MODELING AND CONTROLLER DESIGN OF PNEUMATIC ACTUATOR SYSTEM WITH CONTROL VALVE

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Abstract- Pneumatic actuators offer several advantages over electromechanical and hydraulic actuators for positioning applications. Nonetheless, pneumatic actuators are subject to high friction forces, dead band and dead time, which make fast and accurate position control difficult to achieve. This research paper presents the process of controller identification, design, modeling and control for pneumatic actuator system. System Identification approach is used with the purpose to estimate the mathematical model of pneumatic actuator system and for controller design. Data collection of input and output signal of the system has been performed from experiment procedure. This data is used for estimate the model by selecting Auto-Regressive Exogenous (ARX) model as a model structure. The accepted model is based validation test namely as residual correlation, Akaike Final Prediction Error and best fit percentage. Different control schemes such as PID and LQR (Linear Quadratic Regulator) have been applied for controller design. PID controllers with Ziegler Nichols tuning are enabled to provide good performance in various systems. The effects of Tustin transformation, zero order hold and discrete model are tested in PID controller designed. The methodology for this paper combines off-line model based on analysis with on-line iteration.

Different external loads are added in order to investigate the effectiveness to the designed controllers in real time system. The tracking performance of the closed loop system is satisfied which offers considerable robustness even on a slight increase in load. The results obtained in the experiment are successful to prove that the output signals which with the controller are almost the same for both simulation and experimental modes.

Index terms*:* Pneumatic actuator system, ARX model, System identification, PID controller, LQR controller