[PRD] Prediction

Note: this report summarizes the output that can be found on the Jupyter Notebook (`Phase2/src/PRD_Prediction.ipynb`) which also includes the source code in-line (html can be consulted). This report has been created with the sole purpose of meeting the requirement of 5 pages for the visual report.

Reference of this document

This note presents the results of using a Multi-Layer Perceptron (Fully Connected Neural Network) as prediction algorithm.
The document **PRD_Prediction_Wind_Power_Approach** explains the approach used and the results using a Linear Regression with Regularization, and this document presents the results of using a MLP.

1) Multi-Layer Perceptron

The same method using `GridSearchCV` and pipelines has been used, in this case though, using the object `MLPRegressor` from `scikit-learn`.
The pipeline scheme is (reminder from approach):

- Use PCA to reduce the input feature space to 12+2.
- Extrude with Polynomial features (degree 2)
- Apply scaling
- Predict, in this case using an MLP.

The input space for `GridSearchCV` for the MLP has been set to:

- Hidden Layers: either one hidden layer of 10 neurons, or two hidden layers of 25 and 10 neurons.
- Alpha (L2 penalty) of 1 or 1e-3.
- The activation unit is identity. This is not a choice since other activation units (RELU, tanh) give an output probability and are thus suitable only for classification tasks.

2) Results

2.1) Cross-validation results

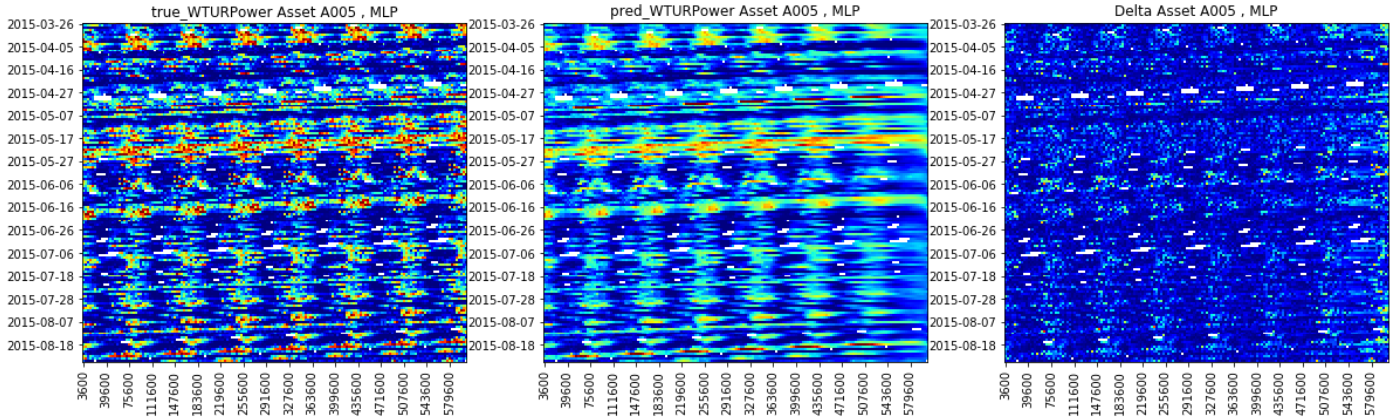
The results output by the cross-validation exercise:

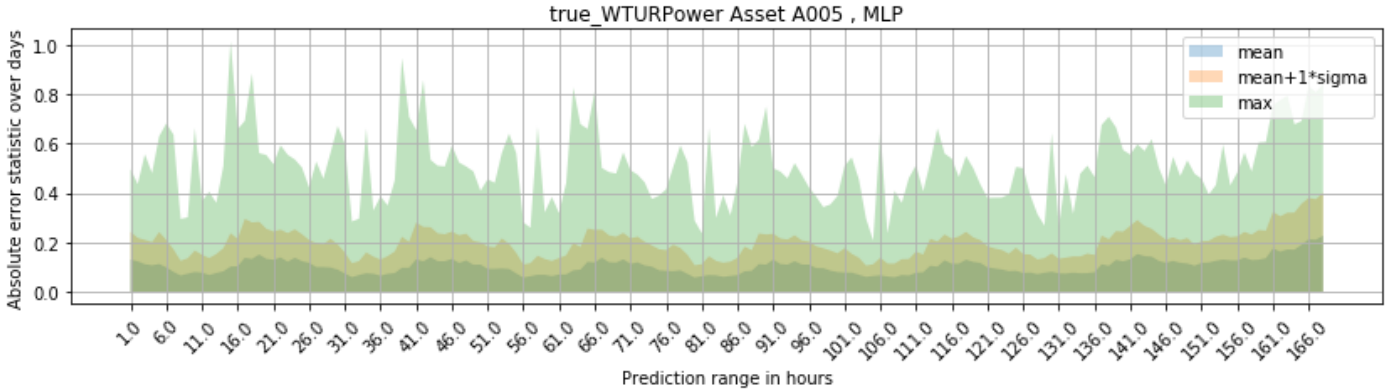
```
Best parameters: {'prediction__activation': 'identity', 'prediction__alpha': 0.001, 'prediction__hidden_layer_sizes': (25, 10)}
```

Meaning that no penalty and a more complex network delivers better results.

2.2) Training error

The training set, is the input set but keeping 5 days for the test. The error found is the following

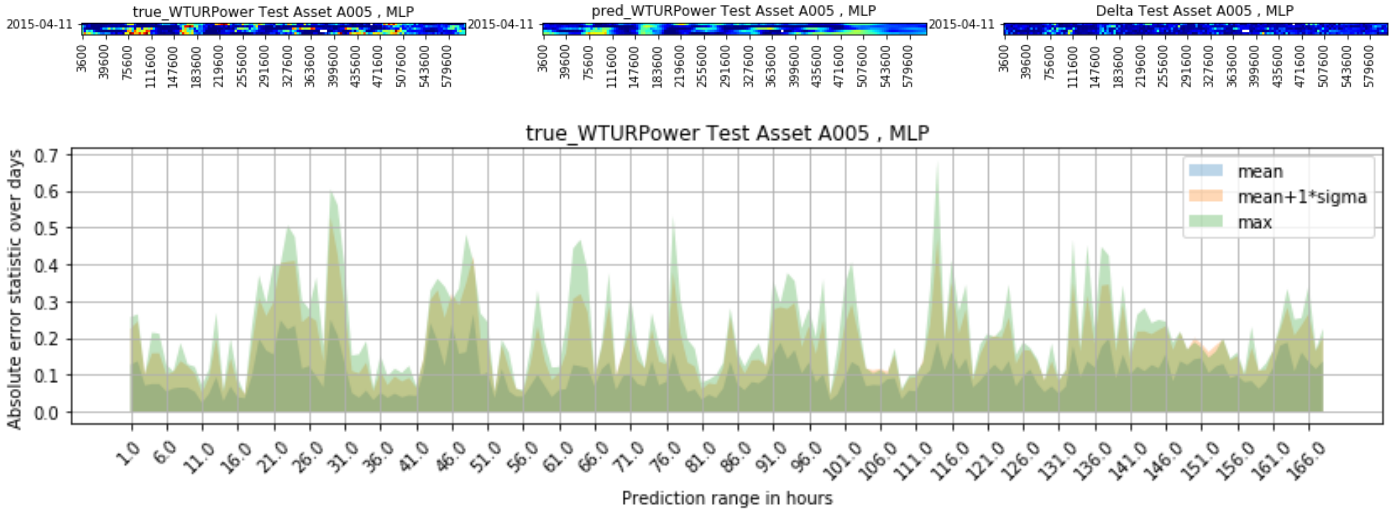





```
MSE error = 0.021689411839162346
R2 score = 0.6695563880732518
```

2.3) Test error

5 random days are keep for testing with the following output performance




```
MSE error = 0.020974849745353734
R2 score = 0.6338180479514872
```

3) Prediction of evaluation set

The prediction is done over the evaluation set, based on (reminder from approach):

- For each asset, the best parameters for an MLP are used to train an MLP over the full training dataset.
- The output (at 1h sampling) is interpolated at 10min sampling.
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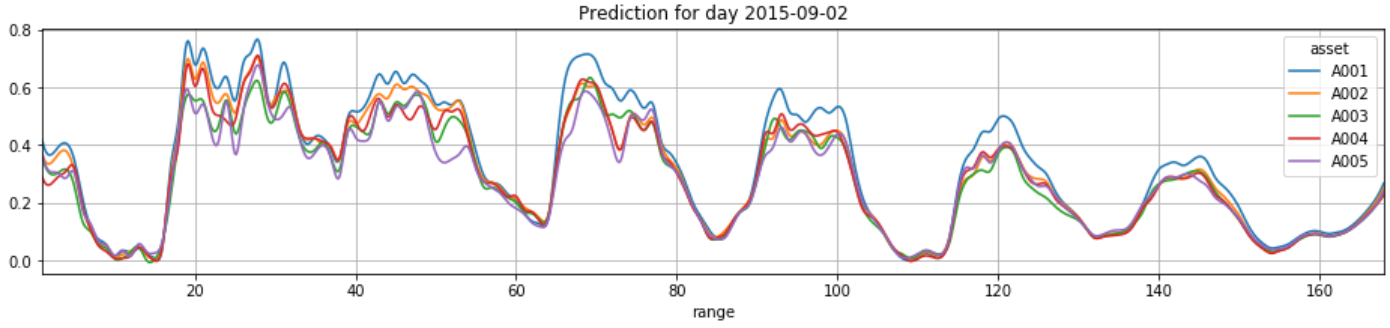
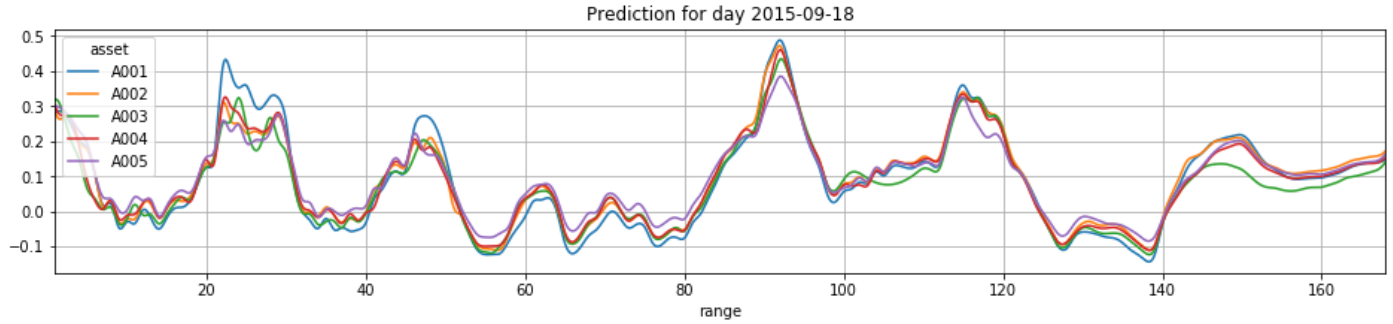
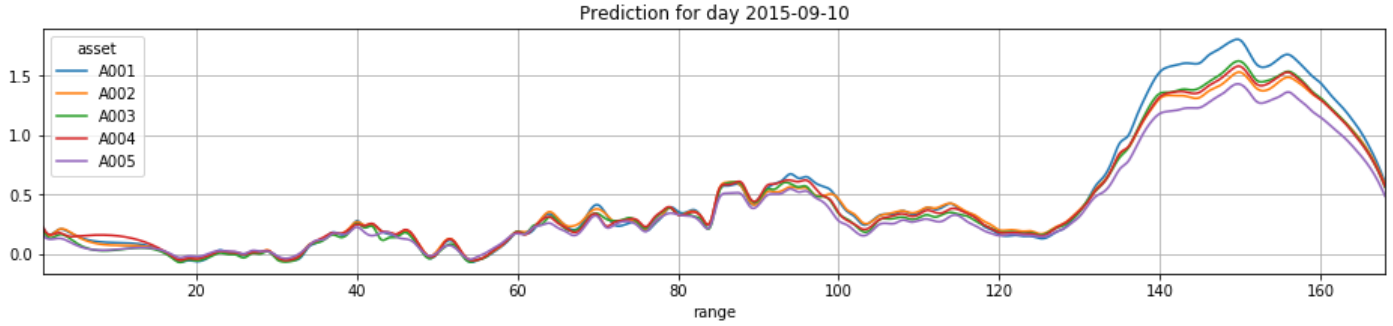
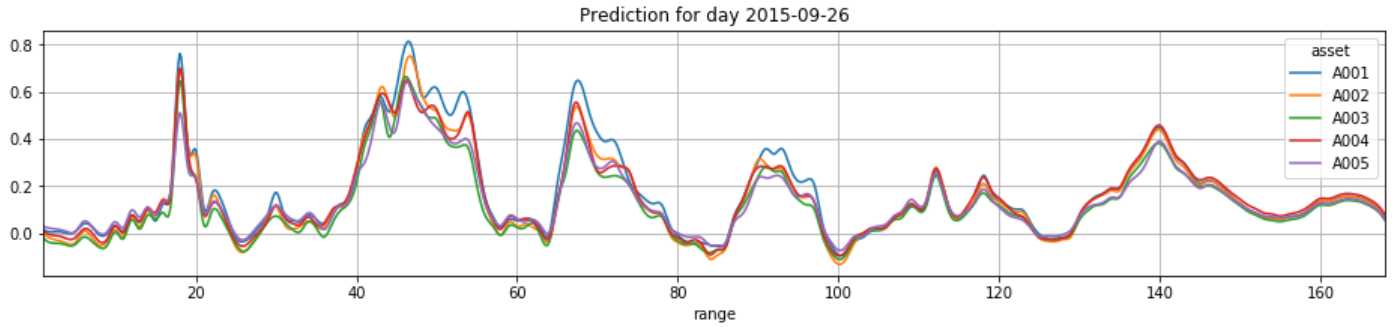
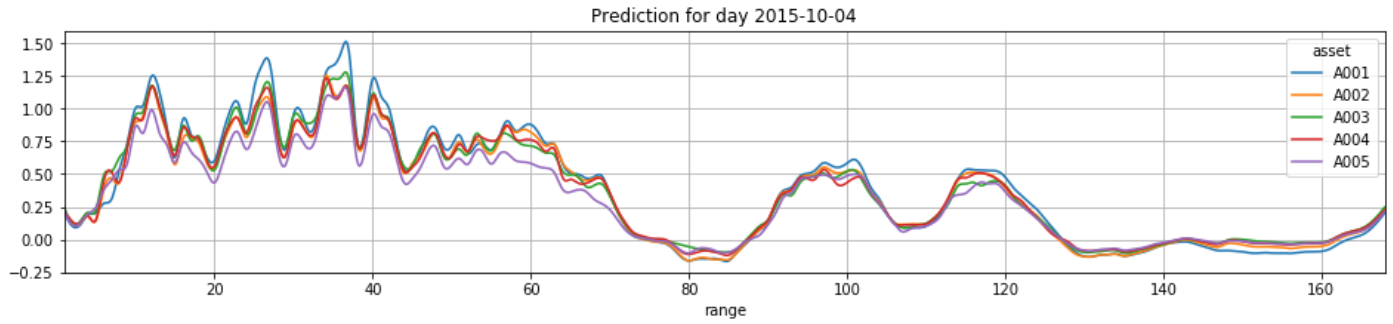
The following curves present the visualization of the output files

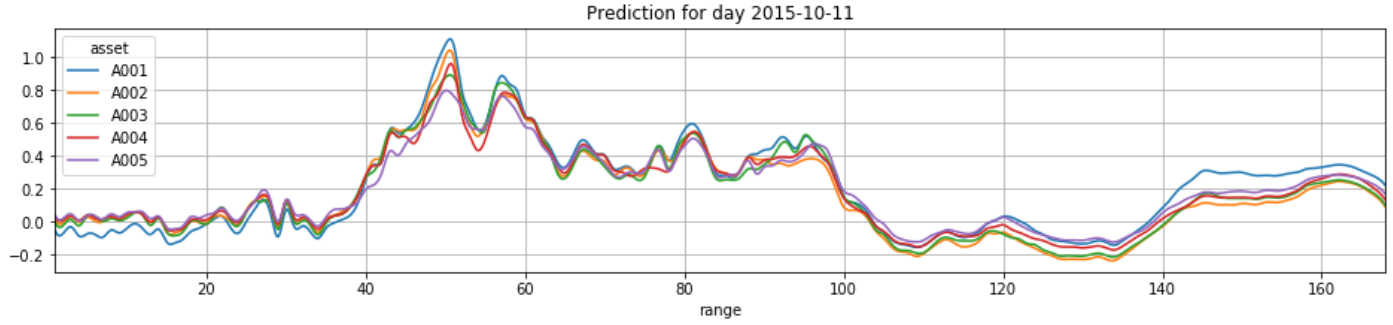












4) Conclusion

The performance of an optimized fully connected neural network is presented. The results are similar to the ones obtained by a simple Ridge regression.