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TITLE:

PERFORMANCE EVALUATION OF COHEN-COON AND ZIEGLER-NICHOLS PID TUNING METHODS IN LIQUID FLOW CONTROL SYSTEM

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AUTHOR'S DECLARATION

"I hereby declare that this report is the result my own work except for quotations and summaries which have been duly acknowledged."

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ABSTRACT

This study discusses the method to optimise liquid flow process control by using efficient Proportional-Integral-Derivative (PID) tuning values. In order to achieve that, this study explores the application of Cohen-Coon and Ziegler-Nichols tuning method, which the main character for obtaining desired control outcomes. An evaluation of the effectiveness of proportional (P), proportional and integral (PI), and proportional plus integral and derivative (PID) tuning parameters is conducted using a Liquid Flow Process Control Training System (Model: SE113). The Cohen-Coon method is known in handling processes with significant dead time (Td), providing a balanced approach between speed and stability [3] [9]. Besides, Ziegler-Nichols method is a foundational method for tuning PID controllers, widely used in industrial control systems. The response curve is used to extract the process response characteristics, such as Response Rate (RR), Dead Time (Td), and Constant Time (Tc), which are necessary for accurate controller tuning. The process responses obtained are used to calculate tuning parameters using the Cohen-Coon and Ziegler-Nichols tuning method. By comparing both tuning methods, this study aims to focus on their respective strengths and limitations in liquid flow control applications and recommend the most appropriate method that able to achieve the best performance for liquid flow control system.

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CHAPTER ONE

BACKGROUND

1.1 Introduction

In industrial process control, especially in liquid flow systems, accurate management of fluid dynamics is crucial for ensuring product quality and operational effectiveness. Proportional-Integral-Derivative (PID) controllers are commonly used to attain this accuracy because of their simple implementation and efficiency across multiple applications. A PID controller is a device utilized by control engineers to manage temperature, flow, pressure, speed, and various other process variables in industrial control systems. PID controllers utilize a feedback loop mechanism to regulate process variables and are regarded as the most precise and stable type of controller. Proper tuning of PID parameters is essential, as incorrect configurations can result in poor performance or instability in the system.

The Cohen-Coon tuning method, developed by Gregory Cohen and George Coon in 1953, is a well-known method for setting PID parameters. Created as an improvement over previous techniques like the Ziegler-Nichols method, the Cohen-Coon method relies on a first order plus time delay model and seeks to attain a quarter-amplitude decay ratio in the response of the system. On the other hand, Ziegler-Nichols method developed in 1942, provides empirical tuning rules based on the system step response or frequency response, aiming to achieve a desired level of stability and performance.

Liquid flow management systems are essential to various industries, such as food and beverage, pharmaceuticals, and chemical processing. In these industries, accurate flow measurement and regulation are crucial for maintaining uniform product quality and compliance with safety regulations. For example, in chemical production, precise flow management is crucial for sustaining reaction rates and product levels, significantly influencing the efficiency and safety of processes.