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An Intelligent Based Mathematical Modeling of some Problems Associated with A micro Grid System

By

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B.Sc, May 2018 in Electrical Engineering

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Abstract

Introducing a novel control strategy to ensure operating on the maximum power point (MPP) of the photovoltaic units (PV) under any weather conditions has been considered an essential target. Unfortunately, the implemented maximum power point tracking (MPPT) techniques have shown some stability problems, remarkable oscillations, and some drawbacks in tracking the MPP under rapid climate changes.

Lately, fractional control strategies (FCs) have opened a new avenue in establishing efficient control systems due to their powerful emulation of the real behavior of complicated systems physically. The FCs provide more degrees of freedom to the system modeling by increasing the number of parameters that can be varied and controlled within the model of the system. This new track in the control strategies improves the proximity between the modeling and the real system and minimizes the assumptions, which leads to a better imitation of the real behavior and better performance of the control system in achieving more stability, fewer oscillations, lower overshoot and reduced settling time in response to the transient conditions occurred during rapid variations in the environmental circumstances.

Therefore, this study proposes a robust fractional optimized control strategy for MPPT in the PV system that has a combined action between two fractional control approaches, including; the fractional order incremental conductance method (FOINC) and the fractional-order

proportional integral controller (FPI) to catch the MPP of the PV system with a high steady state under different levels of radiations. Developing the conventional incremental conductance using fractional calculus theory improves its accuracy by adding an extra degree of freedom to the whole system resulting from the fractional parameter in its basic equation. Furthermore, another degree of freedom can be added to the control system by integrating fractional order properties into the PI controller. This novel modified methodology has improved the MPP′s fast dynamics and high tracking accuracy. Additionally, for designing a reliable and self-adaptive control system, a novel nature-inspired algorithm named artificial hummingbird algorithm (AHA) has been implemented to adjust accurately, simultaneously, and adaptively the MPPT-based FCs parameters under different operating conditions.

For validation of the proposed control strategy, five types of conventional propositional integral- derivative (PID) and fractional PID (FPID) controllers have been implemented, and their results have been compared to recommend the most efficient and reliable type of controllers based on unbiased comparisons.

Furthermore, a bunch of state-of-the-art algorithms, including the coot bird natural life model (Coot) and chimp optimizer, have been executed and compared with that of the proposed AHA to prove its superiority. These intensive comparisons reveal that the proposed FOINC with FPI optimized by nature-inspired AHA can track MPP in minimum execution time with fewer oscillations and higher levels of harvest power.