Journal of Oceanography and Marine Research

Extended Abstract

A Metaheuristic Parameter Estimation Technique Of Solar Cells For Marine Applications

Shilpy Goyal, Parag Nijhawan, Souvik Ganguli*

Department of Electrical and Instrumentation Engineering, Thapar Institute of Engineering and Technology, India

Keywords: Marine electrical equipment; marine photovoltaic system; three diode model; parameter estimation.

The need for a renewable energy network in the maritime industry has grown, owing to increased fuel costs and marine pollution. Diesel engines typically power many boats, emitting large quantities of exhaust fumes, such as carbon dioxide, nitrous oxide (NOx), sulphur oxide (SOx), which pollute water and air and cause global warming and human health hazards. Renewables such as wind, solar, wave energy and tidal energy are used to power generation in marine applications as part of reducing marine pollution. Owing of its cleanliness and usability, solar energy, among the diverse technology available for green transport, is considered an extremely promising source of renewable energy in maritime applications. This explores the uniqueness of military PV specifications which contribute to the creation of the Navy and the Marine Corps' new PV technologies. It calculated how well solar panels could be mounted on vessels and evaluated the payback time for saving fuel oil from adopted investment. It clarified that, given their mainland applications and the proposed process, PV systems are still being used in modern marine technology, with the PV arrays monitoring maximum power point (MPP) using MPPT technology and direct power to the flyback converter.

Solar power is also used widely in PV systems for electricity generation. Nevertheless, PV systems are prone to environmental factors external to them, such as temperature and global irradiance. For this, PV models are important and the PV models have a single diode (SDM), a double diode (DDM), and a three-diode model (TDM). Between these models is provided a TD PV model to generate a very precise PV model by integrating all losses into the PV model. In this study, a new configuration of a wide PV range of green sea-flood ships and a large-scale model of optimization of the MPPT problem are discussed. To overcome this problem a metaheuristic optimization is used and the predictive model control is used to achieve online MPPT output in real-time. Precise and effective PV models are mainly dictated by their parameters. Therefore, an effective method for precisely extracting these parameters is especially critical to establish.

Several methods for extracting PV parameters have been published in the literature. They can be categorized in three categories: empirical, numerical and meta-heuristic. Throughout the theoretical method the parameters of the solar cell are derived from a sequence of transcendental equations. The main benefit of the empirical approach is the calculation speed and fairly reliable performance. The points on the PV characteristic curve suit numerical extraction procedures based on certain algorithms. Like the analysis approach, an objective conclusion can be obtained as all points on the characteristic curve are taken into account in the algorithm. The Newton-Raphson method in the literature is the most widely used method. To estimate the I-V parameters of a single PV diode configuration the Levenberg Marquardt algorithm is implemented. The key drawback of the analytical techniques like Newton Raphson is that as the number of parameters to be measured increases, accurate results cannot be obtained.

Meta-heuristic techniques were developed to address the limitations of empirical and iterative techniques. Their key benefit is that continuity and differentiability in the objective function are not necessary. Over the past decade, meta-heuristics have also been used to estimate the circuit model parameters of solar photovoltaic cells. The literature used meta-heuristic methods were the Particle Swarm Optimization (PSO) algorithm for the three-diode model of industrial solar cells because the two diode models did not clearly identify the various actual components of a solar cell, Moth Flame Optimization (MFO). But no optimizer is going to find the perfect global solution for all issues, allowing researchers to use various optimizers to determine the ideal nine parameters of the TD PV model.

A new optimization strategy can be implemented for the optimisation of nine parameters of the TD PV model with the Harris Hawk Optimization (HHO) Algorithm. Two or more Harris Hawks' cooperative hunting practices enabled this algorithm to hunt running prey like rabbits. Therefore, their main tactic is the surprise attack as these Hawks cooperated and struck the prey in several ways and at the same time, they came together on a discovered running prey. The discovery and extraction phases of the HHO algorithm therefore were focused on the surprise attack by Hawks and the running of rabbit resources.

Shilpy Goyal, Parag Nijhawan, Souvik Ganguli*

Department of Electrical and Instrumentation Engineering, Thapar Institute of Engineering and Technology, India
E-mail: souvik.ganguli@thapar.edu