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An Innovative Solar Power Forecasting on Grid Using Feed Forward Neural Network Simulation to Better Teach the Photovoltaic Generation to Students

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ABSTRACT
The research deals with a novelty approach to science and education regarding power electrical forecasting photovoltaic generation. This teaching method is based on Solar Power Electrical Forecasting on grid using Feed Forward Neural Network Simulation. This apparatus is able to forecast the power electrical which the production photovoltaic generation household scale during one hour ahead. The power energy production is then estimated with different orientations and based on meteorology data. The Solar Power Electrical Forecasting on grid using Feed Forward Neural Network Simulation provides students with the unique opportunity to learn, in a playful manner, the fundamental principles of photovoltaic generation on grid household scale. Several examples of practical work are detailed to give an accurate appreciation of many simulations in photovoltaic generation. A lot of simulations could be studied such as the implementation of global solar irradiance, and the electrical characterization of solar cells with various technologies based on meteorology data.

Keywords: *Solar, Forecasting, Photovoltaic generation, Feed Forward Neural Network, Simulation*

1. INTRODUCTION

The use of renewable energy to meet consumer needs for electrical energy is very important and the use of renewable energy is one of the efforts to reduce the use of fossil energy which is decreasing and requires very large energy production costs. The environmentally friendly renewable energy source in question is a Photovoltaic Power Plant that is integrated with a grid or on-grid system that is applied to residential homes. The on-grid photovoltaic generation system that is applied to residential homes in order to supply electrical energy comes from two sources, namely photovoltaic generation system and electrical company, where photovoltaic generation system will serve the needs of electrical energy during the day and there is excess production of electrical energy from photovoltaic generation system connected to the electrical company network so that the KWH meter will calculating the export value of the electrical energy, while for nightly needs the supply of electrical energy for residential homes comes from the electrical company and KWH meters by calculating the value of imported electrical energy. And when the goes out, the supply of electrical energy for the day and night comes from the battery. Therefore, in the process of increasing learning about electricity science, especially electrical energy that comes from renewable energy, media is made so that students understand more about the production of electrical energy, especially in terms of forecasting electric power produced by renewable energy, namely photovoltaic generation system, the photovoltaic generation system module is made and used as a media for simulating photovoltaic generation system on-grid with a feed-forward neural network so that students can learn and understand more about photovoltaic generation system, especially photovoltaic generation system on-grid which is applied in household life. Previous research about global solar irradiance prediction has presented a variety of mathematical methods depending on meteorology data. It has also been described in reference to Ryu Ando et. al.[1] of the planned power generation that matches the planned values submitted in advance with the actual values of PV power generation is required by installing battery energy

storage systems (BESS). The integrated missing-data tolerant model for probabilistic PV power generation forecasting. Taking historical PV generations as input, this model is based on a recursive long short-term memory network (Rec-LSTM), which can provide multi-step ahead forecasting of the probability distribution of PV generation and has also been published by Qiaoqiau Li et.al [2]. Another study by Utpal Kumar Das et. Al [3] about the preparation of a solar irradiance pattern on the basis of weather conditions and the percentages of cloud cover collected from online weather forecast reports.

In this research, a novel methodology that model simulation learning power for photovoltaic generation on grid using feed-forward neural network modeling based on meteorology. A feed-forward neural network model is used to power forecast photovoltaics on grid using calculating feed-forward neural networks. The main contributions of this paper are as follows:

1. A new problem formulation for very short-term power forecasting using the feed-forward neural network construction is a model proposed for learning.
2. Implementation of this proposed presents interesting research for very short-term power prediction for one day ahead

2. RESEARCH METHODS

The proposed study is solar power forecasting in photovoltaic generation systems on-grid based on meteorology data results using feed-forward neural network methods. The simulation of the feed forwards neural network simulation model for learning can be programmed 60 minutes ahead.

2.1. Feed Forward Neural Network Simulation Model

Artificial Neural Network (ANN) is a combination of the training data set consisting of N training patterns recognition $\{(x_n, y_n)\}$, where n is the pattern value and ANN consists of an interconnected group of neurons, and it processes information using a connectionist approach to computation. The input vector x_n and desired output vector y_n have dimensions *K* and *N*, respectively; o_n is the network output vector for the *n*th pattern. The neurons have five basic components, i.e. input, weight bias, threshold, summing junction, and output, which can see in Figure 1. Illustrated architecture feed-forward NN.

The proposed model in the research is used to forecast the load generation value for the next hours or 60 minutes ahead, solar power forecasting based on meteorology data, and the load generation value data from the photovoltaic generation system on grid.

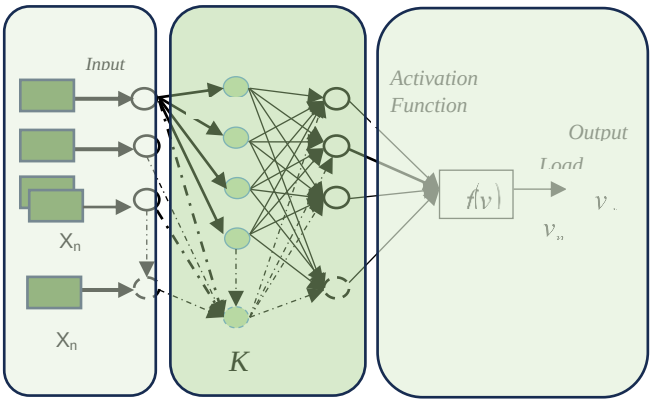

Figure 1. Basic structure architecture feed-forward neural network (Input, Process, Output).

For used the feed-forward artificial neural network modeling can be divided into three stages: (1) the design model and input data pattern stage which includes the choice of the ANN type, the number of its layers, the number of neurons in each layer; (2) The choice of training data and testing data in which samples based on meteorology data are presented to the feed-forward neural network and the weights are adjusted accordingly till a predetermined condition is satisfied; (3) the validation result test passed the stage, in which the obtained feed-forward neural network forecasting model is tested using measurement data at hydro thermal generation. For prediction, the load generation data are normalized to the range of [0,1], to avoid neuron saturation during the learning process. The neuron number of the first hidden layer is 20 and we have to consider a feed-forward neural network with 525 inputs load generation data for forecasting.

In the first case, the feed-forward neural network will learn about the load generation of the pivot location. The feed-forward NN model will be able to give the result of load forecast at the target thermal generation with fuel oil (HSD) based on meteorology data. When compared to actual data, feed-forward NN also presents the whole load values for an eleven-hour window, giving feed-forward neural networks the possibility to learn the existing relationship between them and to construct an idea about load evolution during the time window. In the second case, the entire load generation data are used for very short-term forecasting using a feed-forward neural network model based on meteorological data at the solar generation on grid. The research with the proposed feed-forward neural network model has to predict solar power generation values for the next hour or 60 minutes ahead by taking into account the forecasting data based on meteorology data.

3. DISCUSSION AND RESULT

This proposed research discusses the result and analysis of feed-forward neural network (FF-NN) method used to forecast future solar power photovoltaic generation on grid by using a 60-hour ahead forecasting process. And the basic stage or process of optimization forecasting is as follows:

a. Determine the value input and output variables of the feedforward neural network model based on meteorology data, the forecast effect is relatively good.
b. Group the data. Input data and output data variables from analysis using a modified FF-NN model are used for the feedforward neural network method.
c. Therefore, to make the optimization forecasting better and this simulation and modeling simulations for solar forecasting on grids using feed-forward neural network simulations to better teach the photovoltaic generation to students
d. The activation function for optimization. In the process feedforward neural network, the activation function connected among different layers is the sigmoid, and the activation function is connected to the output value.

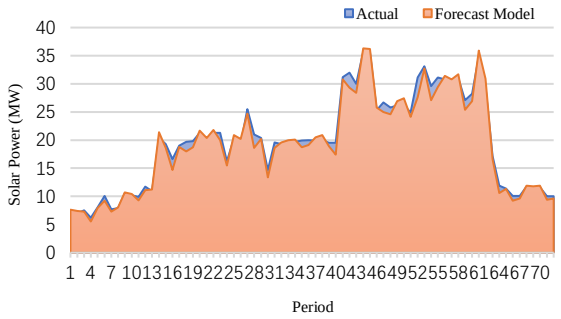

Figure 2. Solar power forecast on grid model using feed forward neural network photovoltaic generation.

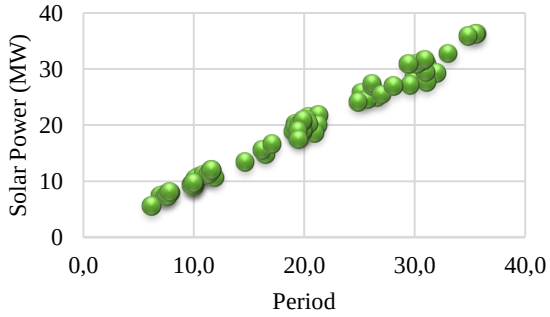

Figure 3. Solar power forecast on grid model using feed forward neural network photovoltaic generation for 60 minutes ahead.

As seen in Fig. 2 Illustrates a comparison of the two models for the solar power forecasting data between actual data and Feed Forward Neural Network (FF-NN) models. And Fig. 3 Illustrates a very short-term (60 minutes ahead) solar power forecast using Feed Forward Neural Network.

4. CONCLUSION

A novelty methodology for the very short term 60 minutes ahead for solar power forecasting on grid of photovoltaic generation has been introduced. The solar power forecast models on grid of a PV generation in the very short term 60 minutes ahead based on meteorology data. It clearly shows that the solar power forecast on grid using feed-forward neural network simulation method based on weather data gives a better result output, which means the solar power forecast largely depends on variable weather data values so that it becomes to improve economic value added for electricity user from photovoltaic generation. Therefore by using the learning module regarding solar power forecast on grid using feed forward neural network based on meteorological data simulation on photovoltaic generation system, it can be concluded that there has been an increase in understanding of learning from students.

AUTHORS' CONTRIBUTIONS

Unit Three Kartini and Masviki Agam conceptualization and designed the model; Unit Three Kartini, Parama Diptya Widayaka, L. Endah Cahya Ningrum, Tri Wahyu, and Masviki Agam performed the experiments; contributed investigation, software, materials, validation, reagents, data curation, and formal analysis tools; writing original draft preparation, review and editing, Unit Three Kartini project administration, and funding acquisition.

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