Performance Comparison of Passive Fault Tolerant Control Strategy with PID and Fuzzy Control of Single-Tank Level Process with Sensor and System Fault

:

Fault-Tolerant Control (FTC) strategy has gain maximum attention in recent years in industries due to economical and safety hazards perspective.

Targeting at the decreasing control performance of the single-tank level control process under the constraint of system and sensor faults, this work presents model-based Passive Fault-Tolerant Control (PFTC) strategy which are based on conventional and artificial intelligence control. The deviation between system outputs and model output are called residuals and are used to detect and identify faults.

The mathematical model of single-tank level system is derived from real time process data using process reaction curve method. These works have been carried by our VI Semester BE (EEE) students in our Institute.

The work discusses about the performance comparison between model-based PFTC using fuzzy logic and conventional proportional + Integral + Derivative controller (PID). The proposed PFTC strategy is applied on single-tank level control process with system and sensor faults and verifies the performance of PFTC using fuzzy logic plus conventional PID control and other PFTC configuration. Proposed PFTC using fuzzy logic plus PID control gives better control performance even though fault occurs in the system.

The control performance of different PFTC strategies is measured in terms of Mean Square Error (MSE), Root Mean Square Error (RMSE) and Mean Absolute Error (MAE) indices.

This work attributes the proposed model based PFTC strategy using conventional feedback and artificial intelligence (Fuzzy Control) for system and sensor faults in single-tank level process.

The applied design provides control strategies that are capable to maintain stability as well as performance when different faults occur. From the simulation results, when fault occurs, the PFTC using fuzzy control design has achieved its desired set point and stability.

Meanwhile, the PFTC using PID feedback control design achieves its desired set point but is unable to reduce its steady state error as compared to PFTC using fuzzy control.

Hence, it can be proved that PFTC using fuzzy control design is one of the most efficient techniques to ensure that the system performance does not degrade and set point is achieved even in presence of faults.

The effectiveness of the proposed fault- tolerant control strategy was established on MATLAB Simulink platform. In these works instead of conventional PID controller model predictive controller (MPC) have been applied on experimental setup and checked the performance of the PFTC with multiple faults (Sensor, actuator, valve chocking). Also instead of fuzzy logic, other soft computing methods have been used (Artificial Neural Network (ANN), Adaptive Neuro Fuzzy Inference System (ANFIS)) for designing FTC strategy.

Our VI Semester BE (EEE) students are expressing their gratitude and very thankful to our management for supporting them for setting in our laboratory.
