Analysis and Optimization of Wind Turbine Power Generation Using Supervisory Control and Data Acquisition(SCADA) Data: Exploring the Impact of Wind Speed and Direction on Performance

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Description of the Dataset

Source of Data:

The data originates from Kaggle, specifically from the dataset titled “Wind Turbine SCADA Dataset” uploaded by the user Berker İsen. This dataset is publicly accessible. The dataset includes SCADA (Supervisory Control and Data Acquisition) data collected from wind turbines, which is commonly used for monitoring and managing wind turbine operations.

Data Generation:

In Wind Turbines, SCADA systems measure and save data like wind speed, wind direction, generated power, etc., for 10-minute intervals. This file was taken from a wind turbine’s SCADA system that is working and generating power in Turkey.

Format and Contents:

The data is in a CSV file, making it accessible and easy to manipulate using standard data analysis tools. Key columns in the dataset include: Date/Time (for 10-minute intervals). LV ActivePower (kW): The power the turbine generates for that moment. Wind Speed (m/s): The wind speed at the turbine's hub height (the wind speed that the turbine uses for electricity generation). Theoretical_Power_Curve (KWh): The theoretical power values that the turbine generates with that wind speed are given by the manufacturer. Wind Direction (°): The wind direction at the hub height of the turbine (wind turbines turn to this direction automatically.

Research Objectives

Objectives:

Wind energy is a critical component in both large utility networks and small microgrids, providing numerous socio-economic benefits[1]. Two components specifically draw attention to wind power generation: wind speed and wind direction[2]. In this study, we focus on the potential impact on Wind Turbines and relationships between the main variables in a wind turbine SCADA dataset: LV ActivePower, Wind Speed, Wind Direction, and Theoretical Power. By understanding these relationships, we aim to gain the relationship between the natural wind conditions and the turbine's power output and identify potential optimization strategies for energy generation.

References