iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 Issue: V Month of publication: May 2019

DOI: https://doi.org/10.22214/ijraset.2019.5136

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 7 Issue V, May 2019- Available at www.ijraset.com

Comparison between One Degree of Freedom and Two Degree of Freedom of PID Controller

Shejole Jagruti Rajendra[1], Dhatrak Aishwarya Pandurang[2], Chavan Archana Bapusaheb[3], Sonawane Gauri Sanjay[4], Prof. Ankit s. Jain[5]
[1, 2, 3, 4, 5]Electrical, MET Institute of Engineering

Abstract: PID controller is basically used in the application of closed loop control mechanism mostly required in industry for Actuators control. Two design methods for PID controllers are proposed based on the two degrees-of-freedom (2-DOF). One method specifies the closed-loop set-point to output transfer function and the other specifies the closed-loop disturbance-to output transfer function. The 2-DOF controllers are approximated as a PID controller with set point weighting. Analytical expressions for the PID controllers are derived for common process models. The examples demonstrate that the reviewed design methods result in very good control for a wide variety of processes, and that they can provide better performance over internal model control methods when they are tuned to have the same degree of robustness as measured in terms of the peak sensitivity.
Keywords: PID, 2-DOF, set point weighting, time delay

I. INTRODUCTION

It is interesting to note that more than half of the industrial controller in use today are PID controllers or modified PID controllers. Because most PID controllers are adjusted on-site, many different types of tuning rules have been proposed in the literature. Using these tuning rules, delicate and fine tuning of PID controllers can be made on – site. In this project we have to do the comparison of One Degree of Freedom and Two Degree of Freedom, and validate by MATLAB simulation model. PID Controller are basically used in the application of closed loop, control mechanism mostly required in industry for motor control. In PID a user can specify the use of P, I, D constants KP, Ki, Kd. For smooth, quick responsive, Distinctive measure. For the Demonstration & Implementation and MATLAB as mathematical tool for purposed system Transfer Function Analysis where as a user can implement same system with controller Architecture for real application. In some case One Degree of Freedom i.e. Single equation is not capable of Executing Complex structure task or process in that case additional controller or control scheme is needed. Such Combination of Combining two different PID Model is known as Two Degree of Freedom in which Secondary Closed Loop Feedback is implement for better performance.

II. LITERATURE SURVEY

Proportional-integral-derivative (PID) control has been widely applied in industry. More than 90% industrial controllers are of the PID type. A PID controller has only three parameters, but they are difficult to tune for a good trade-off between system performance and robustness. Since the Ziegler-Nichols tuning rule was initiated in 1942, a large number of PID tuning rules have been proposed in literature. According to statistics in, there are more than 260 PI (which corresponds to PID with the derivative action vanishing) and 140 PID tuning rules (regarding PI/PID controllers in the standard form) for a single stable first-order plus time delay process. Despite a wealth of research on PID controller tuning, surveys show that many of the industrial PID controllers are poorly tuned and many of them use default factory settings without any specific tuning at all. And a tacit reason for this phenomenon is that convenient and efficient PID tuning rules are still in lack.[2] Internal model control (IMC) was applied to derive simple PID tuning rules for typical processes. However, the rules give sluggish load response when a process is lag dominated, due to zero-pole cancellation involved in the derivation. To overcome this problem, a method revising the integral parameter properly was proposed in, which gives improved disturbance rejection when a process is lag dominated. The rules are made more accurate in, which further enhance the disturbance rejection while maintaining similar set point response. [2] In parallel, direct synthesis (DS) is widely used to design PID controllers. In the DS approach, the closed-loop setpoint-to-output (s2o) or (load) disturbance-to-output (d2o) transfer functions are specified for desired performance while satisfying the stability conditions. The PID controllers are solved approximately with specified closed-loop transfer functions. Conventionally, the closed-loop s2o transfer function is specified for deriving a PID controller as apt for good set point response. Recently, it has been argued that by specifying the closed loop d2o transfer function instead, the resulting PID controller can achieve enhanced disturbance rejection while maintaining satisfactory set point response by means of set point weighting. Meanwhile, note that IMC and DS are closely related. We may interpret IMC as a certain DS with particular specifications of the closed-loop transfer functions.[2]

III. TUNING METHOD

A. Degree of Freedom

When a substance is heated its kinetic energy increases. Kinetic energy is made up from the translation and rotation of particles, and the vibration of atoms which constitute the molecules of a substance. A substance may, therefore, absorb heat energy supplied to it in several ways, and is said to possess a number of degrees of freedom. In general, a molecule consisting of N atoms will have 3Ndegrees of freedom; thus, for a diatomic molecule there will be six degrees of freedom: three will be translational, two rotational, and one vibrational. Along the line separating two areas, if temperature is altered then pressure must alter accordingly, or vice versa, to maintain the two-phase equilibrium. At a point where three phases are in equilibrium, alteration of either temperature or pressure will cause one phase to disappear. The system thus possesses (a) two degrees of freedom in the area; (b) one degree of freedom along the line; and (c) no degrees of freedom at the point. [1]

B. One Degree of Freedom

Consider the system shown in figure where the system is subjected to this disturbance input D(s) and noise input N(s), in addition to the reference input R(s), Gc(s) is the transfer function of the controller and GP (s) is the transfer function of the plant.[1]

$$Gyn = \frac{Y(s)}{N(s)} = -\frac{GcGp}{1 + GcGp}$$

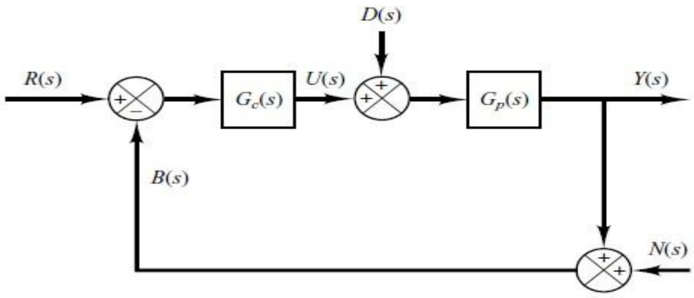


Fig: One Degree of Freedom

C. Two Degree of Freedom

We have the PI-D control is obtained by moving the derivative control action to the feedback, path, and I-PD control is obtained by moving the proportional control and derivative control action or proportional control action to the feedback path, it is possible to move only proportional control action to the feedback path, retaining the remaining portions in the feed forward path. In the literature, PI-PD control has been proposed. The characteristics of this control scheme lie between PID control and I-PD control. Similarly, PID-PD control can be considered. In these control schemes, we have a controller in the feed forward path and another controller in the feedback path. Such control schemes lead us to more general two-degrees-of –freedom control scheme.

Consider the system shown in figure where the system is subjected to this disturbance input D(s) and noise input N(s), in addition to the reference input R(s), Gc(s) is the transfer function of the controller and GP (s) is the transfer function of the plant. [1]

$$Gyn = \frac{Y(s)}{N(s)} = -\frac{Gc1Gp}{1 + Gc1 + Gp}$$

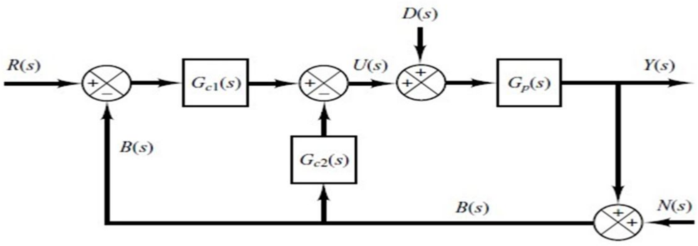
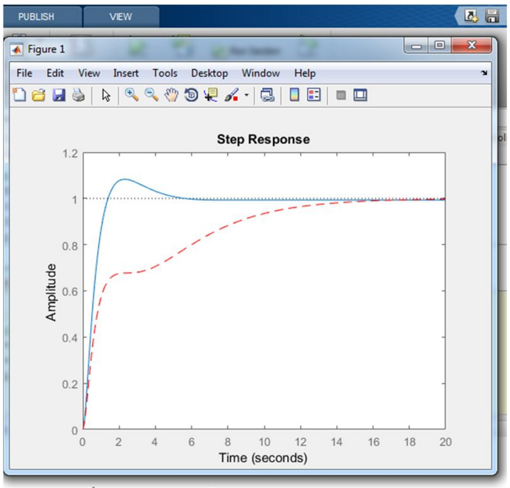


Fig: Two Degree of Freedom

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 7 Issue V, May 2019- Available at www.ijraset.com

IV. RESULT



A. Comment

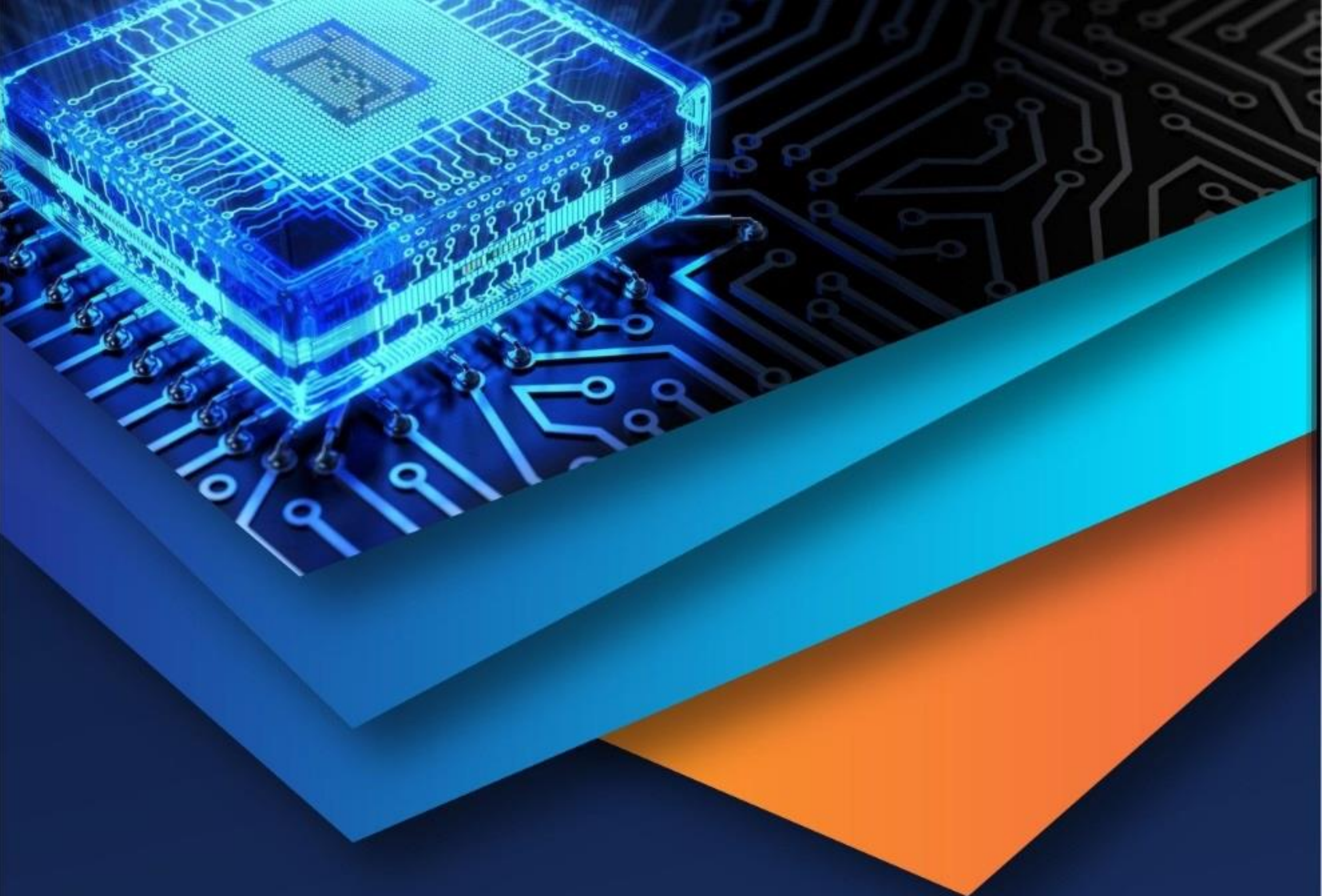
The Settling time of the system is t_s = 13 sec by the One Degree Of Freedom of the system.
The Setting time of the system is t_s =5sec by the Two Degree Of Freedom of the system

V. CONCLUSION

With the help of the degree of freedom tuning method we concluded that as per result the Two Degree Of Freedom is more efficient than One Degree Of Freedom.

REFERENCES

[1] "Modern Control Engineering" By Katsuhiko Ogata
[2] Wuhua Hu, Gaoxi Xiao, and Wen-Jian Cai "PID Controller Design Based on Two-Degree-of-Freedom Direct Synthesis."



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY