PARAMETERES ESTIMATION FOR MOTION CONTROL AND FRICTION COMPENSATION

Branesh Madhavan Pillai

(128018U)

Degree of Master of Science

Department of Electrical Engineering

University of Moratuwa

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DECLARATION

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ABSTRACT

Physical systems used for control applications require proper control methodologies to obtain the desired response. Controller parameters used in such applications have to be tuned properly for obtaining the desired response from the systems. Tuning controller parameters depends on the physical parameters of the systems. Therefore, the physical parameters of the systems have to be known. Number of techniques has been developed for finding the mechanical parameters of DC motors. But, no straight forward method has been established for estimating the parameters of the load so far. This research presents a method of determining mechanical parameters viz. moment of inertia and friction coefficient of motor by introducing the Disturbance Observer (DOB). This research also stresses that load parameters have appreciable effect on the response of the systems and have to be determined. A DC servo motor velocity control system is considered for applying the method. For this research, Sensorless torque detection technique is used to find the external torque. Disturbance observer is used as a disturbance rejection tool and also to improve the system's robustness. Moment of inertia and friction coefficient of the DC servo motor are determined using the method. It is evident that moment of inertia and friction coefficient can be determined for any type of DC servo motor using the proposed method. Effect of parameters on the system is emphasized by considering the PID controller tuning. It is found that PID controller when tuned based on estimated parameters could yield optimum response. The effectiveness of estimated parameters is verified by applying it towards the conventional bilateral control system in the different situations including the contact motion and non contact motion. Validity of the proposed method is verified by the experimental results.

Friction, especially its nonlinear component, may degrade the tracking performance of robots. Uncertainties in the parameters but also in the structure of the friction model may lead to inexact friction compensation in Servo-Mechanism. This will lead to a difference between the predicted friction and the real friction torques, in certain cases creates instability. This research presents a method of compensating friction of DC motor by introducing the Reaction torque observer (RTOB). Friction compensation requires correct measurement of the reaction torque. But a torque sensor has its own frequency response and measuring the torque accurately has become difficult. For this reason torque sensing has become often erroneous with sensors. For this study sensorless torque detection method named Reaction Torque Observer is used. When compensated, the DC Servo system should behave as if there is no friction. This could be clearly visible when there is no applied load. When the external load is applied to the system the proposed method should compensated for the friction. Validity of the proposed method is verified by the experimental results.

Keywords: Moment of Inertia, Friction Coefficients, Parameters Estimation, Disturbance Observer, Reaction Torque Observer, Velocity Controller, Bilateral control, Friction compensation.

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