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Artificial neural network-based photodiode radiometer for instantaneous global solar irradiance measurements

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A low-cost, BPW21 Si-photodiode-driven solar radiometer was designed and used for long-term measurement of global horizontal solar irradiance. This was necessitated by the fact that the Kipp & Zonen CMP11 pyranometer available in the department and used as the secondary standard pyranometer, is expensive for most of our running renewable energy projects. A data acquisition system (DAS) was used to simultaneously measure the radiometer and the CMP11 voltages, as functions of time of day. Artificial neural networks (ANNs) were then used to calibrate the radiometer voltages against the CMP11 calculated irradiances. A data set spanning four months was collected and used to create, train, test, and validate the networks. During training, radiometer voltages and time of day were inputs to the ANNs, while CMP11 irradiances were the targets. Data for selected days not used in the training were then used to test and validate the ANNs. The photodiode sensor used has an acute spectral response compared to the CMP11. Despite this setback, ANNs were successfully used to match radiometer and CMP11 irradiances. This novel approach returns instantaneous global horizontal irradiances for the entire day. Root-mean-square error (RMSE), mean absolute error (MAE) and mean absolute percentage error (MAPE) was used to assess the performance of the radiometer. The design matched the CMP11 with RMSE values ranging from 10 W/m2 to about 22 W/m2, with a standard deviation of about 1 W/m2. The average MAPE was 3.5%, while the average MAE was 6 W/m2.

Apply to be considered for a student ; award (Yes / No)?

No

Level for award;(Hons, MSc, PhD, N/A)?

N/A

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