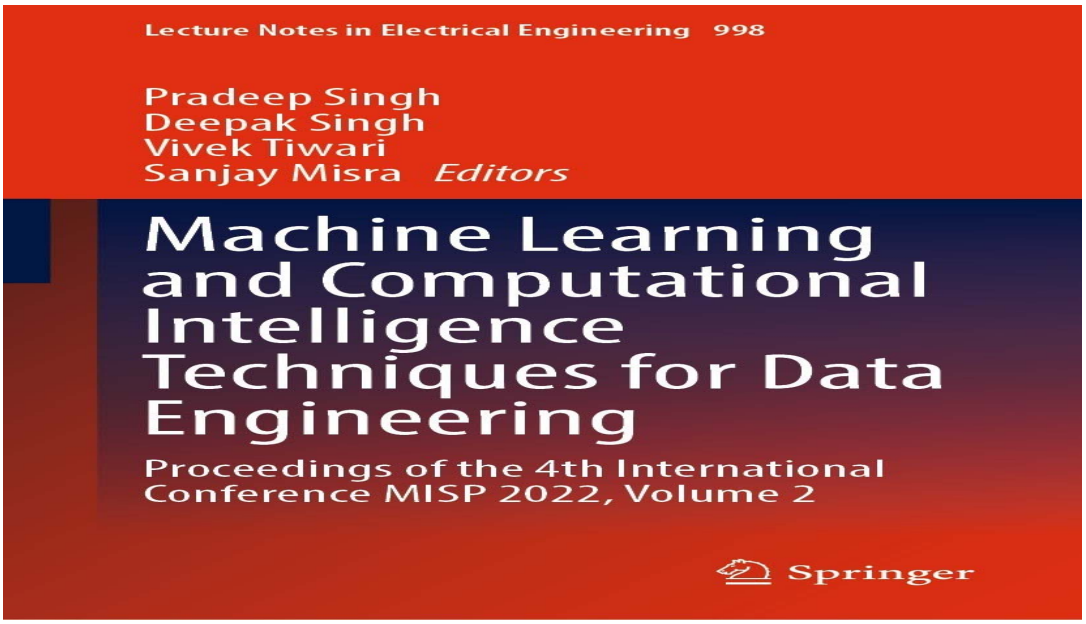

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Development of a Short Term Solar Power Forecaster Using Artificial Neural Network and Particle Swarm Optimization Techniques (ANN-PSO)

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Abstract

Globally, the use of renewable energy has increased significantly since the late twentieth century. Nigeria is also leading the exponential growth of renewable energy use. This article will predict the solar energy collected in 11 power distribution company areas (DISCO) in Nigeria: Abuja, Benin, Eko, Enugu, Ibadan, Ikeja, Jos, Kaduna, Kano, Port-Harcourt, and Yola. Artificial Neural networks and Particle Swarm Optimization (ANN-PSO) techniques are used to forecast solar irradiance. This research compares the results using cognitive acceleration coefficients. From this study, the regression coefficient (R) values of 0.9968 and 0.99533 were obtained from Yola and Ikeja Distribution Company, respectively. Also, mean absolute percentage error (MAPE) values of 3.07% in Yola and 5.67% in Jos were obtained. The normalized root means square error (nRMSE) values of 0.9813, 2.4522, and 0.9470 were obtained from Yola, Ikeja, and Benin DISCOs, respectively, and mean squared error (MSE) values of 2.29% in Abuja, 1.80% in Ibadan, 1.83% in Ikeja, and 0.0915% in Jos. The simulation was also performed for July 2021, which was not part of the dataset used in this study. The result of the forecaster revealed high levels of forecasting accuracy.

Keywords

- **Solar forecasting**
- **Sustainability**
- **Artificial neural network**
- **Particle swarm optimization**
- **Nigeria**

References

1. Ellabban O, Abu-Rub H, Blaabjerg F (2014) Renewable energy resources: current status, future prospects and their enabling technology. Renew Sustain Energy Rev 39:748–764

CrossRef **Google Scholar**

2. Bull SR (2001) Renewable energy today and tomorrow. Proc IEEE 89(8):1216–1226

CrossRef **Google Scholar**

3. Lerner J, Grundmeyer M, Garvert M (2009) The importance of wind forecasting. Renew Energy Focus 10(2):64–66

CrossRef **Google Scholar**

4. Etukudor C et al (2021) Yield assessment of off-grid PV systems in Nigeria. In: 2021 IEEE PES/IAS PowerAfrica. IEEE

Google Scholar

5. Etukudor C et al (2018) Optimum tilt and azimuth angles for solar photovoltaic systems in South-West Nigeria. In: 2018 IEEE PES/IAS PowerAfrica. IEEE

Google Scholar

6. Gbenga A et al (2019) The influence of meteorological features on the performance characteristics of solar photovoltaic storage system. In: Journal of Physics: Conference Series. IOP Publishing

Google Scholar

7. Charles A (2014) How is 100% renewable energy possible for Nigeria? Global Energy Network Institute

Google Scholar

8. Ohunakin OS, Adaramola MS, Oyewola OM, Fagbenle RO (2014) Solar energy application and development in Nigeria: drivers and barriers. Renew Sustain Energy Rev 32:294–301

Google Scholar

9. Isoken G, Idemudia DBN (2016) Nigeria power sector: opportunities and challenges for investment in 2016. In: Client alert white paper, pp 1–15

Google Scholar

10. Mohanty S et al (2017) Forecasting of solar energy with application for a growing economy like India: survey and implication. Renew Sustain Energy Rev 78:539–553

CrossRef Google Scholar

11. Obibineche C, Igbojionu DO, Igbojionu JN Design, development and evaluation of a bucket drip irrigation system for dry season vegetable production in South-Eastern Nigeria. Turk J Agric Eng Res 2(1):183–192

Google Scholar

12. Vasumathi B, Moorthi S (2012) Implementation of hybrid ANN–PSO algorithm on FPGA for harmonic estimation. Eng Appl Artif Intell 25(3):476–483

CrossRef Google Scholar

13. Engelbrecht A (2012) Particle swarm optimization: velocity initialization. In: 2012 IEEE congress on evolutionary computation. IEEE

Google Scholar

14. Lago J et al (2018) Short-term forecasting of solar irradiance without local telemetry: a generalized model using satellite data. Sol Energy 173:566–577

CrossRef Google Scholar

15. Marzouq M et al (2020) Short term solar irradiance forecasting via a novel evolutionary multi-model framework and performance assessment for sites with no solar irradiance data. Renew Energy 157:214–231

CrossRef Google Scholar

16. Sözen A, Arcaklioğlu E, Özalp M (2004) Estimation of solar potential in Turkey by artificial neural networks using meteorological and geographical data. Energy Convers Manage 45(18–19):3033–3052

CrossRef Google Scholar

17. El Alani O, Ghennioui H, Ghennioui A (2019) Short term solar irradiance forecasting using artificial neural network for a semi-arid climate in Morocco. In: 2019 International conference on wireless networks and mobile communications (WINCOM). IEEE

Google Scholar

18. Jamali B et al (2019) Using PSO-GA algorithm for training artificial neural network to forecast solar space heating system parameters. Appl Therm Eng 147:647–660

CrossRef Google Scholar

19. Gundu V, Simon SP (2021) Short term solar power and temperature forecast using recurrent neural networks. Neural Process Lett 53(6):4407–4418

CrossRef Google Scholar

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Appendix 1: Average Monthly Solar Irradiance

Month	A	B	C	D	E	F	G	H	I	J	K
January	188.48	200.74	210.1	200.1	194.1	*226.67*	239.6	237.6	235.3	239.743	2
February	**200.9**	197.76	**216.86**	195.1	187.6	225.09	239.8	232.1	241.8	245.414	2
March	184.42	209.96	218.7	**236.2**	**210.8**	**255.19**	**266.9**	**266.1**	**273.7**	**274.763**	**2**
April	197.63	207.55	203.54	226.5	203.1	235.16	243.2	247.2	272.9	266.275	2
May	175.75	**211.95**	216.53	208.2	195.2	231.72	236.2	242.4	258.6	257.976	2
June	158.97	191.4	200.26	166.9	162.9	220.28	220.4	233.9	246.2	237.313	2
July	156.5	157.38	182.96	158.2	147.3	205.72	202.7	207.7	236.8	245.696	1
August	154.31	**168.53**	**169.18**	**170.9**	**152.5**	**176.09**	**187.2**	**191.1**	229.4	200.977	**1**
September	164.05	182.47	181.98	197.3	168.6	196.32	229.5	218.2	259.7	242.074	1
October	**151.76**	190.84	202.09	190.3	168.3	217.99	240.5	236.4	245.6	243.905	2
November	177.52	200.12	223.59	206.2	190.2	233.48	251.7	254.1	237.9	241.642	2
December	177.97	188.12	200.67	179.06	175.84	194.84	221.2	220.8	**200.85**	**192.833**	2

Key: A—Port harcourt, B—Benin, C—Enuga, D—Eko, E—Ikeja, F—Ibadan, G—Jos, H—Yola, I—Kano. J–
Kaduna, K—Abuia

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