

Fed-batch Cultivation Control Based on Genetic Algorithm PID Controller Tuning

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PID controller is widely used in feed-back control of industrial cultivation processes. The design of control systems requires adjustment of controller parameters, solving the control problems in an appropriate way. As a basis for the design procedure have to be defined a certain criteria evaluating the performance of the control system. In this paper a Universal discrete PID controller for the control of *Escherichia coli* fed-batch cultivation processes is designed. *E. coli* fed-batch culture has been widely used for production of various bioproducts including primary and secondary metabolites, proteins, and other biopolymers. Fed-batch processing is especially beneficial since a change in the nutrient concentrations affects the productivity and yield of the desired product. Both overfeeding and underfeeding of nutrient are detrimental to cell growth and product formation. Development of a suitable feeding strategy is critical in fed-batch cultivation. Various strategies have been developed to control the nutrient concentration within the optimal range. For the considered process in order to prevent the growth inhibition and to maximize the biomass concentration the glucose concentration have to be controlled at low levels based on glucose measurements. The Universal discrete PID controller is used to control feed rate and to maintain glucose concentration at the desired set point. The tuning of the PID controller parameters is done applying the GA. To evaluate the significance of the tuning procedure, four criteria reflecting the performance of the PID controller are used. Additional simulations are performed for comparison of the results from the different criteria. To obtain realistic tests of the robustness of the controller and performance of the tuning procedure noise have been introduced in the simulation. As a result the optimal PID controller settings are obtained. For a short time the controller sets the control variable and maintains it at the desired set point during the process. Application of the designed controller provides maintaining of the accuracy and efficiency of the system performance.