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Analysis of Novel Smart MPPT Approaches Based on M5-Pruned and REPTree Algorithms for Photovoltaic Systems

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Abstract: This paper presents three novel smart MPPT methods that combine a decision tree with a modified incremental conductance and a perturb-and-observe technique to improve the efficiency of solar photovoltaic systems while reducing power ripples in both the photovoltaic system and the associated boost converter during fluctuations in the weather, especially changes in solar irradiation and temperature. Initially, we constructed a mathematical model for solar panels. Subsequently, we developed three innovative smart MPPT techniques utilizing M5-Pruned and REP-Tree through Weka software, conducted simulations by using MATLAB/SIMULINK, and compared the outcomes with those derived from modified incremental conductance (MINC) and perturb and observe (P&O) MPPT approaches. The simulation results under various conditions indicated that the three innovative smart methods, which utilize M5-Pruned and REPTree, effectively track the maximum power point (MPPT), reduce power ripples in photovoltaic systems and the output ripple of the associated boost converter to it, and enhance the efficiency of solar systems compared to MINC and P&O. Novel approaches exhibit efficiency above 99.77% in comparison to MINC and P&O methods, with an efficiency of 98.88% and 98.83%, respectively. These methods exemplify robust artificial intelligence algorithms for maximum power point tracking (MPPT) due to their efficacy, simplicity in learning and design, and low complexity.

Keywords: *photovoltaic panel; boost converter; modified incremental conductance; M5-Pruned; REPTree.*

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