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Review on CSTR PLANT Error Optimization

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Abstract— ***The controller attempts to minimize the error over time by adjustment of a control variable, such as the position of a control valve, a damper, or the power supplied to a heating element, to a new value determined by a weighted sum Where k p, K i and K d all non negative, denote the coefficients for the proportional, integral and derivative terms. Dead time's producea decrease in the system phase and also give rise to a non-rational transfer function of the system making them more difficult to analyse and control. Because of this characteristics dead time control problems have attracted the attention of engineers and researchers who have developed a special type of controller like PID controllers, Smith Predictor(DTC), MPC and various algorithms to control dead times.***

Keywords— ***Pid, Optimization, PSO, CTSR.***

I. INTRODUCTION

A proportional-integral- derivative (PID) controller is a commonly used in industrial control systems. A PID controller continuously calculates an error value as the difference between a desired set point and a measured process variable. The controller attempts to minimize the error over time by adjustment of a control variable, such as the position of a control valve, a damper, or the power supplied to a heating element, to a new value determined by a weighted sum Where k p, K i and K d all non negative, denote the coefficients for the proportional, integral and derivative terms.

Dead time or time delays are found in many processes in industry. In fact most tuning methods for PID controllers used in industry consider dead times as an integral part of process dynamics models. Dead times are mainly caused by the time required to transport mass, energy or information, but they can also be caused processing time or b accumulation of time lags in a number of simple dynamic system connected in series. Dead time's produce decrease in the system phase and also give rise to a non-rational transfer function of the system making them more difficult to analyse and control. Because of this characteristics dead time control problems have attracted the attention of engineers and researchers who have developed a special type of controller like PID controllers, Smith Predictor(DTC), MPC and various algorithms to control dead times.

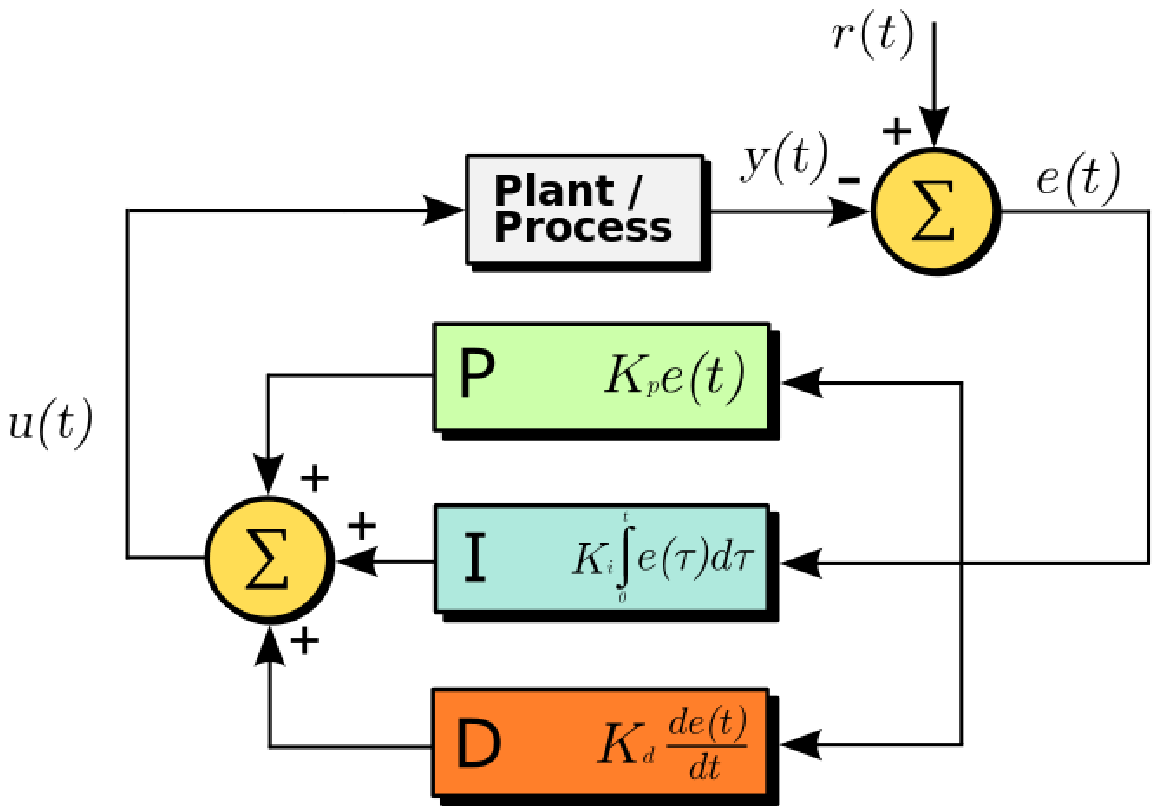

Figure 1: Block diagram of a PID controller in a feedback loop

As a PID controller relies only on the measured process variable, not on knowledge of the underlying process, it is broadly applicable [22]. By tuning of the three parameters of the model, a PID controller can deal with specific process requirements. The response of the controller can be described in terms of its responsiveness to an error, the degree to which the system overshoots a set point, and the degree of any system oscillation. The use of the PID algorithm does not guarantee optimal control of the system or even its stability.

Motivation

To design a PID Controller for cstr system using PSO algorithm. The model of a Continuous Stirred Tank Reactor modal is used as a plant. The main objective is to obtain a stable, robust and controlled system using PSO. The CSTR system is modelled in Simulink and the PSO algorithm is implemented in MATLAB. Comparing with Genetic algorithm and Particle swarm optimization (PSO) method, the proposed method was more efficient in improving the step response characteristics such as, reducing the steady-states error, rise time, settling time and maximum overshoot of a CSTR system. CSTR involves complex reactions with high nonlinearity, and it is very hard to be controlled by the conventional methods. However, to avoid computational complexity brought in by such nonlinear controller. Pso Algorithm (PSO) based PID controller tuning is attempted for the concentration control of Continuous Stirred tank reactor (CSTR).. The Integral Square Error (ISE) criterion is used to guide Pso algorithm to search the controller parameters like Kp, Ki, Kd. Simulation is carried out with PID controller Structures. The comparison between PSO-based PID (PSO-PID) performance and the GA-PID is presented. The motivation of AI technology is to make computers behave more like humans in solving problems.AI is fundamentally different from general programming. Soft computing is a tool of artificial intelligence which differs from hard computing in that, unlike hard computing, it is tolerant of imprecision, uncertainty, partial truth and approximation. In effect, the role model of soft computing is the human mind

II. LITERATURE REVIEW

Ali Zribi et al[1]: In this paper, a novel adaptive tuning method of PID neural network (PIDNN) controller for nonlinear process is proposed. The method utilizes an improved gradient descent method to adjust PIDNN parameters where the margin stability will be employed to get high tracking performance and robustness with regard to external load disturbance and parameter variation. Simulation results show the effectiveness of the proposed algorithm compared with other well-known learning methods.

A. Jayachitra and R. Vinodha [2]: Genetic algorithm (GA) based PID (proportional integral derivative) controller has been proposed for tuning optimized PID parameters in a continuous stirred tank reactor (CSTR) process using a weighted combination of objective functions, namely, integral square error (ISE), integral absolute error (IAE), and integrated time absolute error (ITAE).

Optimization of PID controller parameters is the key goal in chemical and biochemical industries. PID controllers have narrowed down the operating range of processes with dynamic nonlinearity. In our proposed work, globally optimized PID parameters tend to operate the CSTR process in its entire operating range to overcome the limitations of the linear PID controller. The simulation study reveals that the GA based PID controller tuned with fixed PID parameters provides satisfactory performance in terms of set point tracking and disturbance rejection.

MeeraViswavandya [3]: This paper proposes the application of fractional order PID controller (FOPID) for reactive power compensation and stability analysis in a stand-alone micro grid. For enhancement of voltage stability and reactive compensation of the isolated system, a SVC based controller has been incorporated. This paper emphasizes the role of fractional PID based SVC controller for reactive power management and improved stability in the stand alone micro grid, as it provides a special advantage of having two more degree of freedom for accurate tuning in comparison with the conventional controller The system performance, particularly the variations in different parameters values are studied properly with different input parameters and loading conditions. Further improvement of stability margin and optimisation of the system parameters have been achieved by the controller, based on Imperialist competitive algorithm.

Geetha M et al [4]: Tuning the parameters of a controller is very important in system performance. Ziegler and Nichols tuning method is simple and cannot guarantee to be effective always. In order to overcome the parameter uncertainties, enhance the fast tracking performance of a process system, a brand-new two-dimension PID fuzzy controller, fuzzy PI+ fuzzy ID, is proposed in this paper. The self-tuning fuzzy PI+ fuzzy ID controller is fast; computing on-line easily and can reduce stability error. To demonstrate the advantages of the fuzzy PI+ fuzzy ID controller has been applied to an application in the control of Continuous Stirred Tank Reactor (CSTR) level loop. The simulation and real-time implementation were executed and its results show that the proposed control scheme not only enhances the fast tracking performance, but also increases the robustness of the system. From the simulation it is clear that there is substantial improvement in the Self-tuning Fuzzy PID controller in terms of peak overshoot, settling time, peak time, rise time, Integral Square Error (ISE) and Integral Absolute Error (IAE).

Jau-Woei Perng et al[5]: In this study, the stochastic inertia weight particle swarm optimization (SIWPSO) algorithm and radial basis function neural network (RBFNN) methods were used to identify the optimal controller gain for the fractional order proportional integral derivative (FOPID) controller of time-delay systems; furthermore, a graphic approach was used to plot 3D stability regions in the k p, ki , and kd parameter space. This paper presents an intelligent SIWPSO-RBF algorithm for identifying the optimal solution for a FOPID control system. To explain how to use the SIWPSO-RBFNN method, this paper presents two cases describing how the proposed algorithm can be useful in FOPID-type controllers with two fractional-order time-delay systems. Furthermore, the proposed algorithm can be used in two desired procedures if the system transfer functions are known. The first procedure involves identifying the optimal k p and ki gains while kd varies and the parameters λ and μ are known. The second procedure involves identifying the optimal k p, ki and kd gains while λ and μ vary. Finally, several simulations of the proposed algorithm verified the effectiveness of a FOPID controller regarding fractional-order with time-delay systems.

III. CONCLUSIONS

This paper presents an intelligent SIWPSO-RBF algorithm for identifying the optimal solution for a FOPID control system. To explain how to use the SIWPSO-RBFNN method, this paper presents two cases describing how the proposed algorithm can be useful in FOPID-type controllers with two fractional-order time-delay systems. Furthermore, the proposed algorithm can be used in two desired procedures if the system transfer functions are known. The first procedure involves identifying the optimal k p and ki gains while kd varies and the parameters λ and μ are known. The second procedure involves identifying the optimal k p, ki and kd gains while λ and μ vary. Finally, several simulations of the proposed algorithm verified the effectiveness of a FOPID controller regarding fractional-order with time-delay systems.

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