UNIVERSITI TEKNOLOGI MARA

SIZING OPTIMIZATION OF STAND-ALONE PHOTOVOLTAIC SYSTEM WITH HYDROGEN ENERGY STORAGE USING SQUIRREL SEARCH ALGORITHM

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ABSTRACT

The current trend in electricity generation is renewable energy technology, with photovoltaic (PV) systems being one of the most promising. PV systems are a type of Distributed Generation (DG) that is commonly used in rural places when grid electricity is unavailable Stand-Alone Photovoltaic (SAPV) systems are frequently employed as electricity delivery systems for rural electrification, system sizing is a major difficulty in their installation. The technical and economic performance of the systems is improved when they are designed properly. Furthermore, when multiple models of system components must be included in the design, sizing becomes computationally expensive. As a result, optimization techniques are widely used in the sizing algorithms for such systems in order to achieve optimal results. The optimization on stand-alone photovoltaic system sizing with hydrogen energy storage considering improved Squirrel Search Algorithms is presented in this thesis. The aims and objectives are to formulate an iterative-based sizing algorithm for SAPV sizing system with and without Hydrogen Energy Storage (HES), to develop a Squirrel Search Algorithm (SSA) for sizing optimization of SAPV system with and without HES and to improve the performance of SSA in an algorithm known as Improved Squirrel Search Algorithm (ISSA) for the sizing optimization via transmutation. The non-computational intelligence-based approach, Iterative-based Sizing Algorithm (ISA), was initially developed as a benchmark for the computational intelligence (CI)-based sizing algorithm. In addition, the objective function of the sizing optimization is either minimizing the Loss of Load Probability (LOLP) or Life-Cycle Cost (LCC). Two cases of SAPV systems were investigated, i.e. system with PV modules, batteries, charge controllers, and inverters as the system components and system with similar components with HES being included. The results revealed that SSA was able to yield optimal LOLP and LCC that were comparable to those obtained using the baseline algorithm ISA, but with significantly less computing time. Apart from that, comparisons of ISSA with other optimization approaches were conducted to demonstrate its superiority. In terms of computing time and population size, ISSA was determined to be superior to selected Computational Intelligences (CI). The ISSA-based sizing algorithm showed comparable performance in optimizing SAPV systems with and without HES in terms of LOLP and LCC, while achieving a significantly faster computational speed of 202.17% and 234.34% when compared to ISA in systems without and with HES, respectively. These findings showed that ISSA is capable of accurately and quickly sizing the systems under investigation, . As a result, the development of ISSA is justified.

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