

Design of a Robust Lipschitz Observer - Experimental application

Christian Feudjio¹, Philippe Bogaerts²

Jean-Sebastien Deschenes³, Alain Vande Wouwer¹

¹ Automatic Control Laboratory, University of Mons, Belgium

{Christian.FeudjioLetchindjio, Alain.VandeWouwer}@umons.ac.be

² 3BIO - Modeling and Control of Bioprocesses, University of Brussels, Belgium

³ Universite du Quebec a Rimouski, Canada

Abstract

The culture of micro-algae in photo-bioreactors (PBR) has received a regain of interest in the last two decades in view of the multiple potential applications ranging from the production of biofuels to pigments, nutrients and wastewater treatment process [1]. For monitoring and advanced control purposes, measurements from states of the process are mandatory. As sometimes it is impossible to get them because either hardware sensors related are too expensive or simply do not exist yet, software sensors (or observers) [2, 3] are used to reconstruct the evolution of unmeasured states from the process. In particular, it is impossible to measure on-line the microalgae internal quota (Q), i.e., the content of the internal substrate pool. The aim of this study is to propose a systematic method for the definition of the linear part of a Lipschitz Observer, so as to ensure that the model of the process is stable and observable. Validation is then done on experimental data.

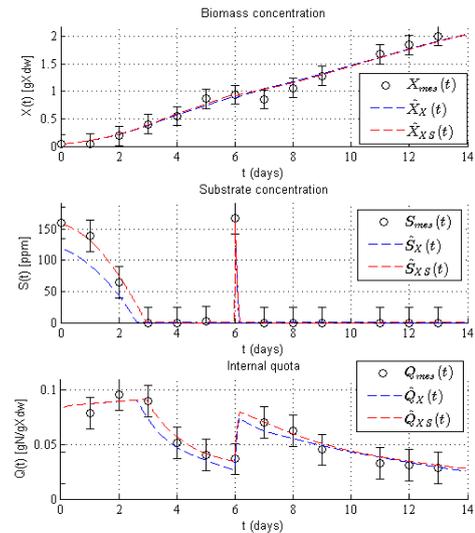


Figure 2: Estimation of Biomass (X), Substrate (S) and Internal Quota (Q) using Biomass measurements versus using both Biomass and Substrate measurements

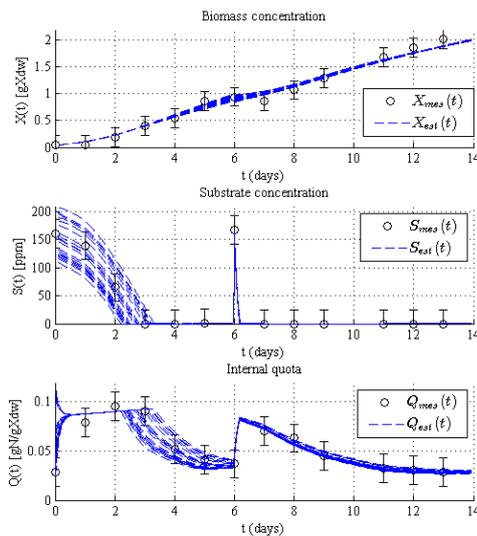


Figure 1: Estimation of Biomass (X), Substrate (S) and Internal Quota (Q) from various initial conditions using Biomass measurements

Acknowledgements

This paper presents research results of the Belgian Network DYSCO (Dynamical Systems, Control, and Optimization), funded by the Interuniversity Attraction Poles Programme initiated by the Belgian Science Policy Office.

References

- [1] Y. Chisti, "Biodiesel from microalgae", *Biotechnology Advances*, (50) 291–300, 2007.
- [2] Ph. Bogaerts, A. Vande Wouwer "Software Sensors for bioprocess", *ISA transactions*, (42) 547–558, 2003.
- [3] G. Goffaux, A. Vande Wouwer, and O. Bernard, "Improving continuous–discrete interval observers with application to microalgae-based bioprocesses", *Journal of Process Control*, (19) 1182–1190, 2009.