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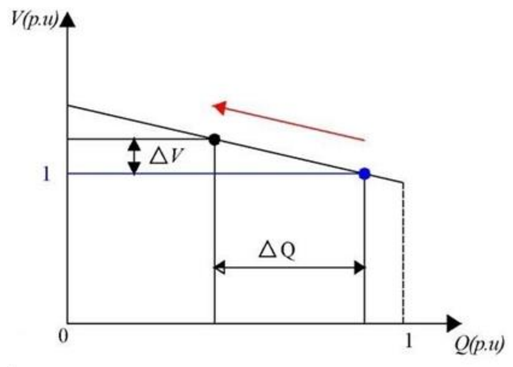
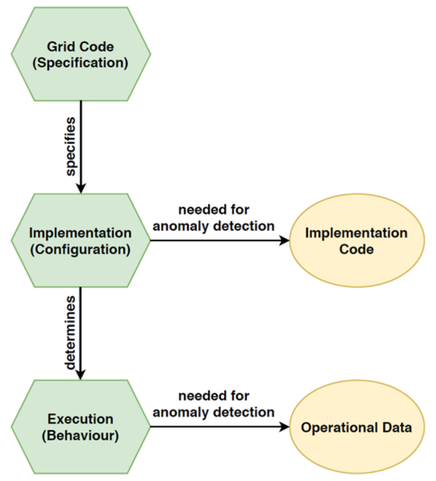
DATA DRIVEN DETECTION OF MALFUNCTIONS IN POWER SYSTEMS

BACKGROUND AND MOTIVATION

- Power grids need to be reliable and to work within specified limits
- Grid operators (DSO) need to surveil decentralized grid connected devices
  - Photovoltaic (PV) inverters on the Low Voltage (LV) level
  - Energy storage systems
  - Ideally only use operational data





Control functions of PV inverters (top) & definition of operational data (right)

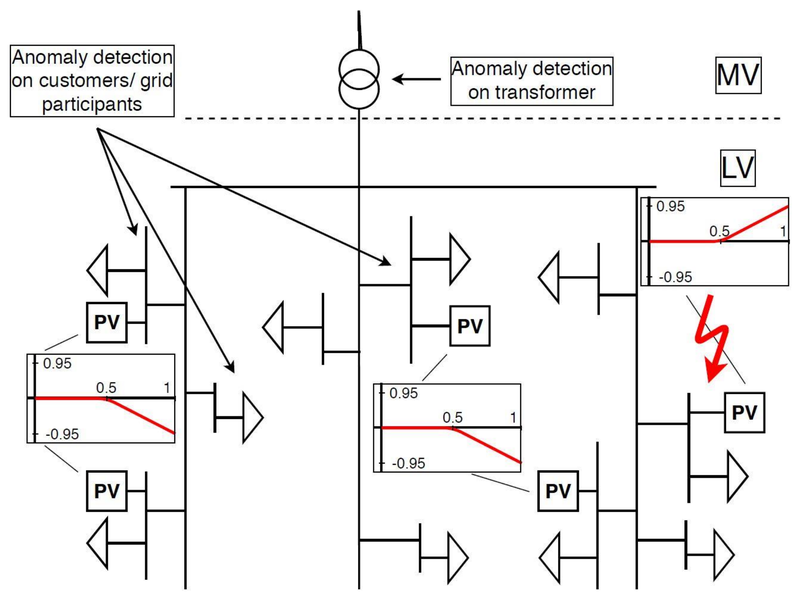
PROPOSED APPROACH

Requirements & Goals:

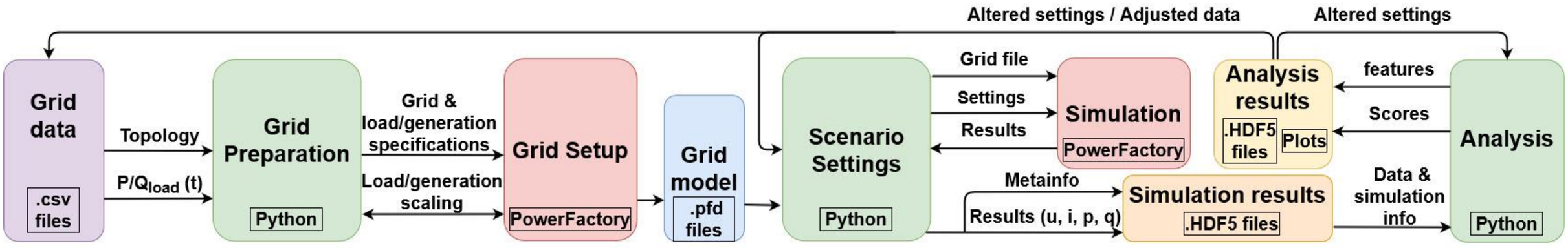
- Data driven detection and classification of anomalies
- Development of a complete architecture for monitoring of grid connected devices
- Detection of misconfigurations

Method & Scenario:

- Synthesising necessary data using grid modelling software
  → yearlong simulation including a malfunction



Set-up for anomalies to be detected in a power grid



Framework used for development

PRELIMINARY RESULTS

Voltages of terminals plotted against each other (left):

- X component: voltage of the one terminal; Y component: voltage at another terminal at one point during simulation
- Change in correlation is a potential feature for detection > Less correlation leads to bigger 2nd PC

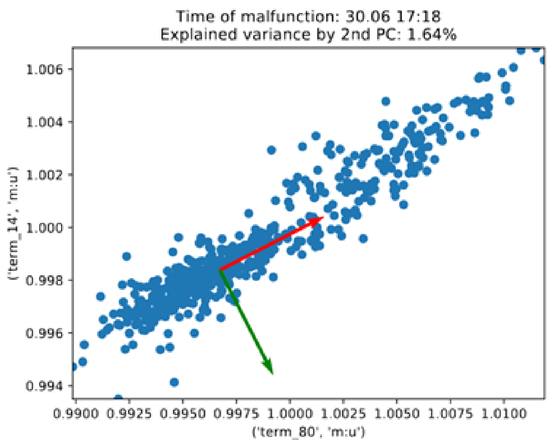
Feature: 2nd Primary Component of data of last 24h of most correlated term (right): GP trained with data before point in time (blue), prediction made for time after (red) used for detection

CONCLUSIONS

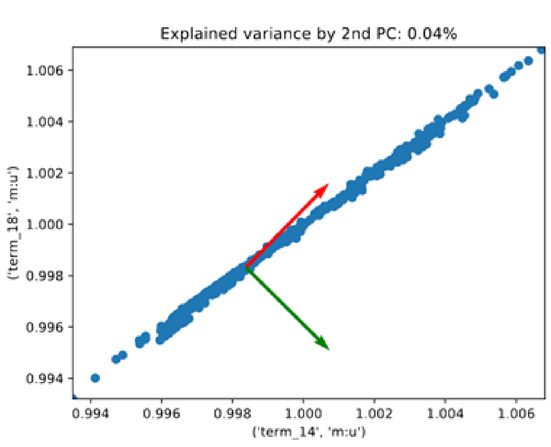
- Multi-stage malfunction detection approach incorporating multiple machine learning techniques applied on operational data as well as data mining
- Current Challenges: Exploration of features, Refine methods (GP Kernels…), Pretrain ANN
- Future Work: Variation of use cases / grids…, Classification, Disaggregation

Primary Component Analysis:

Malfunctioning vs regular term.:

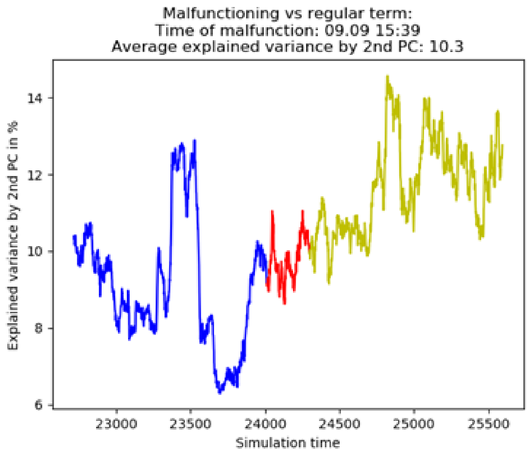


Regular vs regular term.:

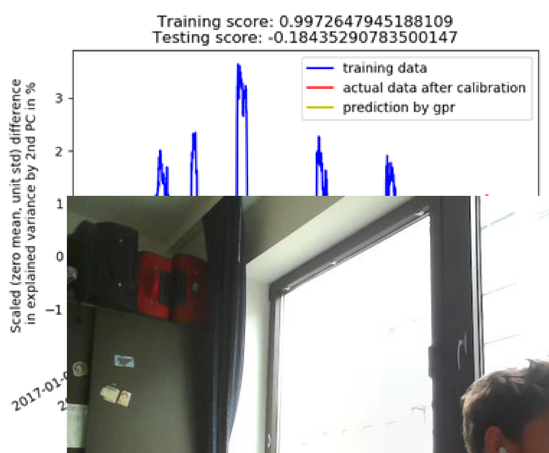


Gaussian Process Modelling

2nd PC before and after mlfct.:



2nd PC learnt & predicted:



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