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Solar Radiation Machine Learning Production Depend on Training Neural Networks with Ant Colony Optimization Algorithms

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Abstract: Solar radiation one of the most important application in solar energy research so many research papers introduce to analyse the influence it. The great importance of Global Solar Radiation (GSR), the number of radiation stations are very less when compared to the stations that collect regular meteorological data like air temperature and humidity. This paper investigates new machine learning model meanly depend on an Artificial Neural Network (ANN) and Ant Colony Optimization (ACO). The prediction accuracy of the solar radiation depends on the best way to dataset optimization and training algorithm. This paper shows that prediction using (ANN) with dataset prepossessing by using (ACO) are more accurate and powerful when compared to conventional models

Keywords: Solar Radiation, Machine learning, Ant Colony Optimization, Artificial Neural Network.

I. INTRODUCTION

Evolution and change the world and technology turn world attention to energy and environmental protection and relies on renewable energy and energy [1]. Renewable energy sources solar radiation is one of the most important renewable energy sources and causes of revolution is the economy and the environment, one of the most important tasks for the design and development of solar systems is the attention to detail and long study of solar radiation strong knowledge in order to develop solar panels for each segment benefited from sunlight or better known as solar radiation.GSR: Is to know some sensors to measure pyranometers in many areas with very high Sun, But the problem is the increase in costs and that many States do not have the Internet reward at stations in order to gather sufficient information on solar radiation. In most places that the models, you have to know enough information about solar radiation and study it well through Meteorological They know the temperature on the timing of the Sun and the humidity and vapour density effect on solar radiation. Particle swarm optimization (PSO) is a stochastic population-based search method inspired by the social behaviour of animals such as birds, fish and ant. PSO is quite simple to implement and has few control parameters. PSO has many variations. the position of a particle can be limited to a range from the early days of (PSO), using this method for optimization of neural networks (ANNs) has been in the center of attention [2]. Although neuro evolution means evolving networks and PSO is not known as a complete evolutionary algorithm, optimization of networks by PSO mimics evolution of networks; hence, it can be compared to other neuro evolution algorithms

HOW TO MEASURE SOLAR ENERGY:

Measure the amount of solar radiation energy reflect fallen upon unit area in unit time of hard radiation.
Direct solar radiation measurement devices contained vertically [3]:

- Know such devices a pyrheliometer:
- Total solar radiation measurement devices, that used to measure the entire radiation from each hemisphere including indirect solar radiation road surface after spread
- Measuring devices all terrestrial radiation solar radiation:
- Flow measurement devices for total radiation upward and downward

DIFFICULTIES IN MEASUREMENT:

Through studies and experiments have been known to difficulties in measurement is the solar radiation intensity variation and length of temporal brightness depending on the angle of solar radiation on the Earth's surface and different length of day throughout the year, And here is it has the highest proportion of qualified solar the cells and that all this is measured at meteorological stations and here comes the cost Where the devices are expensive, And not only that there is another problem in the influence of moisture and humidity and it affects solar cells Earthen assemblies and vaporized water molecules as it works to reduce the levels of sunshine whenever she visited temperature or humidity The less efficient solar cells [4].

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Dataset and Methodology

we introduce the dataset that we have used in our machine learning experiments. In addition to that, the pre-processing procedures that we have made to the data before doing the machine learning tasks will be discussed. As shown in table1

Table [1]. Sample of Solar Radiation Database Records

Radiation	Temperature	Pressure	Humidity	Wind Direction	Speed
368.73	57	30.39	73	89.46	4.5
390.71	57	30.39	69	353.86	3.37
411.99	57	30.39	74	339.56	9
432.21	57	30.39	75	13.27	9

shows some example records of the design dataset which consists of the radiation, temperature, pressure, humidity, wind direction and speed. These parameters aid in data mining tasks. The data were obtained from data.gov We have eliminated some columns such as UNIX Time, Data and time.In addition to feature selection and standardization, we have divided the solar radiation dataset into two parts: training data (75%) and testing data (25%). The original dataset contains 8700 records. The training data contains 6525 records and the testing data contains 2175 records. The training data is used to train machine learning before optimization date and after ant colony optimization, finally the testing data is used to calculate the error and the accuracy of each

Ant Colony Optimization

ACO is a Meta heuristic optimization algorithm that can be used to find approximate solutions to difficult combinatorial optimization problems. In ACO artificial ants build solutions by moving on the problem graph and they, mimicking realants, deposit artificial pheromone on the graph in such a way that future artificial ants can build better solutions. ACO has been successfully applied to an impressive number of optimization problems [5].As shown in figure [1]

AC Optimization
Initialize
While stopping not satisfied do
each ant starting in a position node
Repeat
For each ant do
Choose next node
Updating ant age (agefactor = 0.9)
Apply step by step pheromone update

$$T_{ij}(new) = T_{ij}(old) + \delta * (T_{max} - T_{ij}(old))$$

End For
Apply the best pheromone update
End While
End

Figure [1]. Ant Colony Optimization Pseudocode

Artificial Neural Network

Artificial Neural Network (ANN) is an information processing paradigm inspired by biological neural networks. Nowadays, ANN is widely used in many applications in various aspects of engineering and science [6]. The neural network consists of multiple layers including input layer, output layer and hidden layer. Each layer consists of multiple neurons.
Multi-Layer perceptron (MLP) is a type of feed forward neural networks that have one or more hidden layers between the input and output layers. MLP layers are fully connected which means that a neuron in one layer is connected to all neurons in the following layer. Each connection has a different weight value. MLP is trained with back propagation algorithm. The back propagation algorithm uses gradient descent to calculates the error contribution of each neuron after passing a batch of data to the network. Then it modifies the weights so that the network gives the expected output for a given input.

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In this study, we used the solar radiation dataset to train an MLP using back propagation learning algorithm. The architecture of the network was designed as following: 1 input layer (10 neurons), 1 hidden layer (20 neurons), and 1 output layer (1 neuron). The learning rate was set to 0.001. We tested different activation functions and it seems that identity is most suitable activation function for this type of data. Practically, two known performance metrics was used to assess the prediction performance: the root mean square error (RMSE), and the mean absolute error (MAE) as shown in table [2] and figure [2], [3]

Table [2] Machine learning AccuracyResult

	RMSE	MAE	Score
Neural Network	3.042416	0.601968	0.831693
Neural Network(ACO)	0.083814	0.015948	0.996607

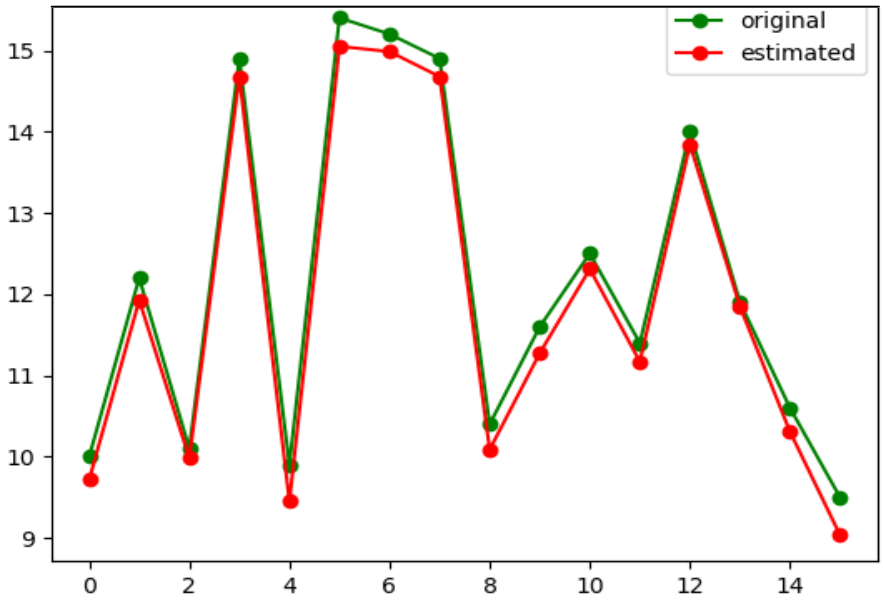

Figure [2]. Neural NetworkAccuracy Result

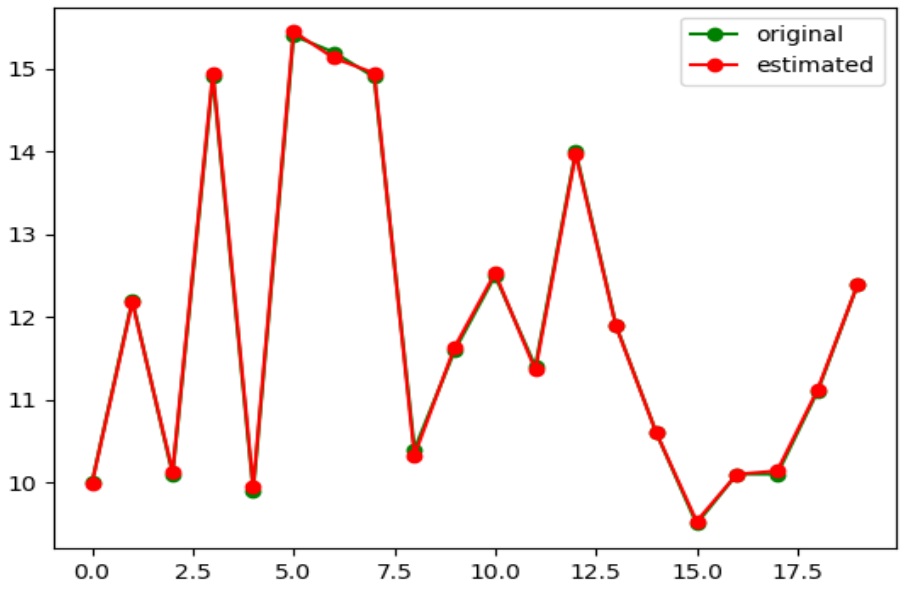

Figure [3]. Neural Network (ACO)Accuracy Result

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CONCLUSION

We did two machine learning tasks to predict the value of solar radiation. The results show the powerful mechanism of pre-processing database based on as ant colony optimization than run the artificial neural network. Finally the proposed model had a better accuracy and less error.

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