A DC/DC Buck-Boost Converter-Inverter-DC Motor Control based on model-free PID Controller tuning by Adaptive Safe Experimentation Dynamics Algorithm

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2022 57th International Universities Power Engineering Conference (UPEC) | 978-1-6654-5505-3/22/$31.00 ©2022 IEEE | DOI: 10.1109/UPEC55022.2022.9917628

***Abstract*—Model-free PID control is currently utilized for the examination of a DC/DC Buck-Boost Converter-Inverter-DC motor structure in this study through optimization of the adaptive safe experimentation dynamics (ASED) method. PID controller has been popularized on its uncomplicated construct, convenient employment with limited tuneable parameters, and broad applicability to diverse mechanistic circumstances. Demonstrated nonlinearity, complexity, and high dimensional parameters within MIMO structure of the DC/DC Buck-Boost Converter-Inverter-DC motor then demand controller with immense precision. The ASED method is hereby adopted as the optimization approach with considerable precision as needed towards fine-tuning the PID controller for its ability to minimize both output of control tracking and energy consumption at reduced processing interval by the exclusion of mathematical modeling in assessing input and output of the system. Traced outcomes regarding voltage of the converter and bidirectional angular velocity are further accounted for performance appraisal of the recommended motor system equipping model-free PID controller following optimization of the ASED approach. A comparison was further operationalized between the proposed ASED approach and its conventional SED-based counterpart. Convergence stability was successively reached by the proposed approach via undertaken simulation with minimization of the specified objective function. Acquired results hereby confirmed smaller values of the objective function and total norm error by the ASED approach towards the precision of operation tracing against the performance of its conventional counterpart.**

***Index Terms*—Model-free control, buck-boost converter, control system, PID controller, Optimization.**

I. Introduction

Sustainable power sources, electric-powered transportations, autonomous machines, and communicational devices are among the familiar industries which employ the power electronic converters [1], [2]. A similar system combining functionalities of an elaborated circuitry and working motors is then observable in multiple operations towards extreme manoeuvre accuracy under the administration of a strategic controller. Considerable efforts in the academic front further explored its employment on buck/boost composition through the handling of single-directional motors upon requested operations [3], [4]. Manipulation of Buck-Boost Converter-Inverter is alternatively suggested in the study by [5] towards handling the angular velocity of a dual-directional motor .

Multiple handling mechanisms including proportional-Integral (PI), fuzzy-logic-control (FLC), linear quadratic regulator (LQR), and sigmoid-PI are formerly proposed for the main purpose of trajectory tracing within DC motors as operationalized using power electronic converter [6], [7]. Nevertheless, foreseeable algorithms seemingly discarded the challenge encountered for angular velocity within dual-directional motors to emphasize the domain of single-directional motor with detached handling of buck/boost converter. Such as on the exception of the passivity-oriented handling mechanism which adopts the Lyapunov and Sylvester principle towards the administration of the latter circumstance [5]. Following the method's adoption of the Lyapunov and Sylvester principle and thorough reliance on structural modelling, shortcoming ensues in the form of immense imprecision between academic and real-time outcomes as contributed by its over-simplified modelling. In return, responses with respect to the structure's handling precision would be jeopardized.

Improved alternative is then given forwarding model-free handling mechanism towards greater resolution to operational challenge. Note that development of model-free approaches