PROJECT DETECT
Diagnosis onlinE of sTate of health of EleCTric systems

ENERGY LAB

PV fault diagnosis method based on time series electrical signal analysis

8th International conference on Time Series and Forecasting

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Carole Lebreton*, Fabrice KBIDI*, Frédéric Alicalapa*, Michel Benne* and Cédric Damour*

*Energy Lab, Université de La Réunion, 15, Avenue René Cassin CS 92003, CEDEX 9, 97744 Saint-Denis, France;

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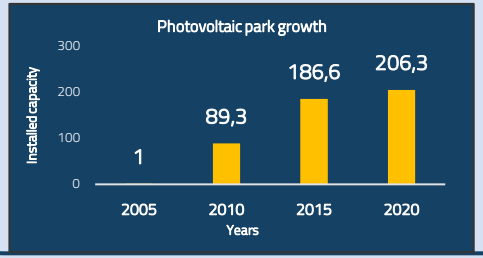
Context and Objectives

Context

Decarbonized energy mix by 2030 in Reunion Island. 31.3% of electricity production is from renewable sources in 2020.

Massive integration of intermittent energies into the power grid (growth of photovoltaic capacity).



Over 200MW installed in 15 years

- Effect of PV cell aging on performance
- Risk of failures increase
- Risk of loss in performance / profitability

DETECT Project

Validation of the developed method on **emulated systems**

Low-cost technologies

Real-time solutions without system shutdown

Development of fault diagnosis strategies for PV systems

Use of **meteorological and climatic variables**

no need for additional sensors in situ

Data traitement – time series decomposition

Step 1 :

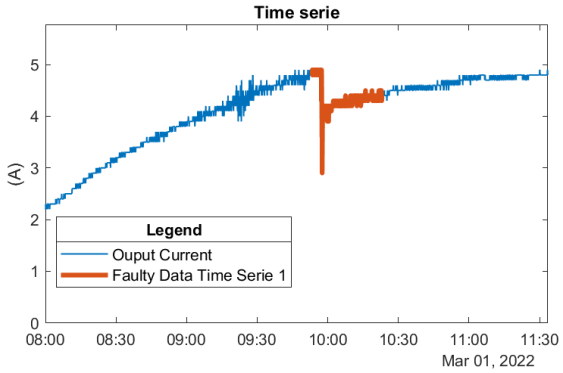
- Identification of measured variables sensitive to faults occurrence

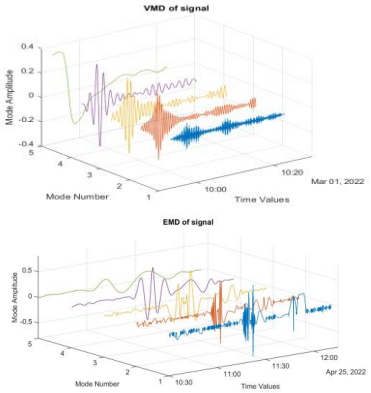
Step 2 :

- Selection of the most suitable tools to highlight the symptoms (data processing)

Step 3 :

- Diagnosis based on the symptoms interpretation





Signal-based Diagnosis Method → Decision-making system

Experimental platform

- 2 PV strings :
  - one faultless PV line (reference)
  - one PV array for fault generation (tests)

- A reference radiometric station (CR1000):
  - pyranometer for irradiance control: SPN1 - Delta-T Devices
  - ambient temperature sensor: Thermocouple type T - TC SA
  - PV temperature sensor (test array): Thermocouple type K - TC SA

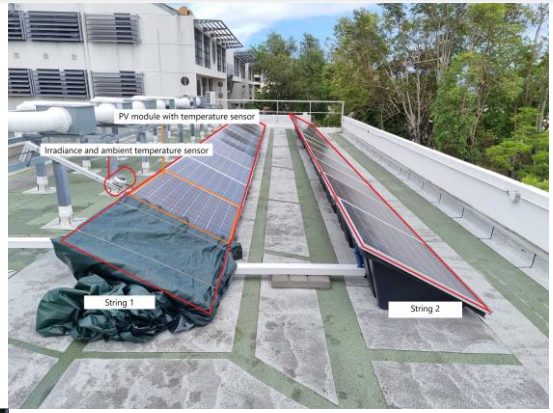
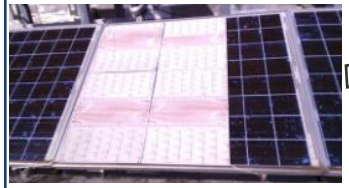


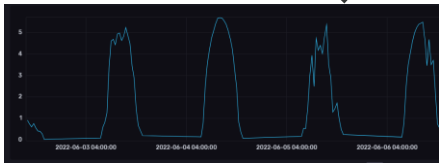
Figure : PV array and fault experimental setup (partial shading)

Algorithm presentation

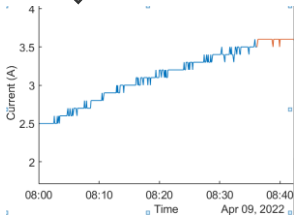
Data acquisition



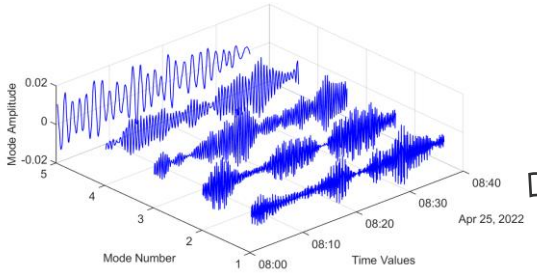
Acquisition on InfluxDB platform



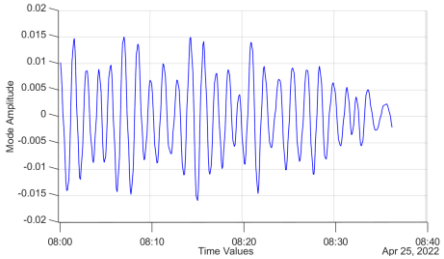
Inverter Output Current requested with MatLab©



Decomposition-based extraction, selection of the main IMF

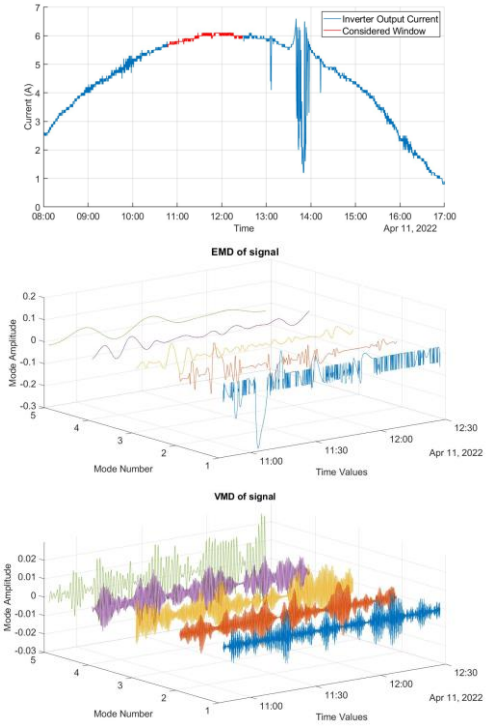


Intrinsic Mode Function (IMF) selection

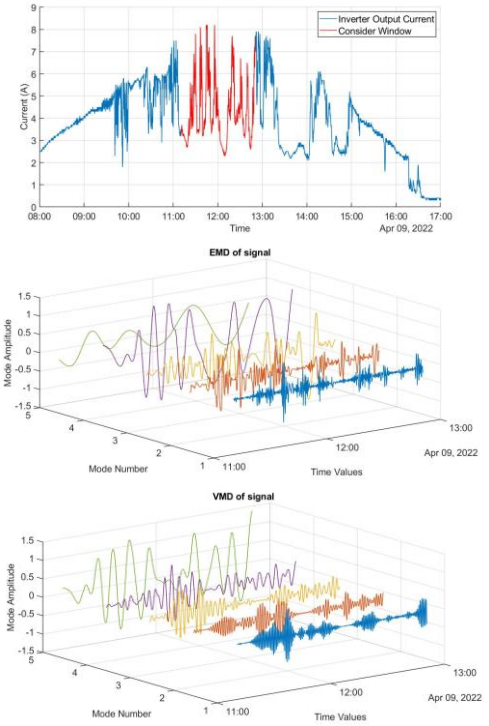


First results

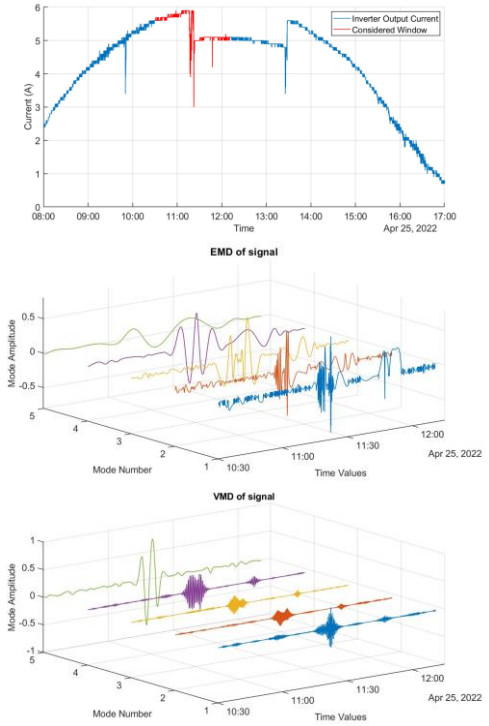
Clear sky day



Cloudy sky day



Faulty conditions: partial shading



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Conclusion and perspective

Conclusion

- Test of EMD and VMD approaches on:
  - clear sky condition,
  - cloudy sky condition,
  - Partial shading faulty condition.
- First results confirmed on a set of experimental data.
- EMD and VMD promising for low cost PV fault diagnosis (proof of concept).

Perspective

- Selection of the most significant IMF and indicators development for fault isolation and diagnosis.
- EMD and VMD performances comparison.
- Transposition of the developed strategies to other types of faults.

THANK YOU FOR YOUR ATTENTION

Contact :

Fabrice Kbidi, Research engineer, Emulation and Implementation, Project Manager, fabrice.kbidi@univ-reunion.fr

Carole Lebreton, Research engineer, Diagnosis, carole.lebreton@univ-reunion.fr

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