ABSTRACT

Model Predictive Control (MPC) schemes are now widely used in process industries for the control of key unit operations. Linear Model Predictive Control (LMPC) schemes which make use of linear dynamic model for prediction, limit their applicability to a narrow range of operation (or) to systems which exhibit mildly nonlinear dynamics. The key unit operation in chemical plants namely, the Continuous Stirred Tank Reactor (CSTR) exhibits a highly nonlinear dynamic behavior. The need to achieve tighter control of such strong nonlinear process (CSTR) has led to a more general control formulation in which nonlinear dynamic model is used for prediction.

In the present work, a nonlinear observer based Model Predictive Controller (NMPC) for nonlinear systems has been proposed. An approach to design NMPC based on Fuzzy dynamic model, Fuzzy Kalman Filter (FKF) and Augmented State Fuzzy Kalman Filter (ASFKF) has been presented. The efficacy of the proposed NMPC schemes have been demonstrated by conducting simulation studies on the CSTRs. The analysis of the extensive dynamic simulation studies revealed that the NMPC schemes formulated produce satisfactory performance for both servo and regulatory problems. Simulation results also include an inferential control case, where the reactor concentration is not measured but estimated from temperature measurement and used in the NMPC based on FKF and ASFKF formulations.