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Standardization of micrograph analysis using AI-supported defect classification and quantification

A primary objective of quality assurance in additive manufacturing is the regulation of defects within the components, as these have a substantial impact on the mechanical properties and durability of the resulting products. Porosity serves as a crucial indicator of process window performance and a pivotal parameter for process qualification. To determine the porosity of a given material, test specimens are constructed and, subsequent to their removal for micrograph analysis, prepared by embedding, grinding, and polishing in order to facilitate microscopic imaging of partial areas. In order to ensure the reliability of the results, it is essential to consider the influence of various parameters on the micrograph analyses, as this can affect the comparability of the results. One reason for this is the manual definition of threshold values for the identification of areas within the sample that are defective. The standardization of methods for the detection, classification, and quantification of areas exhibiting deficiencies is a prerequisite for the meaningful comparison of analytical results. Furthermore, the absence of automation in the individual analysis steps represents a significant challenge. Consequently, the threshold values utilized for identifying defects are defined in disparate ways, and disparate pre-processing methodologies are employed. To address the inherent issues of micrograph analysis, a methodological framework is presented that employs both classical image processing techniques that adhere to deterministic methodologies and AI-based processing methods. A variation of exposure and focus settings when imaging the same sample area forms the basis for a data set that is used to investigate the robustness of the model at different manual preparation steps. The tests carried out with the model indicate that the results regarding the component porosity are largely independent of the exposure parameters used. Furthermore, due to the full automation, the results can also be reproduced by different individuals, which guarantees the objectivity of the results.

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Track Classification: Process- and Quality Control & Sustainability