Stability analysis of a bioreactor model with delayed feedback control

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We consider a well known mathematical model, describing the process of anaerobic biological treatment (methane fermentation) of organic wastes in a continuously stirred tank bioreactor. The model is presented by two nonlinear ordinary differential equations and one algebraic equation for the gaseous (methane) output. We introduce a feedback control law, which depends on the on-line measurable output and involves a discrete delay. This is a practically oriented problem, because there is always a time delay between output measurements and system's response in industrial applications, cf. [1]. Delayed bioreactor models have been recently investigated by many authors as an attempt to explain different phenomena in practical experiments, see e. g. [2] and the references therein. The aim of the paper is to study the stabilizability of the considered closed-loop model with respect to the time delay. A numerical extremum seeking algorithm, implemented in web-based environment [3] is applied to optimize the methane flow rate in real time. Simulation results are presented to illustrate the efficiency of the algorithm.

References

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