Comparing ANN frameworks for solar PV power estimation

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Abstract:

The escalating demand for renewable energy sources necessitates robust methods for predicting solar photovoltaic (PV) power output. This prediction is crucial for maintaining grid stability as solar power integration increases. This study investigates the efficacy of various artificial neural network (ANN) architectures in estimating and forecasting the total output power of PV systems. Three distinct ANN models - Multilayer Feedforward Neural Networks (MLFFNNs), Recurrent Neural Networks (RNNs), and Nonlinear Autoregressive Exogenous (NARX) models - are employed. Historical data from four PV substations is utilized for training, with solar radiation and surface temperature as input variables and total output power as the target variable. To address the challenge of limited monitored plant data, an upscaling technique is implemented to estimate regional solar PV output. The trained ANN models are rigorously validated, and their performance is comparatively assessed. This comparative analysis aims to identify the ANN architecture that delivers the most accurate solar PV power predictions, ultimately facilitating the seamless integration of renewable energy sources into the grid.