World Academy of Science, Engineering and Technology
International Journal of Electrical and Computer Engineering
Vol:13, No:02, 2019

Design of Identification Based Adaptive Control for Fermentation Process in Bioreactor

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Abstract : The biochemical technology has been developing extremely fast since the middle of the last century. The main reason for such development represents a requirement for large production of high-quality biologically manufactured products such as pharmaceuticals, foods, and beverages. The impact of the biochemical industry on the world economy is enormous. The great importance of this industry also results in intensive development in scientific disciplines relevant to the development of biochemical technology. In addition to developments in the fields of biology and chemistry, which enable to understand complex biochemical processes, development in the field of control theory and applications is also very important. In the paper, the control for the biochemical reactor for the milk fermentation was studied. During the fermentation process, the biophysical quantities must be precisely controlled to obtain the high-quality product. To control these quantities, the bioreactor’s stirring drive and/or heating system can be used. Available commercial biochemical reactors are equipped with open loop or conventional linear closed loop control system. Due to the outstanding parameters variations and the partial nonlinearity of the biochemical process, the results obtained with these control systems are not satisfactory. To improve the fermentation process, the self-tuning adaptive control system was proposed. The use of the self-tuning adaptive control is suggested because the parameters’ variations of the studied biochemical process are very slow in most cases. To determine the linearized mathematical model of the fermentation process, the recursive least square identification method was used. Based on the obtained mathematical model the linear quadratic regulator was tuned. The parameters’ identification and the controller’s synthesis are executed on-line and adapt the controller’s parameters to the fermentation process’ dynamics during the operation. The use of the proposed combination represents the original solution for the control of the milk fermentation process. The purpose of the paper is to contribute to the progress of the control systems for the biochemical reactors. The proposed adaptive control system was tested thoroughly. From the obtained results it is obvious that the proposed adaptive control system assures much better following of the reference signal as a conventional linear control system with fixed control parameters.

Keywords : adaptive control, biochemical reactor, linear quadratic regulator, recursive least square identification
Conference Title : ICEET 2019 : International Conference on Electrical Engineering and Technology
Conference Location : Sydney, Australia
Conference Dates : February 27-28, 2019