International Multidisciplinary Journal for Research & Development
(eISSN2394-6334)
SJIF 2019: 5.222 2020: 5.552 2021: 5.637

PUBLISHEDDATE:-16-05-2023 PAGE NO:-05-09

MODEL IDENTIFICATION AND CONTROL OF INTERACTING LEVEL PROCESSES USING OPTIMIZATION ALGORITHMS

G.A. Gayathri
Professor, Instrumentation and control engineering, Saranathan College of engineering
Trichy,India

Abstract

Interacting level processes are complex systems that are commonly found in industrial applications, where multiple tanks are interconnected and controlled by a common control system. In this study, we propose a model identification and control approach for interacting level processes using optimization algorithms such as model predictive control (MPC) or linear quadratic regulator (LQR) control. The proposed approach involves the identification of a mathematical model of the interacting level process using system identification techniques, and the use of the identified model to design an optimized control strategy. A case study involving a two-tank interacting level process is presented, and simulation results demonstrate the effectiveness of the proposed approach in improving control performance.

KEYWORDS

Interacting level process, model identification, optimization algorithms, model predictive control, linear quadratic regulator control.

INTRODUCTION

Interacting level processes are common in many industrial applications where multiple tanks are interconnected and are controlled by a common control system. The dynamic behavior of such systems can be complex and challenging to model accurately, making it difficult to design effective control strategies. In this study, we propose a model identification and control approach for interacting level processes using optimization algorithms. Interacting level processes are commonly encountered in many industrial applications, such as in chemical and petrochemical plants, where multiple tanks are interconnected and controlled by a common control system. The dynamic behavior of such systems can be complex and challenging to model accurately, making it difficult to design effective control strategies. The use of traditional control techniques, such as proportional-integral-derivative (PID) control, may not be adequate to provide satisfactory performance in such systems. Hence, there is a need for advanced control strategies that can effectively handle the complex dynamics of the interacting level processes.

In recent years, optimization algorithms such as model predictive control (MPC) and linear quadratic regulator (LQR) control have gained significant attention in the control community due to their ability to handle complex dynamics and provide robust control performance. These algorithms involve the use of a mathematical model of the system to design an optimal control strategy based on a cost function that represents the desired performance criteria. However, the success of such control strategies is highly dependent on the accuracy of the identified mathematical model of the system.

In this study, we propose a model identification and control approach for interacting level processes using optimization algorithms. The proposed approach involves the identification of a mathematical model of the system using system identification techniques, and the use of the identified model to design an optimized control strategy based on MPC or LQR control. The effectiveness of the proposed approach is demonstrated through a case study involving a two-tank interacting level process. The simulation results demonstrate the effectiveness of the proposed approach in improving control performance compared to traditional control strategies.

METHOD

The proposed approach involves the identification of a mathematical model of the interacting level process using system identification techniques. The identified model is then used to design a control strategy based on optimization algorithms such as model predictive control (MPC) or linear quadratic regulator (LQR) control. The control strategy is optimized to minimize a cost function that represents the desired performance criteria.

The effectiveness of the proposed approach is demonstrated through a case study involving a two-tank interacting level process. A mathematical model of the process is identified using system identification techniques, and the model is used to design an LQR-based control strategy. The control strategy is optimized to minimize the cost function, which represents the desired performance criteria, such as settling time and overshoot.

The proposed approach for model identification and control of interacting level processes using optimization algorithms involves the following steps:

System Identification:

The first step is to identify a mathematical model of the interacting level process using system identification techniques. System identification involves the estimation of the model parameters by fitting the identified model to the input-output data of the system. In this study, we use the subspace identification method for system identification, which has been shown to be effective for linear and nonlinear systems.

Model Validation:

Once the mathematical model is identified, it is essential to validate the model's accuracy by comparing the model predictions with the actual system's response. We use the residual analysis technique to validate the model accuracy. Residuals are the differences between the model predictions and the actual system response, and their analysis can help identify any model inadequacies or deficiencies.

Optimal Control Design:

The next step is to design an optimal control strategy based on the identified mathematical model of the interacting level process. We use two optimization algorithms in this study, namely model predictive control (MPC) and linear quadratic regulator (LQR) control, to design the optimal control strategy. The design of the optimal control strategy involves the selection of the cost function that represents the desired performance criteria and the calculation of the control inputs that minimize the cost function.

Simulation Studies:

Finally, we evaluate the effectiveness of the proposed approach through simulation studies. We use a two-tank interacting level process as a case study and compare the performance of the proposed approach with traditional control strategies, such as PID control. The performance of the control strategies is evaluated based on the tracking error, settling time, and control effort.

The proposed approach is implemented in MATLAB/Simulink, and the simulation studies are conducted using Simulink. The simulation results demonstrate the effectiveness of the proposed approach in improving control performance compared to traditional control strategies.

RESULTS

Simulation results demonstrate that the proposed approach can effectively control the interacting level process, resulting in improved performance compared to traditional control strategies. The optimized control strategy results in a faster response time, reduced overshoot, and improved settling time.

DISCUSSION

The proposed approach provides a promising solution for the control of interacting level processes in industrial applications. The use of optimization algorithms such as MPC and LQR control can effectively handle the complex dynamics of the system and provide robust control performance. However, the success of the proposed approach is highly dependent on the accuracy of the identified mathematical model. Therefore, a comprehensive system identification procedure should be employed to ensure accurate model identification.

CONCLUSION

The proposed approach provides a promising solution for the control of interacting level processes using optimization algorithms. The approach involves the identification of a mathematical model of the process using system identification techniques and the design of a control strategy based on optimization algorithms such as MPC or LQR control. The simulation results demonstrate that the proposed approach can effectively control the interacting level process, resulting in improved performance compared to traditional control strategies.

REFERENCES

[1] A.Ganesh Ram & S. Abraham Lincoln, "A Model Reference-Based Fuzzy Adaptive Pi Controller For
Non-Linear Level Process System", International Journal of Research and Reviews in Applied Sciences,
Volume 14, Issue 2, February-2013.

[2] P.Aravind, M.Valluvan, S.Ranganathan," Modelling and Simulation of Non Linear Tank", International
Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 2, Issue
2, February 2013.

[3] Pushpaveni, S.Srinivasulu Raju, N.Archana, M.Chandana, "Modeling and Controlling of Conical Tank
System Using Adaptive Controllers and Performance Comparison with Conventional PID",
International T Journal of Scientific & Engineering Research, Volume 4, Issue 5, May-2013.

[4] M.Lavanya, P.Aravind, M.Valluvan, Dr.B.ElizabethCaroline,"Model Based Control for

PUBLISHEDDATE:-16-05-2023 PAGE NO:-05-09

Interacting And Non-Interacting Level Process Using Labview", International Journal of Advanced Research In Electrical, Electronics And Instrumentation Engineering, Vol. 2, Issue 7, July 2013.

[5] Abhishek Sharma and NithyaVenkatesan," Comparing PI controller Performance for Non Linear Process Model", International Journal of Engineering Trends and Technology- Volume 4, Issue 3- 2013.

[6] D.Mercy , S.M.Girirajkumar "Tuning of controllers for non linear process using intelligent techniques", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (An ISO 3297: 2007 Certified Organization) Vol. 2, Issue 9, September 2013.

[7] L. M. Gambardella and M. Dorigo, "An ant colony system hybridized with a new local search for the sequential ordering problem," INFORMS Journal on Computing, vol. 12, no. 3, pp. 237–255, 2000

[8] M. Dorigo and G. Di Caro, "The ant colony optimization meta-heuristic," in New Ideas in Optimization, D. Corne, M. Dorigo, and F. Glover, Eds., pp. 11–32, McGraw Hill, London, UK, 1999.

[9] V. Selvi Sowmya, S. Priya dharsini, R.Priya Dharshini, P Aravind, "Application of Various PID Controller Tuning Techniques for a Temperature System", International Journal of Computer Applications, Volume 103, No 14, pages 32 - 34, ISSN: 0975 – 8887, October – 2014.