Shell.ai Hackathon for Sustainable and Affordable Energy

AI Solar Power Prediction Challenge

Problem Statement

SIGN UP NOW

shell.com/hackathon

Powered by:

Microsoft NVIDIA OpenACC NIRMAAN SINE

Shell.ai Hackathon for Sustainable and Affordable Energy

AI SOLAR POWER PREDICTION CHALLENGE: PROBLEM STATEMENT

Introduction

Tackling climate change is an urgent challenge. Shell is transforming to become a net-zero emissions energy business by 2050, in step with society and our customers. We are exploring new opportunities to provide more low-carbon energy such as biofuels, hydrogen, charging for electric vehicles and electricity generated by solar and wind power. To achieve this, we are working collaboratively on early-stage ideas with the potential to impact the future of energy.

Solar power is one of the fastest growing renewable energy sources. Global solar photovoltaics (PV) generation is now almost 3% of the total electricity mix and will increase by 15% annually, from 720 TWh in 2019 to almost 3,300 TWh in 2030.[1]

However, the major challenge with solar PV power production is its intermittency caused by variable weather conditions. Cloud coverage can cast shade over the solar farms in a few minutes and significantly reduce power production. Other factors such as ambient temperature, humidity, and wind speed can also affect the PV temperature and power output. Since grid operations management is based on a delicate balance between the supply and demand, any uncertainty in energy production (or consumption) could pose a risk to a grid network.

Predicting the intermittency in advance can be of tremendous value, in the following ways:

1. Grid operators can schedule deferrable loads to run on clean solar power, increasing the overall share of clean power in the energy mix.
2. Producers don't have to sell energy at a low or negative price, having sufficient incentive to run a solar business.

Cloud coverage remains one of the big risk factors. For example, opaque clouds over the solar farm could reduce the power output by 50-80% in a short interval., causing severe network failures.[2] One way of mitigating this risk requires an accurate prediction of solar irradiance by modelling cloud behavior. Therefore, in this hackathon we are asking you to predict solar irradiance for short timescales of up to 120 minutes using data driven models to improve the robustness of the grid.

Problem Statement

The main challenge is to forecast solar irradiance for a specific region of interest given local weather conditions and sky camera images. The problem is divided into 2 levels. As irradiance has high correlation with the cloud coverage the first level of the hackathon is to forecast cloud coverage. In the second level, you will be asked to tackle the complex challenge of predicting solar irradiance to improve the quality of short-term power forecasts.

LEVEL 1

Predicting cloud cover in a short time span of 120 minutes is very challenging. On this time scale, changes in local cloud cover are driven by a combination of dynamical and physical parameters such as wind speed, wind direction sea-level pressure, humidity and temperature over the asset of our interest. Short interval cloud cover prediction requires accurate estimates of cloud motion and presence using weather data and sky camera images or physics-based weather models, or a combination of both. In this level, you are expected to predict the total cloud coverage as a percentage of the open sky for a fixed field of view at 4 horizon intervals of 30, 60, 90 and 120 minutes from a 6-hour window of historical data. You will be provided with the following data:

Train set:

1) 1-year raw sky camera images [3] at 10 - minute frequency
2) 1-year local weather data [3] at 1- minute frequency

Sampling Frequency:

Sampling the data is part of the challenge. Consider the following:

1) Sample frequency to be consistent with forecast horizon.
2) Since weekdays and weekends may have different distributions, consider your training set carefully.
3) Balance your dataset throughout the year.

Test set:

You will be provided with 300 sets of test data, distributed over a year . The test set will have the same format as the training data. Each test set consists of the following:

1) A set of images from the same camera at a 10-minute frequency, covering a time span of 6 hours.

2) Weather information at 1-minute frequency, covering the same 6-hour window

Submission:

Participants are requested to submit four predictions for each problem set:

1) Percentage of total cloud cover estimated in the next 30 minutes

2) Percentage of total cloud cover estimated in the next 60 minutes

3) Percentage of total cloud cover estimated in the next 90 minutes

4) Percentage of total cloud cover estimated in the next 120 minutes

Kindly submit the results in sample csv format provided.

Evaluation:

The metric to evaluate the performance of the solution will be MAD (Mean Absolute Deviation). The output of your level 1 results can directly impact your level 2 output so make sure you think about the overarching aim of this exercise.

LEVEL 2

In this level we move to the next part of the challenge – predicting the solar irradiance. More information related to this will be shared in due course of time.

References:

1. IEA report 2020
2. Shell internal research
3. NREL

Schematic :