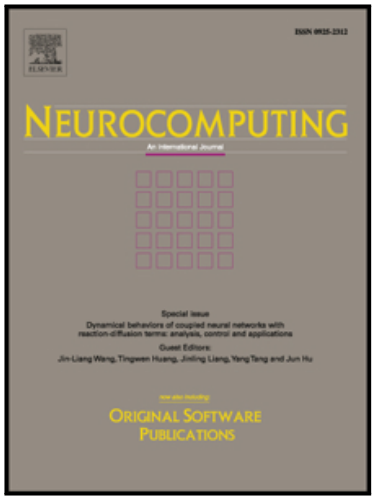
Communicated by Dr. Yuan Yuan

Accepted Manuscript



Anomaly Detection and Predictive Maintenance for photovoltaic Systems

Massimiliano De Benedetti, Fabio Leonardi, Fabrizio Messina, Corrado Santoro, Athanasios Vasilakos

PII: S0925-2312(18)30548-4
DOI: 10.1016/j.neucom.2018.05.017
Reference: NEUCOM 19567

To appear in: *Neurocomputing*

Received date: 19 January 2018
Revised date: 27 April 2018
Accepted date: 3 May 2018

Please cite this article as: Massimiliano De Benedetti, Fabio Leonardi, Fabrizio Messina, Corrado Santoro, Athanasios Vasilakos, Anomaly Detection and Predictive Maintenance for photovoltaic Systems, *Neurocomputing* (2018), doi: 10.1016/j.neucom.2018.05.017

Anomaly Detection and Predictive Maintenance for photovoltaic Systems

Massimiliano De Benedetti[a], Fabio Leonardi[a], Fabrizio Messina[a,*], Corrado Santoro[a], Athanasios Vasilakos[b]

[a] *Department of Mathematics and Computer Science, University of Catania, Via S.sofia 64, 95125 Catania,Italy*
[b] *Lab of Networks and Cybersecurity, Innopolis University, Russia, 1, Universitetskaya Str., Innopolis, 420500*

Abstract

We present a learning approach designed to detect possible anomalies in photovoltaic (PV) systems in order to let an operator to plan predictive maintenance interventions. The anomaly detection algorithm presented is based on the comparison between the measured and the predicted values of the AC power production. The model designed to predict the AC power production is based on an Artificial Neural Network (ANN), that is capable of estimating the AC power production using solar irradiance and PV panel temperature measurements, and that is trained using a dataset previously gathered from the plant to be monitored. Live trend data coming from the PV system are then compared with the output of the model and the vector of residuals is analyzed to detect anomalies and generate daily predictive maintenance alerts; there residuals are aggregated over 1-day and processed to detect out-of-threshold samples and system degradation trends; these trends are extracted by computing the Triangular Moving Average (TMA) where the window size is automatically determined. The paper also reports experimental data results revealing that the model leads to a good anomaly detection rate, which is measured as a positive predictive detection rate greater than 90%. Moreover, the algorithm is able to recognize trends of system's deviations from normal operation behavior and generate predictive

*Corresponding author
Email address: messina@dmi.unict.it (Fabrizio Messina)