COMPARATIVE STUDY OF NONPARAMETRIC AND PARAMETRIC PV MODELS TO FORECAST AC POWER OUTPUT OF PV PLANTS

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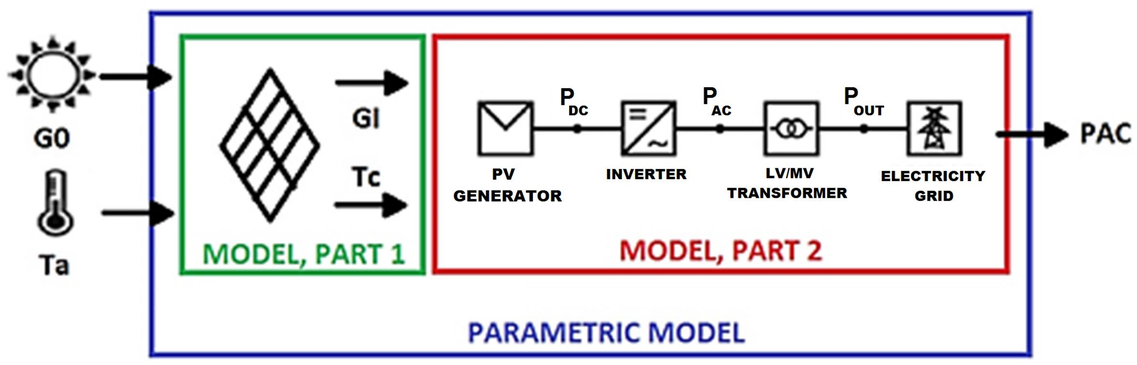
INTRODUCTION

The results of a comparative analysis of two PV models applied to AC power output forecast are presented, not to elect the "best" one, but to present their pros and cons. When selecting one of the approaches, not only the accuracy must be considered, but also the application and the variables and parameters available.

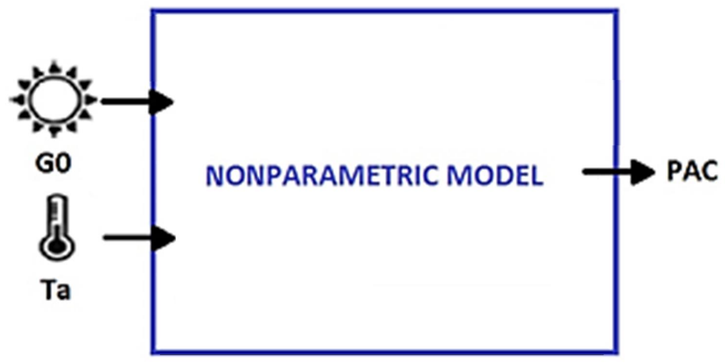
There are two approaches to model a PV system:

- The parametric:



A parametric modeling requires precise and detailed information about the characteristics and behavior of each relevant component of the PV plant. This information is not always available so some simplifications and assumptions are needed, with the subsequent uncertainty in the output of these models.

- The nonparametric:



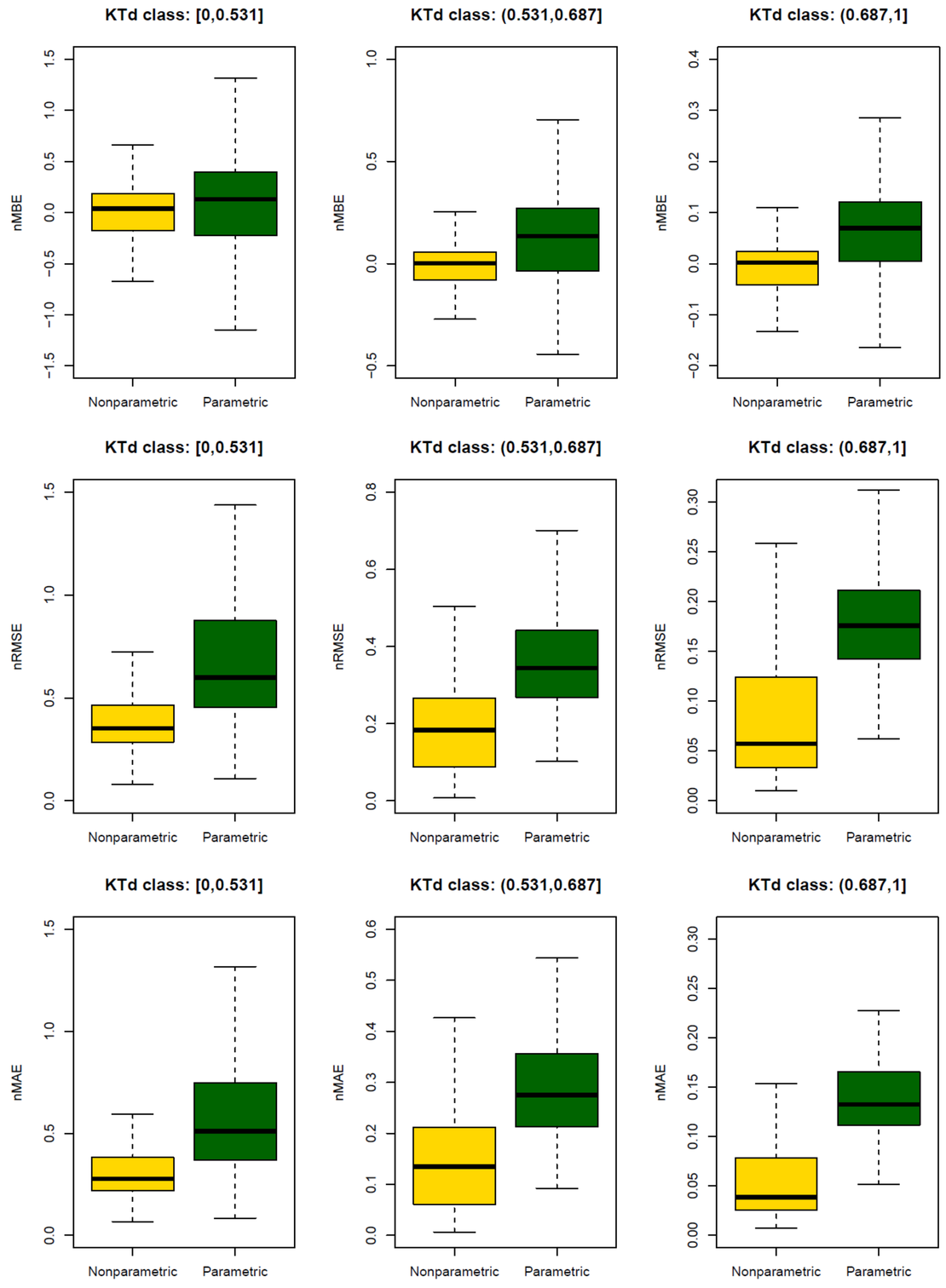
Nonparametric PV models use only historical time series of meteorological variables and AC power measurements, so its accuracy depends mainly on the quality of the data. This characteristic leads to its main disadvantage: the PV plant must exist and be operational for some time. One interesting advantage of a nonparametric model is the potential to compensate systematic errors associated to the inputs.

CONCLUSION

- The PV models used in this study have state-of-the-art statistical performance in terms of daily and hourly energy prediction.
- The two approaches presented similar performance, but the nonparametric is slightly better given the conditions of the study.
- Due to the machine learning tool the nonparametric approach is based on (Quantile Regression Forests), it presented low values for biased metrics (*nMBE* and *cvMBE*).
- The lower statistical performance of the parametric approach is expected due to the uncertainties and errors mainly related to the quality of the input variables (weather forecasts), which can be partially suppressed by the machine learning tool used in the nonparametric approach.
- Daily energy production is forecasted with a weighted *cvMBE* of less than 5%. Considering only the nonparametric model, this statistic is below 2% for cloudy days and it is virtually none for clear days.

STATISTICAL COMPARISON

The study was based on real AC power measurements from a 45.6 MWp PV plant situated in southern Portugal. It has an azimuthal one-axis tracker, with a receiving surface tilted 45°.



Errors of energy production forecast weighted by the energy generated by the PV plant under the corresponding *KTd* class were also calculated:

Statistic	Approach	*KTd* class		
		[0, 0.531]	(0.531, 0.687]	(0.687, 1]
cvMBE	Parametric	2.90%	4.70%	3.40%
	Nonparametric	1.20%	0.10%	0.10%
cvMAE	Parametric	9.30%	9.00%	6.10%
	Nonparametric	8.70%	6.50%	2.20%

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