

Online Performance Monitoring of PAT-based Process and Control



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Background

Applying novel process control concepts like model predictive control to steer a plant to an optimum performance requires:

- Excellent modelling approaches
- Reliable sensor technologies and
- A smart control strategy.

Additional to that an evaluation of the performance and the robustness of the installed system is crucial to ensure the expected benefit. Therefore an accurate performance monitoring system should be developed and installed in order to distinguish aging from weak control of the process and to validate if the system is on the best trajectory.

Results

For demonstration purposes data from an existing large scale production plant has been used.

An advanced control system based on a data driven model directly uses measured data from online sensors of the product quality.

The steps mentioned above have been applied and the following plots have been generated.

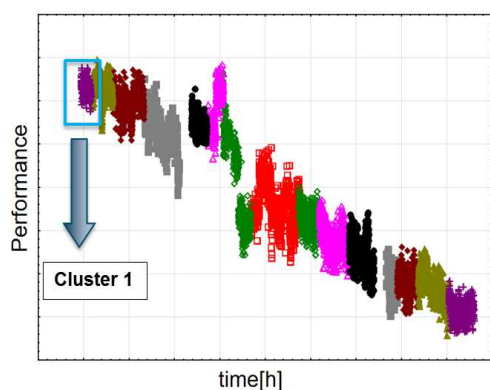


Figure 1: Result of the cluster analysis for the load shown as a time dependent performance curve

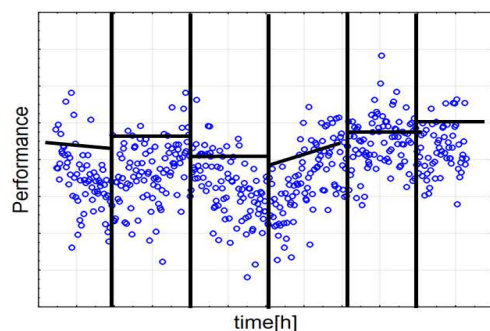


Figure 2: Sub clustering and cross validation to obtain expected best performance of Cluster 1 (cluster 1 is highlighted in figure 1)

Methodology

The algorithm of the performance monitoring methodology developed includes the following steps:

- Data pre-treatment
- Clustering of load levels
- Creating sub clusters to reduce aging effects
- Cross validation of the performance of the sub-clusters
- Derivation of a curve for the expected best performance for each cluster
- Evaluation of the distance between actual and expected performance

Finally the expected performance is compared to the actual performance which will be demonstrated online via a web-interface and an “alarm” signal depending on the discrepancy.

The performance of the plant can be thus easily monitored online.

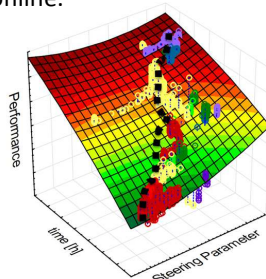


Figure 3: Overall expected best performance (black dots) with respect to actual performance

Conclusion/Outlook

The evaluation of the actual performance compared to the expected performance is an indicator:

- If the advanced control systems runs properly
- If maintenance is necessary either to adapt model parameters (e.g. training periods or parameter weights) or
- If a significant change of the model development is necessary.

Moreover, such a methodology could be applied in various other industrial applications where the most critical performance parameter of the process should be monitored.

References and Acknowledgements

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