Application of Fractional Order Controllers on Experimental and Simulation Model of Hydraulic Servo System

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Abstract Hydraulic Servo System (HSS) plays an important role in industrial applications and other fields such as plastic injection machine, material testing machines, flight simulator and landing gear system of the aircraft. The main reason of using hydraulic systems in many applications is that, it can provide a high torque and high force. The hydraulic control problems can be classified into force, position, acceleration and velocity problems. This chapter presents a study of using fractional order controllers for a simulation model and experimental position control of hydraulic servo system. It also presents an implementation of a non-linear simulation model of Hydraulic Servo System (HSS) using MATLAB/SIMULINK based on the physical laws that govern the studied system. A simulation model and experimental hardware of hydraulic servo system have been implemented to give an acceptable closed loop control system. This control system needs; for example, a conventional controller or fractional order controller to make a hydraulic system stable with acceptable steady state error. The utilized optimization techniques for tuning the proposed fractional controller are Genetic Algorithm (GA). The utilized simulation model in this chapter describes the behavior of BOSCH REXROTH of Hydraulic Servo System (HSS). Furthermore the fractional controllers and conventional controllers will be tuned by Genetic Algorithm. In addition, the hydraulic system has a nonlinear effect due to the friction between cylinders and pistons, fluid compressibility and valve dynamics. Due to these effects, the simulation and experimental results show that using fractional order controllers will give better response, minimum performance indices values, better disturbance rejection, and better sinusoidal trajectory than the conventional PID/PI controllers. It also shows

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