Design and investigation of a test rig based on AI smart vision sensors for automated component inspection of press-hardened car body components

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Abstract

Defects such as cracks, overlaps and impressions occur during the production of press-hardened car body components. At present, these types of defects are counteracted in the industrial environment by costly visual inspections carried out by humans. Due to the poor efficiency of visual inspection compared to automated inspection and the risk of defects not being detected, the use of AI-based smart vision sensors is being evaluated in order to enable an automated component inspection process with their help. For the realisation of the test, the most relevant defect types deformation, crack and overlap are identified using a Pareto analysis. The development of a test rig enables the investigation of relevant influences on the output parameter or similarity value of the AI-based image processing system. These include, in particular, the temperature of the press-hardened components after the end of the process and the exposure to light conditions acting during the component inspection. To ensure subsequent use in the production line, the tests are analysed using a discrimination evaluation based on confusion matrices. The number of false negative ("pseudo defects") and false positive classifications ("slippage") can be used to derive metrics for evaluating the performance of the test system in relation to the various defect types in order to obtain a statement about precision and repeatability. No deviations from the true class were found for testing the defect types deformation and crack. For the purpose of a practical acceptance of the test system, a left-sided hypothesis test according to VDI 2632 is carried out for the defect type overlap in order to be able to make a statement about the classification performance in relation to the statistical population.

Keywords *forming technology, press hardening, image processing, AI smart vision sensors, automated component inspection*