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Research Article

ANALYSIS OF NON-INTERACTING LEVEL PROCESS USING VARIOUS PI CONTROL SETTINGS: A COMPARATIVE STUDY

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ABSTRACT

This study presents a comparative analysis of different proportional-integral (PI) controller tuning methods for the control of a non-interacting liquid level process. Four different PI controller tuning methods, Ziegler-Nichols, Cohen-Coon, Tyreus-Luyben, and Internal Model Control, are evaluated based on their ability to track setpoint changes and reject disturbances. The simulation results show that all four tuning methods can provide satisfactory performance, but the Internal Model Control method outperforms the others in terms of all performance metrics evaluated. The Ziegler-Nichols method produces the worst performance, while the Cohen-Coon and Tyreus-Luyben methods perform better but still have limitations. This study highlights the importance of choosing the appropriate tuning method for liquid level control systems.

KEYWORDS

Liquid level control, PI controller, Ziegler-Nichols, Cohen-Coon, Tyreus-Luyben, Internal Model Control, setpoint tracking, disturbance rejection, performance metrics.

INTRODUCTION

The control of liquid level is an essential process in many industrial applications such as chemical reactors, distillation columns, and heat exchangers. The proportional-integral (PI) controller is one of the most commonly used control strategies for liquid level control due to its simplicity and ease of implementation. However, the performance of the PI controller is highly dependent on the tuning parameters. This study aims to compare the performance of different PI controller tuning methods for the control of a non-interacting liquid level process.

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METHODS

The non-interacting liquid level process is modeled using a first-order transfer function. Four different PI controller tuning methods are used in this study: Ziegler-Nichols (ZN), Cohen-Coon (CC), Tyreus-Luyben (TL), and Internal Model Control (IMC). The performance of the different control strategies is evaluated based on their ability to track a setpoint change and reject disturbances. The performance metrics used for evaluation include Integral of the Absolute Error (IAE), Integral of the Squared Error (ISE), and Integral of the Time-weighted Absolute Error (ITAE).

RESULTS

The simulation results show that all four PI controller tuning methods can provide satisfactory performance for the non-interacting liquid level process. However, the IMC tuning method outperforms the other tuning methods in terms of all performance metrics evaluated. The ZN method produces the worst performance, especially for setpoint tracking. The CC and TL tuning methods perform better than the ZN method but are still inferior to the IMC method.

DISCUSSION

The results suggest that the IMC tuning method is the most effective for the control of non-interacting liquid level processes. This is due to the ability of the IMC method to handle the process dynamics accurately by including a process model in the controller design. The ZN method, on the other hand, produces poor performance due to its over-reliance on the process gain and oscillatory behavior. The CC and TL methods perform better than the ZN method but still have limitations in accurately capturing the process dynamics.

CONCLUSION

In conclusion, this study shows that the choice of PI controller tuning method has a significant impact on the performance of the liquid level control system. The IMC tuning method is the most effective method for the control of non-interacting liquid level processes, while the ZN method should be avoided. The CC and TL methods are also viable options but may have limitations in capturing the process dynamics accurately.

REFERENCES

- blog.opticontrols.com/archives/105," A Tutorial on NON-INTERACTING PROCESS"
- P V Aravind, Balachandra Pattanaik, "Reliability of PID Controller for a Real Time Sensor Interfaced
- Temperature Process", Sensor and Journal, IFSA Publishing, ISSN(print): 2306-8515,ISSN(online):1726- 5479, Volume 231, Issue 3, Page No: 10-14, March 2019.
- Mohammad Shahrokhi and Alireza Zomorrodi, "Comparison of PID Controller Tuning Methods ", 2012
- Ogata K."Modern Control Engineering", 1997, 3rd edition, PrenticeHall.
- Coughanowr D.R.;"Process System Analysis and Control", 2nd edition McGrawHill, 1991
- P Aravind, Naveen Kumar A B, "Design of State Feedback Control for a FOPDT System", International Journal of Interdisciplinary Current Advanced Research, ISSN(print): 2663-0931,ISSN(online):2663-2594, Volume 1, Issue 1, Page No: 1 – 4, January 2019.
- Bing Song, Shuai Tan, Hongbo Shi, Key principal components with recursive local outlier factor for multimode chemical process monitoring, Journal

of Process Control, Volume 47, November 2016, Pages 136–149, 2016.

- Ana S.R. Brásio, Andrey Romanenko, Natércia C.P. Fernandes, Lino O. Santos, First principle modeling and predictive control of a continuous biodiesel plant, Journal of Process Control, Volume 47, Pages 11–21,2016.
- D. Dinesh Kumar, B. Meenakshipriya , Design of Heuristic Algorithm for Non-linear System, Rev. Téc. Ing. Univ. Zulia. Volume 39, No 6, Pages 10 – 15, 2016.
- Murillo-Marrodan, A.; Garcia, E. & Cortes, F, A Study of Friction Model Performance in a Skew Rolling Process Numerical Simulation, International Journal of Simulation Modelling, Volume 17, Number 4 Pages 569-582, 2018.
- S. Ramachandran , P.Aravind, V.Venkataraman, G.Subramanian, "Validation of a Neural Network Model for a Nonlinear Process by Parameter Estimation", International Journal of Applied Engineering Research, Volume 9, Number 24 , Pages 29051-29062, ISSN 0973-4562, 2014