FIREFLY ALGORITHM-BASED NEURAL NETWORK FOR GCPV SYSTEM OUTPUT PREDICTION

This thesis is forwarded to FACULTY OF ELECTRICAL ENGINEERING, UNIVERSITI TEKNOLOGI MARA (UiTM) In partial fulfilment for award of the BACHELOR ENGINEERING (HONS) ELECTRICAL

NOR SYAKILA MOHD ZAINOL ABIDIN
FACULTY OF ELECTRICAL ENGINEERING
UNIVERSITI TEKNOLOGI MARA
40450 SHAH ALAM
SELANGOR, MALAYSIA

ACKNOWLEDGEMENT

Foremost,I would like to express heartfelt gratitude for my supervisor Dr Shahril Irwan B. Sulaiman from Faculty of Electrical Engineering at the Universiti Teknologi MARA for his wisdom, patience, and for giving me the opportunity to study with him and this exciting project for my Final Year Project(FYP). The valuable suggestions and discussions were always helpful and inspiring. Also, the support and encouragement were my greatest motive to aim for the best.

I would also to thank to Puan Hedzlin Zainuddin and En.Zulkifli B. Othman for their useful discussions. Also, many thanks to my colleagues for their help and support.

I would also like to show my deepest gratitude and respect to my family, especially my parents, the ones to whom I owe all the success in my life. No words can express my gratitude to them, but I pray God to bless them and reward them.

My appreciation is also extended to Green Energy Research Centre (GERC),UiTM Shah Alam for making the necessary data available for this study.

ABSTRACT

Solar energy is one of the most promising renewable resources that can be used to produce electric energy through photovoltaic process. A significant advantage of Grid Connected Photovoltaic (GCPV) systems is the use of the abundant and free energy from the sun. It is commonly used in urban areas which are readily accessible to the utility grid. However, there are several issues that could possibly slow down the utilization of GCPV system.One of them is the the expected energy output from the GCPV system is unpredictability due to the fluctuating weather conditions throughout the day. Due to this fluctuation, it is difficult for the system owners to identify whether their systems are performing as expected.

Due to the importance of predicting the system output, numerous works had been proposed to predict the output from GCPV systems.A few studies had been conducted to predict the output from GCPV systems with Multi-Layer Feedforward Neural Network (MLFNN) being employed as the prediction tool. Nonetheless,a MLFNN is not efficifient enough because it become to be a tedious process and time consuming since it required trial-and-error method for selecting MLFNN training parameters.

Therefore, this thesis presents a hybrid Firefly Algorithm (FA)–based MLFNN for predicting the AC power output from a grid-connected photovoltaic (GCPV) system. In the proposed MLFNN, FA was employed as the optimizer and search tools of the MLFNN training parameters. FA was used to optimize the number of neurons in the hidden layer, the learning rate and the momentum rate such that the Root Mean Square Error (RMSE) was minimized. In addition, the MLFNN utilized solar irradiance (SI), ambient temperature (AT) and module temperature (MT) as its inputs and AC power as its output.

The performance of the proposed FA-based MLFNN had been compared with the performance of the Classical Evolutionary Programming-based Neural Network (CEP-based MLFNN). The results showed that the proposed FA-based MLFNN had outperformed the CEP-based MLFNN in producing lower RMSE

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Photovoltaic (PV) systems has been a crucial type of renewable energy that convert sunlight into electricity as the sunlight is freely available throughout the year. The use of photovoltaic (PV) systems for electricity generation helps to produce a clean energy, and is currently growing rapidly even during a time of economic crisis .For instance, the European Photovoltaic Industry Association (EPIA) also stated that the annual worldwide installed capacity of PV system in 2012 was approximately 31.1 GW that is roughly same as in the record installation of year 2011 [1]. The European Photovoltaic Industry Association (EPIA) also expects that the global cumulative PV system capacity will reach 200 GW by the year 2020 and 800 GW by the year 2030 since the demand for electric energy is expected to increase rapidly due to the global population growth and industrialization.

PV systems were first used as stand-alone systems to provide electricity to rural areas where no other sources of energy were present. The advances in the technology and the concerns about global warming are encouraging to provide Grid-Connected Photovoltaic (GCPV) System in urban areas where the utility-grid is readily available.