BODY ASSEMBLY: OPTIMUM ATTACHMENT POSITIONS IN REAL TIME

Application for manufacturing industry - Optimizing process parameters by combining expert knowledge with machine learning (AI)

SUMMARY

The individual components of a car, especially the doors, must be perfectly positioned in order to meet the customers' expectations in terms of visual appearance and technical performance. For a perfect appearance, the gaps must be absolutely uniform. Yet variations in raw materials and changing circumstances mean that the optimum attachment position is not always constant. By combining expert knowledge, in the form of statistical process modeling, with data-driven machine learning in real time, it is possible to calculate exactly the right position.

CURRENT SITUATION

It is hard to determine the right position to attach a car door. When the door is attached to the car body, neither the door nor the bodywork are painted. No windows and none of the fittings have been installed yet. There are no seals. The influence of all these factors on the door position, due to deformation and the extra weight, must be anticipated and allowed for so that the door ends up in the right place. That is why at present, costly adjustments have to be made to the doors by hand after the assembly work has finished.

PROJECT DESCRIPTION

• Identification of the relevant data through modeling of the production process.
• Feasibility study based on actual production data.
• Spot checking of the recommended positions.
• Financial review of the results.
• Integration of Erium into the customer's IT landscape.
• Successive transition to a fully automatic system.

SOLUTION

The solution is based on the systematic combination of machine learning and process knowledge. First, data generated by production is used: mainly part dimensions and actual positions. And second, Erium integrates the knowledge and experience of process experts: not just geometric models of the vehicles and the gap plan, but also qualitative knowledge about deformation properties of the components. Erium uses this additional information to calculate individual attachment positions for each vehicle, with the gap and offset dimensions in the final position matching the gap plan as closely as possible. And it achieves this after just a few vehicles – in stark contrast to classic machine learning which is extremely data-hungry.

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INDUSTRY 4.0 FEATURES

• Linking component-specific production data and quality data to create a digital product twin.
• Process owners supported with calculation of parameter recommendations.
• Decentralized autonomous optimization of individual production sections with a global effect.

STANDARIZATION APPROACHES

The expert knowledge is statistically modeled in the form of a process graph. The three levels – procedures, object classes and data sources – are linked to each other. The aim is to standardize a UML-based description language (administration shell) that makes the data usable for machine learning in the form of a digital process twin.