Design and implementation a novel system for estimation precise transfer function of DC motor

ABSTRACT

A precise modelling plant system is substantial to improve the design of the DC motor controller, where a low accurate model may cause an unacceptable controller system. This study presents a hardware-in-the-loop (HIL) system for design a high speed motor data acquisition system (HSMDAQS) and injected collected data (ICD) Simulink model to estimate accurately the transfer function (TF) of a DC motor, without needing motor's specification, providing high accuracy estimation tool that can be used to develop the design of a DC motor controller. The proposed system generates synching data to be imported into system identification (Sys Ident) application through a serial port. To show the performance design, a comparative study has been conducted between the experimental realization and simulation results in terms of dead time(td), rise time(tr), and settling time(ts), using a scope simulator. It was used three different DC motors to demonstrate the effectiveness of our approach in terms of average error step responses (AE-SR). The estimation results show that the best FIT between the response of the estimated TF and the collected data augmented by 95.03 % and stabilized despite using different motor's speed. A comparison step response between experimental and simulation shows a very low deviation and minimized AE-SR below 10% for all tested motors. The developed system could be applied in a wide range of industrial applications, offering faster with accurately capturing data, high precision stabilized platform, a simpler implementation for dynamic systems, lower computational cost design, and flexibility.

Keyword: HSMDAQS; TF; PI controller; DC motor; Estimation