Power Consumption Forecasting using Deep Learning

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Overview

The power consumption prediction for industrial automation is very important in order optimize the machine functionality for better production rate and quality. To work on this use case, we have developed a motion system (representing a small part of the complex system) based on a linear axis with single carrier. The carrier (without load) moves horizontally within a limited range (back and forth over) at different speed in different motion pattern (continuous or step motion).

Dataset

The dataset includes thousands of data points (power consumption) respective to various speed and type of motion. All the data points are collected with a time interval of 10 ms. The data points are not time stamp based rather It's a series (associated to a particular speed) representing the power consumption of the drive system based on two different motion patterns of the carrier:

1. Continuous motion pattern
2. Step/Discrete motion pattern

There are two separate datasets for each motion pattern including 45,000 data points. Both datasets include 20 series of power consumption respective to various speed. i.e. ***Pow_500*** represents power consumption of the drive system while carrier is moving at speed of 500 RPM (rotation per minute). The data is very clean and natural that means, it has not been normalized / scaled / sampled. No limitations to normalization / scaling algorithms. You can sample the data if you need (to remove the redundant data points) but keep sampling rate as small as possible.

**(Note: There is no any additional dataset. So make sure to use the data for train/test/validation etc. as per your requirement)*

Datafiles

- ContinousMotion_Data_Horizontalsetup.xlsx (power consumption data related to continuous motion pattern)
- DiscreteMotion_Data_Horizontalsetup.xlsx (power consumption data related to discrete motion pattern)

*******There are two additional data files related to vertical setup of the linear axis (refer bonus challenge for more details)*

Challenge

The challenge is to make best use of the data to train a model which can forecast the future power consumption based on past / present power consumption.

The challenge acceptance criteria are as follows:

1. Deep learning algorithms
2. Multiple input - Multiple output (future prediction) strategy
3. Best forecast possible (as close as possible to expected result)

Bonus Challenge

Among several possible orientation of the linear axis, we have focus on horizontal setup. We also have another set of data related to vertical setup. The orientation of the linear axis does not affect any machine functionality except the consumption patterns because of gravity on the carrier. The approach to the vertical setup data could be same as of horizontal setup data. We will be really happy to have a model which can be useful for forecasting the power consumption for both setup (horizontal as well as vertical).

Data Visualization

The challenge itself is easy and straight forward. The data does not need many efforts behind cleaning and preprocessing. The data pattern itself shows the categorical behavior. The power consumption respective to different speed, shows clear patterns which can be easily visualized using basic data visualization libraries i.e. *matplotlib, scikit learn etc.*

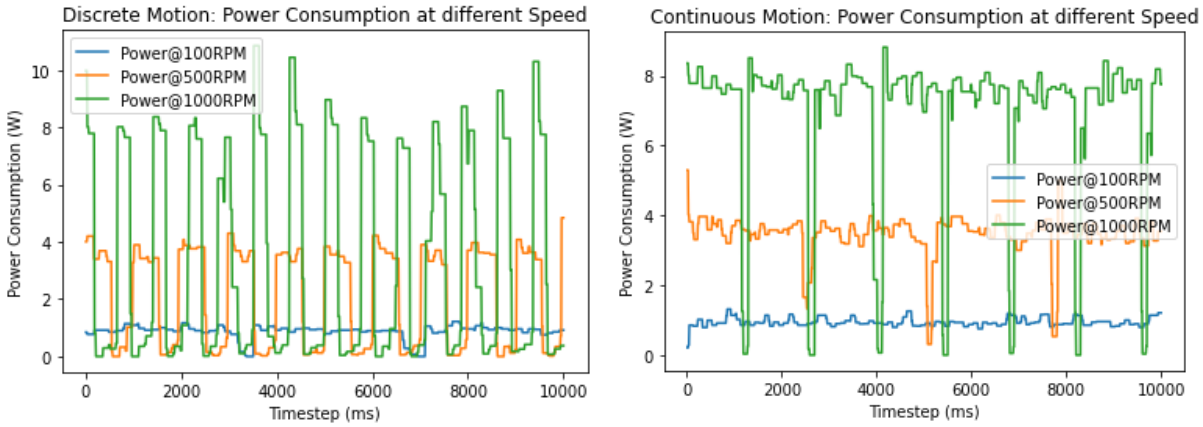

Figure 1: Power consumption patterns (horizontal setup), discrete motion (left), continuous motion (right)

Linear Axis setup

The power consumption data have been collected for two different orientation setup of the linear axis. All the machine configurations (in terms of hardware / software used), motion patterns etc, is same for both the setup.

a. Horizontal setup

Horizontal setup dataset includes 20 different series of power consumption, each of them related to a speed value ranging from 100 – 2,000 RPM. The effect of gravity on the carrier is homogenous irrespective of the motion direction (left / right).

b. Vertical Setup

Vertical setup dataset includes only 10 different series of power consumption, each of them related to a speed ranging from 100 – 1,000 RPM. The power consumption patterns in this this setup is a bit different. Because of the gravity effect on the carrier, the drive system consumes different amount of power while moving upward / downward. There is no any additional changes in motion patterns or data collection.