

PAPER # 2

- **TITLE:**

Fractional Order Darwinian Particle Swarm Optimization for Parameters Identification of Solar PV Cells and Modules.

- **YEAR OF PUBLICATION:** June 2021
- **JOURNAL:** Alexandria Engineering; _(Submission classification: Engineering mathematics).
- **ABSTRACT:**

Improved Fractional Order Darwinian Particle Swarm Optimization (FODPSO) has been proposed to identify the parameters of solar PV cells and modules. For this purpose, the traditional PSO algorithm has been adapted and an improved one using the fractional order calculus has been especially designed as well where the fractional derivatives that is defined by the Grünwald–Letnikov definition in its discrete time form equation was used to apply as the fractional order calculus on The original velocity of PSO for change the traditional PSO algorithm to frictional PSO algorithm. The proposed FODPSO together with the PSO has been applied in both the single and double diode models to describe the specified PV units for purpose of comparison.

To examine the advantages of the proposed FODPSO over conventional PSO, two approaches have been performed; the first approach is implementing the FODPSO and PSO algorithms using input data obtained from previous international publications for different types of PV cells/modules, then comparing the FODPSO algorithm's results to the results of PSO and the other previous optimization techniques that were using the same input data and identical PV cells/modules. The second validation approach is achieved by

performing real measurements in outdoor conditions for another two types of PV modules (mono and poly crystalline Silicon) and inserting these measurements' readings as input data to the PSO and FODPSO algorithms. A comparative study has also been done for both algorithms' results. Enhanced results have been achieved using the FODPSO technique. It is worth mentioning that during the development of this work, other efforts have been made with different techniques that may result in similar or even better results, yet this paper is still introducing for the first time the FODPSO technique (as a modified technique of the PSO) as applied on the PV modeling problem, in addition the paper presents the benefits of the proposed FODPSO over the conventional PSO and presents a comparison that shows the superiority of the FODPSO over the conventional PSO.
