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A hybrid HHT-ICA-SVM modeling approach for short-term PV solar power prediction using SCADA and weather information

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Solar energy production is usually associated with some uncertainties due to the intermittent nature of solar radiation intensity and other weather variables. This brings a big challenge to integrate photovoltaic (PV) solar power into the main grid and prejudices power industries against deploying solar systems. Hence, accurate predictions play an important role to effectively connect PV solar systems into the grid especially for large power systems or microgrids with high-penetration of solar energy. This study proposes a hybrid prediction model combining Hilbert-Huang Transform, Imperialist Competitive Algorithm and Support Vector Machine (Hybrid HHT-ICA-SVM) for short-term (24h-ahead) generation power prediction of a real microgrid PV solar system located in Beijing, China. The model is established by integrating the interactions of the solar system Supervisory Control and Data Acquisition (SCADA) power record and Numerical Weather Prediction (NWP) weather forecast information for one year with one hour time interval. In the presented model, the HHT is used to have a significant effect on ill-behaved weather and SCADA datasets, and the SVM model maps the nonlinear relationship between the NWP weather parameters and SCADA PV power record. The ICA is employed to optimally tune the SVM parameters for higher prediction accuracy. The prediction accuracy and forecast skill of the proposed model have been compared with other seven prediction approaches and a benchmark model using the persistence method. The obtained results reveal outperformed performances of the proposed model with respect to prediction accuracy and forecast skill improvements.

Notes: