App-supported Adaptive Test Planning in Variant Production

Research project "APProVe" successfully completed at the WZL of RWTH Aachen University

Quality inspections are essential in production to ensure quality. In order to keep the inspection effort as low as possible, spot checks are used in large-scale production. Despite the reduced scope of testing, they allow statistically justified statements to be made about product quality. In variant production, however, random inspections cannot be carried out without further ado. Particularly in small and medium-sized companies, the statistical knowledge or personnel capacity required for a sampling inspection is often not available. Due to the high variability, a 100-percent inspection with complete testing of all inspection characteristics is therefore common, especially for small quantities of individual variants. This high level of testing represents a direct disadvantage for small and medium-sized companies in terms of competitiveness.

In the "APProVe" research project, a process has therefore been developed over the past two and a half years to enable a reduction in the testing effort in variant production as well. It is based on adaptive testing, in which the scope of testing is determined on the basis of test process data already recorded. The inspection effort is reduced in three steps: the definition of key characteristics, the formation of mixed lots, the determination of sample sizes and the specification of a risk parameter.

Laboratory for Machine Tools and Production Engineering (WZL) of RWTH Aachen University
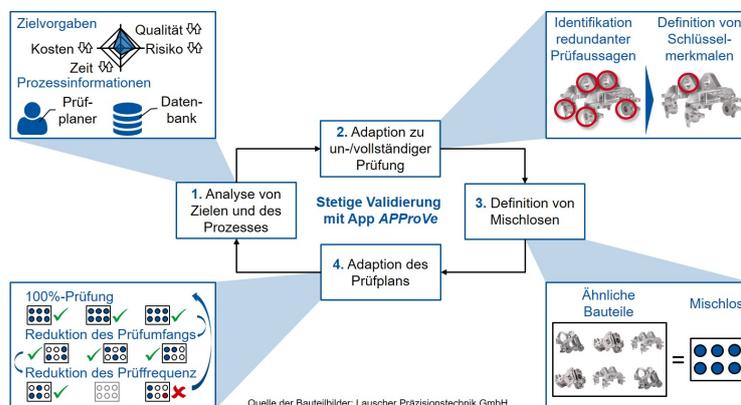
Stefanie Strigl (M.A.)
Head of Press and Public Relations

Campus-Boulevard 30
52074 Aachen
GERMANY

+49 241 80-27554
s.strigl@wzl.rwth-aachen.de

www.wzl.rwth-aachen.de

Control loop for adaptive test planning in variant production (© WZL)

When defining key characteristics, those characteristics are selected as inspection characteristics which represent all relevant information about the component. The formation of mixed lots aims at combining similar variants into a common lot.

The increased lot size in this way enables a random sample inspection. In the last step, the sample size is determined for each key characteristic in the individual mixed lots. Furthermore, the risk for wrong decisions is given, which results from the reduction of the inspection scope compared to a 100 percent inspection of all characteristics. The algorithms developed to reduce the inspection effort are based on machine learning methods, such as grouping algorithms, and statistical methods.

To make the method tangible for practical application, the algorithms were implemented in the freely available programming language "R" and summarized in a web app. The web app is license-free and enables adaptive test planning, even without prior statistical knowledge and high personnel input. The web app guides users through the various steps of test planning and then provides a test plan for download. It is possible to perform a fully automated evaluation as well as to make individual settings manually. Initial applications of the web app within the companies of the project-accompanying committee showed that a reduction in testing effort of up to 90 percent would theoretically be possible. Such a reduction in effort would increase the competitiveness of small and medium-sized companies by reducing the workload of inspection personnel, increasing resource efficiency and reducing production costs.

The "APProVe" research project was launched in March 2019 and was concluded in August 2021 with the holding of the final meeting of the project-accompanying committee. It was carried out in cooperation with the Chair of Production Metrology and Quality Management of the Laboraory for Machine Tools and Production Engineering (WZL) of RWTH Aachen University and the companies GFE Präzisionstechnik Schmalkalden GmbH, iqs Software GmbH, Lauscher Präzisionstechnik GmbH, OVA-LO GmbH, PFW Aerospace GmbH, TCG UNITECH GmbH, Tebit GmbH & Co. KG, Transfact GmbH and Q-Das | Hexagon.

Further information on the research project can be found on the following website: www.approve.wzl.rwth-aachen.de.

Contact at WZL
Meike Huber, M. Sc.
+49 241 80-26946
m.huber@wzl.rwth-aachen.de

Laboraory for Machine Tools and Production Engineering

The Laboratory for Machine Tools and Production Engineering (WZL) of RWTH Aachen University enhances the innovative strength and competitiveness of the industry with trend-setting basic research, applied re-search and the associated consulting and implementation projects in the field of production technology. In the research fields of manufacturing technology, machine tools, production engineering, gear technology as well as production metrology and quality management, practical solutions for rationalizing production are developed with industrial partners from a broad range of branches.