GPVS-Faults: Experimental Data for fault scenarios in grid-connected PV systems under MPPT and IPPT modes

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Overview

The provided Grid-connected PV System Faults (GPVS-Faults) data are collected from lab experiments of faults in a PV microgrid application; There are 16 data files, each file corresponds to one experiment scenario. The scenarios include photovoltaic array faults, inverter faults, grid anomalies, feedback sensor fault, and MPPT controller faults. The faults have various levels of severity. The data files are available in MATLAB '.mat' format and also in '.csv' format. The provided data can be used for research purposes to design, validate, compare, and analyse various algorithms of fault detection, diagnosis, and classification for PV system protection and reactive maintenance.

System/ Experiment/ Data description

The faults were introduced manually halfway during the experiments. The high-frequency measurements are noisy. There are disturbances during and between the scenarios. There are variations of temperature and insolation during and between the experiments. During scenarios of critical faults, the operation is interrupted and the system may shut-down; the challenge is therefore to detect and diagnose the faults before they lead to such a total failure. Besides, MPPT/IPPT modes have adverse effects on the detection of low-magnitude faults.

We refer interested researchers to read and cite the following references for detailed descriptions of:

- Fault scenarios, their experiments, and GPVS-Faults data collection procedures are well-described in [1], [1] also provides the first results for comparisons.
- System description and settings, energy management system, control and communication structure of the main grid-connected system are detailed in [2].
- The description of the static multiblock version of the fault detection algorithm was presented in [3].

References:

[1]. A. Bakdi, W. Bounoua, A. Guichi, S. Mekhilef, (2020). Real-time fault detection in PV systems under MPPT using PMU and high-frequency multi-sensor data through online PCA-KDE-based multivariate KL Divergence. International Journal of Electrical Power & Energy Systems.

[2]. A. Guichi, A. Talha, E. M. Berkouk, S. Mekhilef, S. Gassab, (2018). A new method for intermediate power point tracking for PV generator under partially shaded conditions in hybrid system. Sol. Energy. 170, 974-987. https://doi.org/10.1016/j.solener.2018.06.027.

[3]. A. Bakdi, W. Bounoua, S. Mekhilef, L. M. Halabi, (2019). Nonparametric Kullback-divergence-PCA for intelligent mismatch detection and power quality monitoring in grid-connected rooftop PV. Energy, 116366. https://doi.org/10.1016/j.energy.2019.116366.

Data structure

The GPVS-Faults data files are organised and labelled as "Fxy", where:

- $x \in \{0, 1, \dots, 7\}$ represents the fault scenario, where:
  - $'0'$ stands for fault-free experiment. This can be used for training.
  - $'1', \dots, '7'$ are the seven types of faults conducted in the experiments.
- $y \in \{'L',\ 'M'\}$ represents the operation mode during which the experiment was conducted, where:
  - $'L'$ stands for Limited power mode (IPPT)
  - $'M'$ stands for Maximum power mode (MPPT)
- For example, "F4M" is a data file for an experiment including a fault F4 during MPPT mode, and "F1L" includes fault F1 during IPPT mode.

Each data file includes the following columns:

- Time: Time of real measurement in seconds. The average sampling is $T_s = 9.9989\ \mu s$.
- Ipv: PV array current measurement.
- Vpv: PV array voltage measurement.
- Vdc: DC voltage measurement.
- ia: Phase_A current measurement.
- ib: Phase_B current measurement.
- ic: Phase_C current measurement.
- va: Phase_A voltage measurement.
- vb: Phase_B voltage measurement.
- vc: Phase_C voltage measurement.
- Iabc: Positive-sequence estimated current magnitude.
- If: Positive-sequence estimated current frequency.
- Vabc: Positive-sequence estimated voltage magnitude.
- Vf: Positive-sequence estimated vurrent frequency.

Hint: The ".mat" data files are stored in tables, where the columns represent the above variables which can be accessed through the "." operation. For example: >>load('F7M.mat'); summary(F7M); plot(F7M.Time, F7M.Vdc);

Contact

For questions or requests, please contact the authors of [1].