ZDMP Blog

Surface Inspection

How common Surface Inspection leads to zero defect manufacturing

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Some questions for you

- Do you already use Surface Inspection sensors in your manufacturing?
- Do you wish to enhance the usage of these sensors to reach zero defect manufacturing?
- Do you want to have an easy user interface to display the data?
- Do you want to have an automated tool for the classification of defects?

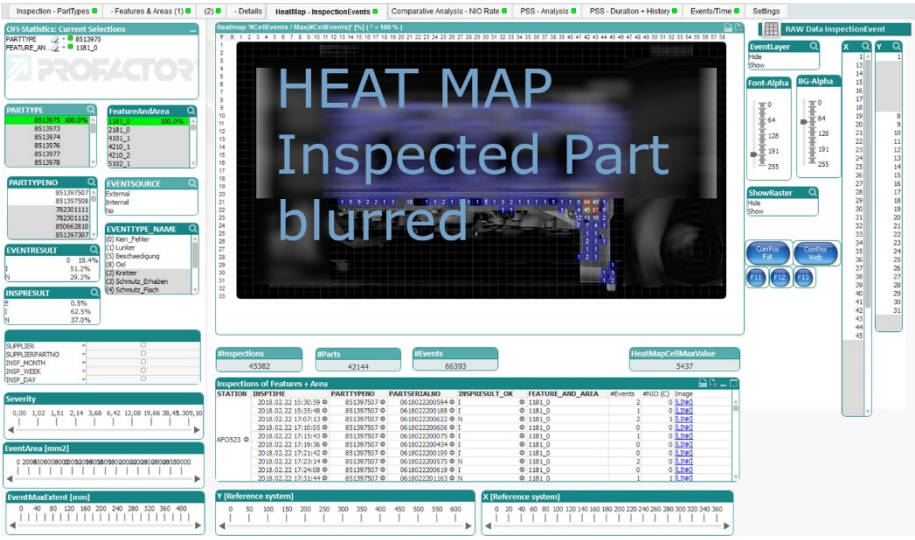
Inspection sensors everywhere

Today, Inspection sensors are used in nearly every production line, either as end-of-line tests or as intermediate quality control stations. For example, many automotive production plants use different kind of sensors (2D or 3D sensors, thermographic or x-ray…) in their daily production. The question after gathering the data is always the same: What can be done with this data?

In some cases, the data is then elaborated by a human worker, to look for anomalies or to check if the detected defects are really defects. However, this is not how this data can lead to a zero-defect manufacturing environment. Machine learning algorithms and supervision models can help to find anomalies or can classify defects. The automated detection of defects leads to advanced machine learning models which can then be used for zero defect manufacturing, a description of examples can be found in [1] and [2].

Intuitive Visualization of defects

In the production environment of FORD, surface inspection of motor blocks to find scratches and blow holes is conducted through a variety of 2D cameras. The amount of taken pictures is enormous. Due to this large and confusing amount of data, only a small part of the taken pictures are reviewed by human workers. What is needed is a visualization tool that digests all taken data – pictures and metadata – and fuses it together. The human worker can now easily switch visualisations and can choose which defect or which supplier they want to see. The tool can provide a statistical analysation of all taken defects connected to suppliers, weeks, inspected areas or dates. This analysis comes in a well-arranged view, see right-side of image.



The benefit of enhanced visualisation

Such a visualisation tool can provide statistical analysis for the worker and be extended to be an automated tool, which predicts defects before they become a quality problem. For example, the tool will be enhanced with machine learning algorithms that will alert the worker when the occurrence of a specific quality affecting defect reaches a certain threshold. The worker can react on that alert before scrap is produced. Mass evaluation of the data makes it possible to detect false positive results faster and to adjust the inspection algorithms accordingly. The classification of the defects provides useful information about who the cause of the defect is - eg Scratches are usually caused in the production line itself, while blow holes are usually caused by the supplier.

In the case of defects that are caused in the production line, the tool provides the worker with hypotheses about from which pre-processing machine the defect could have come, so that for instance the manufacturing tool can be changed before severe defects can occur. In the case of supplier-related defects, filtering the data enables a quality comparison of individual batches. Thanks to the improved data preparation of the statistics software, error data can be exchanged more efficiently with suppliers, who in turn can now improve their processes more quickly. This altogether enables much faster quality improvement cycles in Production.

What will ZDMP achieve

The visualization tool as described above will be integrated in the Process Assurance Run-Time component. This component is part of the software components of WP7, which has Process Assurance as main objective.

The main goal of ZDMP is to support the production industry to reach the goal of zero-defect manufacturing. The here described tool can help to reach this goal. During ZDMP the already existing tool will be developed further in the way that it can provide the prediction of defects. This prediction is a huge benefit for the manufacturer; it reduces the scrap rate significantly and means a load removal for the human worker. Another advantage of the use of this automated tool is the elimination of human faults in the classification of defects.

ZDMP Links

• Architecture Component(s)	Process Quality Assurance
• Work Package	WP7 – Process Quality Assurance
• Tasks	T7.4 Process Quality Assurance

References/Acknowledgements

[1] E. Lughofer, A.C. Zavoianu, R. Pollak, M. Pratama, P. Meyer-Heye, H. Zörrer, C. Eitzinger and T. Radauer, *Autonomous Supervision and Optimization of Product Quality in a Multi-Stage Manufacturing Process based on Self-Adaptive Prediction Models*, Journal of Process Control, 2019

[2] E. Lughofer, A.-C. Zavoianu, R. Pollak, P. Meyer-Heye, H. Zörrer, C. Eitzinger, T. Radauer, *On-line Anomaly Detection with Advanced Independent Component Analysis of Multi-Variate Residual Signals from Regression-Based Causal Relation Networks*, Information Fusion (Elsevier), 2018