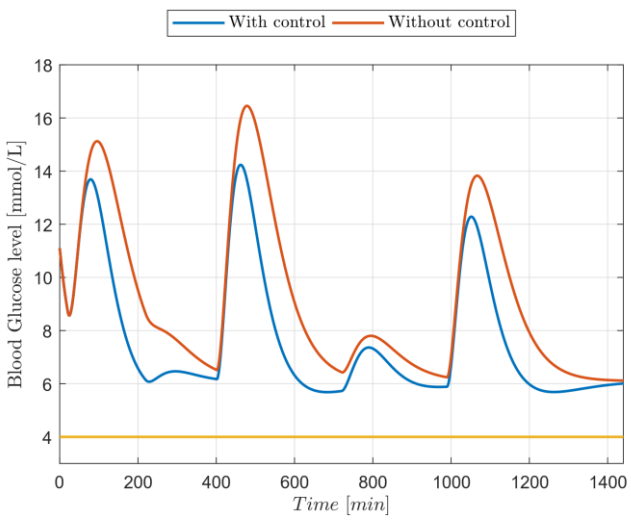

Fig. 3. Without and with control

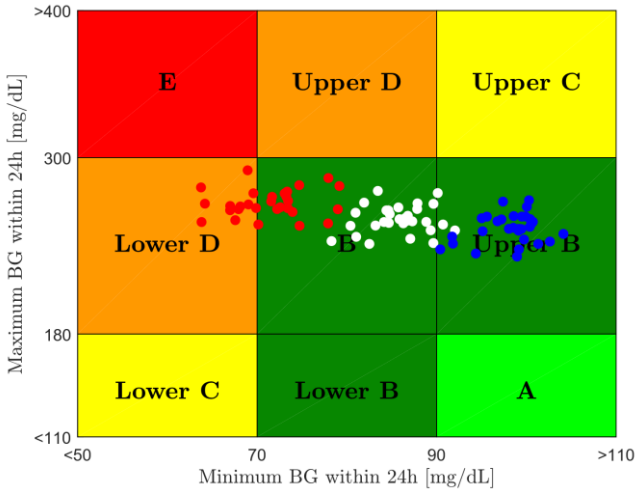

Fig. 4. CVGA (R-without control; W-measured; B-estimated)

Discussion and Conclusion

- The general control algorithm able to **extend individualized therapies**.
- TP-LPV-LMI controller: robust from parameter point of view + direct nonlinearity handling.
- EKF: disturbances handled by the model.
- In-silico validation: real patient data provided by the Hungarian Diabetes Association. The preliminary results have shown that the framework is able to handle the varying parameters.
- The control performance has been better than the recently used ones.

Further Steps

- Gathering more data from real patients in a collaboration with the HDA and international research teams.
- Generating virtual patients with good quality based on the collected measurements.
- Testing and validating the algorithms and make them more robust.

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