PAPER # 3

- **TITLE:**

Validation of an Improved Optimization Technique for Photovoltaic Modeling

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- **ABSTRACT:**

Particle Swarm Optimization technique has been improved by fractional order calculus to be used for photovoltaic (PV) modeling. The modified technique which is called Fractional Order Darwinian Particle Swarm Optimization (FODPSO) has been constructed to estimate the optimal electrical parameters of PV modules. Single and double diode models have been used to designate the PV modules. FODPSO and PSO algorithms have been designed and applied on two different PV modules at different irradiances and temperatures. In order to validate the proposed modeling technique, Root Mean Square Error (RMSE) of the current, Root Mean Square Error (RMSE) of power and Summation of the Individual Absolute Error (SIAE) results obtained using FODPSO and traditional Particle Swarm Optimization (PSO) algorithms have been compared. Minimum RMSE and SIAE have been achieved using the FODPSO technique. To verify the FODPSO results accuracy, accurate measurements of short circuit current, open circuit voltage, and maximum power, voltage at maximum power and current at maximum power have been performed for both PV modules. FODPSO estimated results show excellent

agreement with the experimental ones at different irradiances and temperatures.

Experimental measurements with their uncertainties at 95 % confidence level of short circuit current, open circuit voltage and maximum power, voltage at maximum power and current at maximum power have been achieved for two different poly crystalline silicon modules at various temperatures and irradiances. **Uncertainty evaluation** of real measurements has been performed according to ISO GUM. Accuracy of FODPSO algorithm results has been verified by plotting and comparing IV and PV curves for estimated and experimental results at different environmental conditions.