MECHATRONICS BOOK SERIES SYSTEM DESIGN AND SIGNAL PROCESSING

VOLUME 1

Editors
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CHAPTER 14

Mathematical Model for Three Tank System

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14.1 Introduction

Liquid level control has a very large application domain in industry such as petrochemical industries, paper making industries, water treatment industries and so on. The process in industries requires liquids to be pumped, stored in tanks and then pumped to another tank. Many times the liquids will be processed by chemical or mixing treatment in the tanks, but always the level of fluid in the tanks must be controlled and it flows between tanks must be regulated. Its most representative didactical equipments are the tank system, i.e. one, two, three or four tanks system[1-3].

The three-tank liquid level control system is a multi-input-multi-output (MIMO) system, but with the valves (actuators) between the tanks closed, each tank can be treated as a single-input-single-output system (SISO). The typical control issue involved in the system is how to keep the desired liquid level in each tank in the presence of disturbances and even actuator, sensor or leakage faults in the tank system [4].

The main objective of this work is to develop mathematical model of three tank system. Mathematical model is very important for the next process in controlling the system. Therefore, the detail implementation of mathematical model to the system is urgently important.

This chapter is organized as follows: In section 14.2, review of the industrial tank system. The methodology of the proposed system is obtained in section 14.3. Section 14.4 is the result and discussion and section 14.5 is the conclusion of the chapter.

14.2 Review of The Industrial Tank System

The objective of this project is to investigate the mathematical model of the experimental three tank system with multiple inputs and outputs, the schematic diagram for three tanks system is depicted in Fig. 14.1. The three tanks system consists of three tanks of same dimension. It consists of three separate vertical tanks which is consists of prospect tower-type tank mounted above a reservoir which functions as water storage. All tanks are linked to each other through connecting pipes. The nominal outlet of this system is located at tank 1 and tank 3 with incoming flows through pump 1 and 2 that located at tanks 1 and 3 respectively [6-8]. The process of tracking in this work will be based on the following objectives:

- To measure water level in each tanks.
- To control the water level for each tanks without exceeding the maximum capacity.
- To design the level sensor that will detect the water level in the tank.

From the diagram, it shows that R_i represent the resistance for each tank while C_i are the cross sectional area of each tanks. Cross sectional area for all tanks are the same, thus

$C_1 = C_2 = C_3$;

Cross sectional area of Tank 1 = Cross sectional area of Tank 2= Cross sectional area of Tank 3