Generating Residential PV Production and Electricity Consumption Scenarios via Generative Adversarial Networks

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Why generating PV and load scenarios?

- Analysis, modelling need sufficient PV and load data
- Hard to get enough data
- Forecast or extrapolation?
Solution

A model to estimate the data distribution of solar and load data
PV and consumption scenario generation

- **Existing methods:**
  - Copula Models
  - Fourier series and autoregressive moving average (ARMA) models

- **Problems:**
  - Certain statistical assumptions required
  - Convergence could be slow
  - Hard to scale in high-dimensional spaces
Generative Adversarial Networks

- Generative Adversarial Networks (GANs) is a type of machine learning model called Generative Model.
- A Generative Model describes how data is generated.
- Adversarial: A two-player game.
Generative Adversarial Networks (GANs)

Fake paintings

Forger

Paints

Real paintings

Investigator
The Forger is trying hard to trick the investigator

The Investigator is trying hard not to be cheated

In GAN,

Forger = Generator
Investigator = Discriminator
Generative Adversarial Networks (GANs)

(Real paintings) Training set

(Random noise) (Paints)

(Forger) Generator

(Fake image) (Fake paintings)

(Investigator) Discriminator

Real
Fake
Deep Convolutional Generative Adversarial Networks (DCGAN)

- Generate 5 minute PV generation and consumption power data
- 288 data points for each generated sample (one day)
- 80% for training, 20% for testing
Data Normalisation

- PV: rated DC power
- Consumption: peak load power
- Generate data conditioned on PV size or peak load demand
5 minute PV generation power

Test Data

GAN generated data

Train Data

Power (W)

0 200 0 200 0 200 0 200 0 200

4000 3000 2000 1000 0

4000 3000 2000 1000 0

4000 3000 2000 1000 0

4000 3000 2000 1000 0

4000 3000 2000 1000 0
5 minute consumption power
Cumulative Distribution Functions (CDFs) of generated data
More in the paper...

- Comparison with a Variational Autoencoder
- Case Study: Conditional GAN
Questions?