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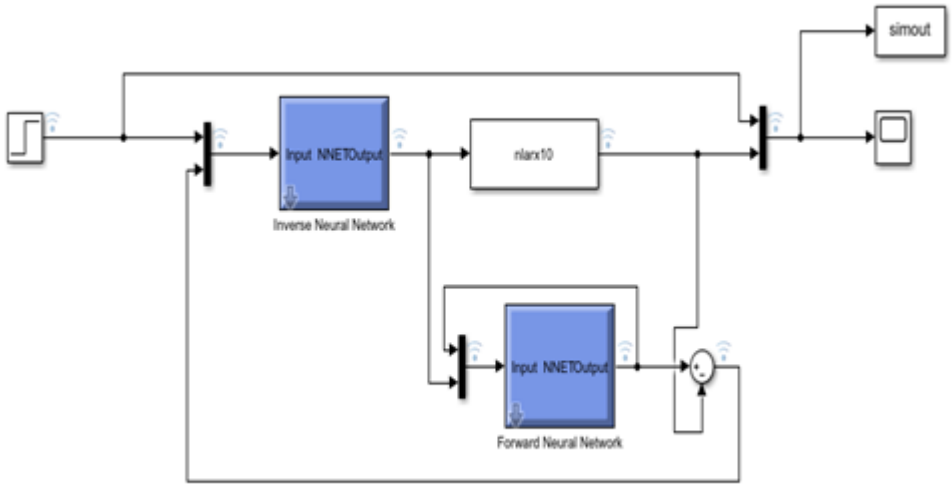


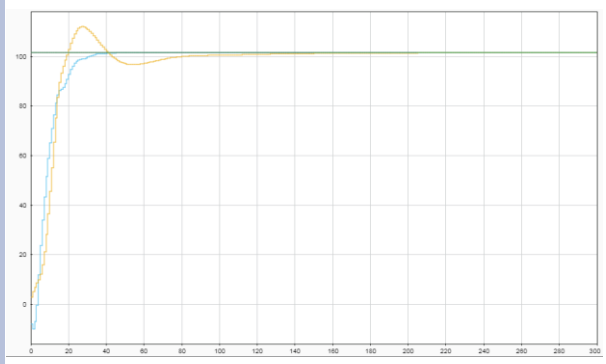
Simulation Diagram of IIMC

Integrated Internal Model Control (IIMC) of Dissolved Oxygen (DO) in Bioreactor

Dissolved oxygen (DO) is one of the key elements that influence bioreactor performance and is essential for aerobic bacteria in bioreactors. Hence, any uncontrolled fluctuation in DO concentration may lead to problems in aerobic growth or a decrease in the efficiency of microorganism metabolism, eventually leading to detrimental production and undesirable by-products. The biological process is highly dynamic, making it challenging to design using a conventional PID controller, as any changes cause instability to the controller parameters. The study presented the development of a control strategy for dissolved oxygen (DO) in a bioreactor. In this study, the system identification toolbox in MATLAB was used to simulate a mathematical model of the process based on simulation data running from MINIFORS (MINIFORS, Infors). An artificial neural network (NN) with a Levenberg-Marquardt training algorithm and feed-forward back propagation network was used as a training method.

The model consists of a single input (aeration rate) and a single output (dissolved oxygen), and the simulation was carried out in a Simulink environment in MATLAB. Based on the result, IIMC shows good performance with no overshoots and undershoots compared to the PID controller with an overshoot of 11.8% and an undershoot of 3.2%. Besides that, IIMC also has a faster settling time, which is 43s, compared to the PID controller, with a settling time of 163s. IIMC is also able to reach multiple set points without overshooting. For the disturbance test, the IIMC performance in dealing with disturbance was satisfactory. The disturbance slightly affected the process; however, the controller reached a targeted set point as designed. Overall performance, IIMC shows good performance in a bioreactor. The findings of this study will be incredibly useful for many industries such as bio-process, wastewater and others.

Step response of IIMC and PID controller.



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