BUILT-IN DIAGNOSTIC PART FOR EARLY PART QUALITY ASSESSMENT

HP INC
Built-In Diagnostic Part for Early Part Quality Assessment

**Abstract:** By 3D-printing a thin, vertical diagnostic part along a side of a print volume, printing problems that occur during parts fabrication can be identified, and their root cause determined, prior to performing the usual cleaning and post-processing operations of the 3D printing process.
This disclosure relates to the field of additive manufacturing.

A technique is disclosed that identifies printing problems that occur during 3D printing of fabricated parts prior to performing the usual cleaning and post-processing operations.

One additive manufacturing technique is a 3D printing technology based on layered additive manufacturing process. It uses the combined effect of fusing enhancers and other agents (detailing, coloring, etc.) deposited on a thermoplastic powder bed to delimit the regions that will be melted by an IR radiation source for each layer to form a 3D object.

Certain of these technologies, such as selective melting of thermoplastic powder, allows printing of numerous parts having different shapes and sizes in a single printing job. After a cooling process, these buckets of powder and printed parts go through a cleaning process, part quality (PQ) assessment, and other post-processes which may take a lot of resources. During the printing process, certain problems could occur that adversely impact part quality. Up to now, many of these defects could be detected only after the final postprocessing phases and a full cleaning of the bucket. If a job includes parts that have unacceptable PQ, those parts are disregarded, after having wasted valuable resources on them. In addition, if after cleaning some parts show defects, it is currently difficult to pinpoint when and where the issue(s) originated relative to the print bucket volume. Thus, more time and resources are required to find a possible root cause of the problem, and an effective solution for it.

According to the present disclosure, and as understood with reference to the Figure, the costs of production are reduced by printing a built-in diagnostic part 10 in each print bucket 20. The diagnostic part 10 is analyzed before cleaning and postprocessing of the print bucket 20. If the diagnostic part 10 indicates a PQ issue, the job can be discarded without expending the resources required to perform the cleaning and postprocessing. In addition, the diagnostic part 10 may help identify the root cause of the issues that caused the defects in the fabrication process and allow them to be corrected before the next printing round.

The diagnostic printed part 10 is a thin printed plane of thermoplastic, disposed along the height and width of the volume of the print bucket 20 in the cross-print direction 30 along with various fabricated parts 40.

The thin surface of the printed thermoplastic diagnostic part 10 can embody a variety of defects, many of which can be evaluated using foreground and/or background lighting. Some of these artifacts compromise PQ, while others anticipate future failures. For example, certain shadows can indicate print head alignment issues, clogged printing nozzles (seen as vertical lines), powder spread differences (seen as horizontal lines) or re-irradiance at certain levels.
In some cases, the design and/or the placement in the bucket of certain parts 40 may be the root cause of the defects in the diagnostic part 10. These parts 40 may be redesigned and/or fabricated in a different location in the print bucket 20 to resolve the issue.

To assess the quality of the printed volume, a user removes the diagnostic part 10 from the print bucket 10 before the cleaning and postprocessing phases. In some cases, the diagnostic part can be removed before the cooling is fully completed, since it is easy to remove as it is located on a side of the printing volume and may cool enough to solidify at an early stage.

The disclosed technique advantageously allows 3D printers to evaluate the PQ of the printed volume earlier in the manufacturing process, saving time and costs if a problem occurred during the printing. In addition, it can help the operator find the root-cause of problems that may have occurred.

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