Linear Control Methods Applied to a Servo Unit

Eduardo Ferreira Vieira d'Almeida

Department of Mechanical Engineering, Queen's Building, Clifton BRISTOL BS8 1TR UK

Introduction

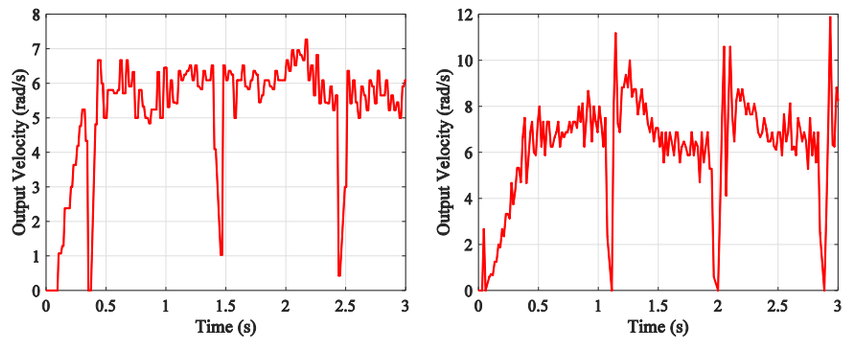
The objective of this project was to design and implement different linear control methods to an electromechanical rig in order to develop an interactive demonstration unit to be used during the system and control lectures in second year classes in the mechanical engineering course at the University of Bristol.

A proportional integral controller (PI) and a proportional integral derivative controller (PID) were implemented as velocity controllers and a proportional derivative controller (PD) and a proportional derivative feedback controller (PDFB) were applied as position controllers.

Materials and Methods

For the numerical simulations of the linear controllers, a mathematical model of the system was developed. With the aid of the finite difference method, the Indirect Method of control design was applied to translate the continuous-time designed controller into a discrete-time equivalent.

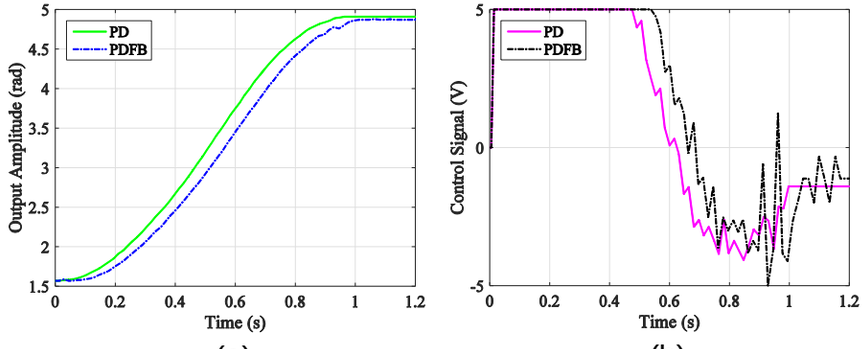
Velocity Control



(a) (b)

Figure 1:
Output velocity obtained in the experiments done with the PI and the PID controllers applied to the rotary arm with a desired velocity of 6.28 rad/s: (a) PID controller; (b) PI controller

Position Control



(a) (b)

Figure 2:
Experimental data obtained in the experiments done with the PD and the PDFB controllers applied to the rotary arm with the modified gains with a 3.14 rad angular displacement starting at 1.57 rad: (a) Output amplitude; (b) Control signal

Results and Discussion

The experiment done with the position controllers designed with the gains obtained in the numerical simulation revealed that the system is not able to represent desired dynamics due to steady-state error. The second experiment with modified gains showed a correlation between the settling time of the PD and the PDFB controllers as observed in the numerical simulations. The experimental data of the velocity controls indicated a considerable amount of error in the data collected from both the PI and the PID controllers.

Conclusion

The numerical simulations revealed that some hypothesis considered in the mathematical model does not represent the real system. The experimental data from the position controllers seemed to indicate that the static friction have a great influence in the system dynamics.