Title:	Forecasting photovoltaic power generation with a stacking ensemble model
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Abstract:

Nowadays, photovoltaics (PV) has gained popularity among other renewable energy sources because of its excellent features. However, the instability of the system's output has become a critical problem due to the high PV penetration into the existing distribution system. Hence, it is essential to have an accurate PV power output forecast to integrate more PV systems into the grid and to facilitate energy management further. In this regard, this paper proposes a stacked ensemble algorithm (Stack-ETR) to forecast PV output power one day ahead, utilizing three machine learning (ML) algorithms, namely, random forest regressor (RFR), extreme gradient boosting (XGBoost), and adaptive boosting (AdaBoost), as base models. In addition, an extra trees regressor (ETR) was used as a meta learner to integrate the predictions from the base models to improve the accuracy of the PV power output forecast. The proposed model was validated on three practical PV systems utilizing four years of meteorological data to provide a comprehensive evaluation. The performance of the proposed model was compared with other ensemble models, where RMSE and MAE are considered the performance metrics. The proposed Stack-ETR model surpassed the other models and reduced the RMSE by 24.49%, 40.2%, and 27.95% and MAE by 28.88%, 47.2%, and 40.88% compared to the base model ETR for thin-film (TF), monocrystalline (MC), and polycrystalline (PC) PV systems, respectively.