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Bioreactor profile control by a nonlinear auto regressive moving average neuro and two degree of freedom PID controllers

Abstract

This paper presents the use of nonlinear auto regressive moving average (NARMA) neurocontroller for temperature control and two degree of freedom PID (2DOF-PID) for pH and dissolved oxygen (DO) of a biochemical reactor in comparison with the industry standard anti-windup PID (AWU-PID) controllers. The process model of yeast fermentation described in terms of temperature, pH and dissolved oxygen has been used in this study. Nonlinear auto regressive moving average (NARMA) neuro controller used for temperature control control has been trained by Levenberg-Marquardt training algorithm. The 2DOF-PID controllers used for pH and dissolved oxygen have been tuned by MATLAB's auto tune feature along with manual tuning. Random training data with input varying from 0 to 100 l/h have been obtained by using NARMA graphical interface. The data samples used for training, validation and testing are 20,000, 10,000 and 10,000 respectively. Random profiles have been used for simulation. The NARMA neuro controller and the 2DOF-PID controllers have shown improvement in rise time, residual error and overshoot. The proposed comtrollers have been implemented on TMS320 Digital Signal Processing board using code composure studio. Arduino Mega board has been used for input/output interface

Keywords

Bioreactor profile; Inverse neural network; NARMA neuro controller; Process control