# *SHORT-TERM ENERGY FORECASTING SYSTEM FOR A PHOTOVOLTAIC POWER PLANT INSTALLED IN SOUTHERN ALGERIA: OUED NECHOU*

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## Overview

Photovoltaic (PV) systems have the ability to preserve the economy and the environment in order to provide permanent energy to networks. On the other hand, when these PV systems have many variables, whether low or high, the unpredictability of the solar energy source is a particular problem in grid management. In this regard, photovoltaic forecasting is an important tool for managing uncertainty and ensuring system stability. In this work we present a robust forecasting model, based on mathematical methods, that aims to provide an estimate of the output power of PV farms for forecast horizons of less than 1 hour. This will allow the manager to better manage his electricity grid in the future by facilitating the integration of the solar energy supplier.

## Methods

The objective of this research is to evaluate the possibility of increasing the performance of PV power forecasting for a half-hour step. Predicting the random characteristic of hourly PV power with high accuracy is a very difficult problem. In this regard, a new hybrid prediction model is developed. The proposed model is mainly based on Gaussian Process Regression (GPR) as an essential predictor and the use of the CEEMDAN (Complete Ensemble Empirical Mode Decomposition with Adaptive Noise) decomposition method. ) as a preprocessing technique. In the following topic and in subsequent sections, for simplicity, the suggested model will be referred to as CEEMDAN-GPR [1,2].

## Results

The performance achieved with the use of our proposed method CEEMDAN-GPR with the endogenous variables CEEMDAN-GPR shows the reliability of the latter compared to the use of the single GPR model in the exogenous or endogenous case, the numerical results of the prediction of the output of the PV system in terms of R and the prediction errors shows that the hybridization of the CEEMDAN decomposition method with the GPR model improves the prediction performance of the GPR model with a significant reduction in the prediction error.The results showed the significant effect of the combination used on the accuracy of the CEEMDAN-GPR models. To demonstrate the accuracy of the CEEMDAN-GPR model, its predictions are compared to the classical model (GPR).

A comparison of the hourly PV power values predicted by the CEEMDAN-GPR hybrid model and its measured values is carried out. From these figures, it can be seen that the CEEMDAN-GPR {PV1…10} model has shown its effectiveness for the prediction of PV power and its outputs are in agreement with the observed values [3].

The results showed a significant improvement in the performance of the CEEMDAN-GPR model appearing in the statistical indices (see Table. 1,Fig.1)

Table 1. PV power prediction results by CEEMDAN-GPR hybrid model and GPR conventional model.

| **Model/Input** | **RMSE (Kw)** | **nRMSE** | **R(%)** |
|---|---|---|---|
| GPR {PV-1} | 127.69 | 27.31 | 88.23 |
| GPR {Pr -1- Pr -10} | 293.61 | 62.81 | 16.64 |
| GPR {Hum -1- Hum -8} | 280.84 | 60.07 | 39.22 |
| GPR {V-1- V-4} | 300.73 | 64.32 | 3.3 |
| GPR {PV/Pr} | 127.46 | 27.26 | 88.25 |
| **GPR{T-1- T-8}** | **183.16** | **39.18** | **89** |
| **CEEMDAN-GPR {PV$_{-1}$}** | **90.92** | **20.94** | **93.09** |

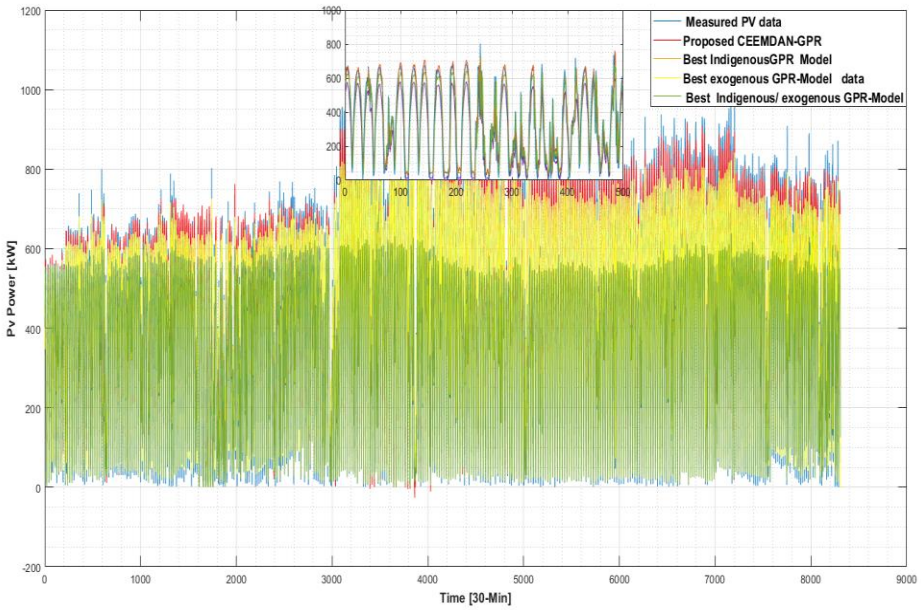


Figure 1. The PV power measured against the best estimated by the different sets.

## Conclusions

The conventional model based on the GPR model was used and allowed the prediction of the time series of photovoltaic power on an hourly scale from that of meteorological data (exogenous variables) and PV data at the previous time (endogenous variables ) as inputs. The performances are such that the correlation coefficient is 89.17 and the rRMSE is 38.84% from the meteorological data (exogenous variables), and the correlation coefficient is 88.23 and the rRMSE is 27.31% from the data of the PV power at the time preceding the predicted day (endogenous variables) as inputs. These performances have improved by the introduction of the CEEMDAN decomposition algorithm to decompose the input data. Consequently, the rRMSE improves by 18% from the exogenous variables, the rRMSE improves by 7% from the endogenous variables. The proposed CEEMDAN-GPR hybrid model brought a significant improvement to the in situ hourly PV power.

## References

1. Mohguen, Wahiba. Améliorations de la méthode EEMD. Diss. 2018.
2. Lin, Jinshan. "Improved ensemble empirical mode decomposition and its applications to gearbox fault signal processing." International Journal of Computer Science 9.6 (2012): 194-199.
3. Guermoui, Mawloud, et al. "New soft computing model for multi-hours forecasting of global solar radiation." The European Physical Journal Plus 137.1 (2022): 162.