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POWER LAW MODEL (PLM) APPROACHES TO PREDICT THE PERFORMANCE OF A SMALL-SCALE PV SYSTEM

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This paper proposes a mathematical approach to predict the real-time performance of the small-scale photovoltaic (PV) system mounted at the Arcadia based on the power law model (PLM), commonly used to predict the I-V curves of solar cells in standard test conditions (STC). The shape parameters involved in the PLM known as m and μ in this study were determined using experimental data collected under normal weather conditions (irradiation and temperature) based on the Newton-Raphson algorithm iterative method. From the investigations performed on the MATLAB platform, the obtained results reveal that the shape parameters do not strongly depend on temperature and irradiation as shown by the low correlation of 0.296 and -0.110 respectively for μ and -0.201 and -0.188 respectively for m . We also notice that the shape parameters are strongly correlated to the output electrical parameters: μ is strongly correlated to the fill factor with a correlation factor of 0.958 while m strongly depends on voltage with a correlation factor of 0.784. Additionally, this approach predicts with high accuracy in real-time, the output electrical parameters of the PV system with the mean value of R2, RMSE, and correlation r of about 0.99, 3.07 %, and 0.99 respectively. Furthermore, we noticed that the parameter μ varies between 0.8 and 1 during winter and from 0.5 to 0.8 in summertime, while m fluctuates between 10 and 20 during winter and from 10 to 25 during summertime. This approach offers high accuracy because the shape parameters take into account the dynamical behavior of the losses (internal and external), such as recombination effect, series and shunt resistance in each PV module, which varies under different weather conditions. The limitation of this model is that we do not have enough information that links the shape parameters to the electrical parameters such as ideal factor, saturation current, shunt, and series resistance to perform the qualitative investigation based on the shape parameters. Additionally, we do not have a mathematical formula that can facilitate the determination of the shape parameters to predict the performance of the PV system.

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Yes, I ACCEPT

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