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# REAL-TIME ADAPTIVE SPEED CONTROL OF DC MOTORS WITH BOUNDED PERIODIC RANDOM DISTURBANCE

Hyun Cheol Cho[1], Kwon Soon Lee[2,*] and Sami M. Fadali[3]

[1]School of Electrical and Electronic Engineering
Ulsan College
San 29 Mugeo2-Dong, Nam-Gu, Busan 680-749, Korea
hcjo@mail.uc.ac.kr

[2]Department of Electrical Engineering
Dong-A University
840 Saha-Gu, Hadan 2-Dong, Busan 604-714, Korea
*Corresponding author: kslee@dau.ac.kr

[3]Department of Electrical Engineering
University of Nevada
Reno, NV 89557 USA
fadali@unr.edu

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Abstract. *Periodic disturbances occur in several engineering applications, especially in data storage systems. Although these disturbances are random, they are commonly treated in the literature as deterministic. We present an adaptive control approach for DC motor systems with a periodic stochastic disturbance whose frequency and magnitude are both random variables. The adaptive control is the sum of a nominal control and a corrective control. The nominal control is derived using a nominal model without disturbances while the corrective control is constructed from a model including a disturbance using Lyapunov stability theory. We tested our approach using computer simulation and experimental implementation with DSP and programmable system-on-chip (PSoC). Our simulations and experimental results show that the proposed control methodology is practical and compares favorably with published approaches.*

**Keywords:** Periodic disturbance, DC motor, Adaptive control, PSoC, Lyapunov theory

1. **Introduction.** Undesirable periodic disturbances occur naturally in rotary systems such as electrical motors and generators. An appropriate control scheme is typically needed to eliminate the effect of such disturbances. Researchers have proposed such controllers for data storage devices, such as hard disk, CD ROM, or DVD in computer systems [1-3], as well as for vibrations in mechanical control systems [4,5].

To date, most of the work on periodic disturbances has considered deterministic disturbances [6-8]. Usually, various estimation methods have been proposed to predict such disturbance model in which phase and frequency are estimated. In practice, periodic disturbances are typically random due to noise and furthermore time-varying in that its phase and frequency are feasibly arbitrary according to change of system environment. Systems with such stochastic dynamics cannot be handled by deterministic analysis and design approaches, thus more efficient control scheme should be required to overcome the problem.

This paper presents a novel adaptive control approach for DC motor systems with a periodic disturbance whose frequency and magnitude vary randomly within known bounds.

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