Design Optimum PI Controller by Reinforcement Learning for Tank Level in Industrial Process

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Abstract. Currently, the PID controller is widely used in many industrial applications, mainly in the oil and gas fields. The efficiency of any process system is essentially influenced by its control and its capacity to endure any adverse change. The control system's capability is proportional to the values of its parameters and how much it is optimized. This fact led to the introduction of ways for optimizing real-world control systems for separator drums situated in the Basrah refinery and based on the PI controller. Two approaches have been employed: first, a Closed-Loop PID Autotuner; and second, Reinforcement Learning (RL). The mathematical model for the proposed system is developed and then simulated using MATLAB in the real-world conditions of the Basrah refinery, further adding some frequent disturbances to assess the proposed system's performance. The findings indicate that when a Closed-Loop PID Autotuner is used, the performance is excellent. Whereas the RL technique is better than PI manual tuning and Closed-Loop PID Autotuner.

INTRODUCTION

Vessels are the necessary components of the working units in different types of industrial treatment. Vessels can be classified into many types to point out tanks, towers, reactors, drums, dryers, and cylinders [1]. Some or all of these types of vessels are used in many industrial applications. Petroleum and chemical processes are one of these applications. Small or medium drums (types of the vessel) were used as separators or surge capacities between the plant's different systems.

Separators are one of the most important components of the oil refinery's overall process [2]. The fluid was separated into gas and liquid phases using a two-phase separator. It is possible to separate vapor from a mixture of liquid and gas by the use of density gradients in two-phase separators [3]. The flashing or separation process in refinery units is mostly sensitive to input disturbances such as temperature, level, and mass flow. All these quantities are affected by separation efficiency [4]. The refineries section is popular with these types of vessels (separator drums). Every refinery includes many of them with collection kinds (two-phase or three-phase separator) depending on the process stage and type of process.

Liquid level control is one of the most common functions of controlling liquids in drums. Controlling liquid levels is very important in modern process control because it can improve product quality and make processes safer for humans and pieces of equipment [5]. The major application in several engineering fields is controlling liquids, which is based on the management of mass flow rates [6]. Controlling the level of a different type of liquid is almost always present in any process [7-9]. Different methods and strategies for level control are used in the manufacturing setting. The fluid flow characteristics and rates that would be noticeable were taken into account while sizing the tanks.

The D5204 is a Recontacting Drum (RD5204) as a separator drum used to improve the gasoline production unit at Basrah Refinery in the south of Iraq. This drum is equipped with two PI controllers, which are used to regulate the level and pressure. The challenges that a real system has in establishing a robust control system capable of high performance for the whole process. Additionally, how much of this control can withstand any flaws or errors that occur during routine processing operations? The primary benefit of a well-designed control system is that it is safe for people and many kinds of equipment.

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