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A METHOD FOR PRINTING SUBSETS OF PARTS OF A LAYER USING DIFFERENT PRINT MODES IN DIFFERENT PASSES

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A method for printing subsets of parts of a layer using different print modes in different passes

After printing a build using a Multi Jet Fusion 3D printer, the build unit is disconnected from the printing unit containing all the 3D printed parts. Once the powder of the build unit is cold enough to extract the parts, the unit is emptied and connected back to the printer to start a new printing process. The cooling of a build in the build unit takes a considerable amount of time and the unit cannot be used for other purposes during this time.

To extract a warm build out of the build unit for external cooling, an internally generated envelope is printed around the build, to ensure that the print quality of the non-cooled parts is not affected during the early extraction. The proposed invention describes a method to process and print the build envelope, a 3D part with no specific part quality requirements but with the need to be easily broken and minimize the material and ink usage, in a way that the quality of the user parts of the build remains the same after its early extraction and without being affected by the printed build envelope.

Our solution addresses the problem of printing internal 3D parts with very different needs together with the parts added by the user to the print bucket, in the same printing process but using different print-modes to get different requirements while preserving thermal conditions.

This implies the splitting of the content of a layer in different passes. In each pass, a subset of parts with similar requirements will be printed in a specific manner according to a print mode configuration.

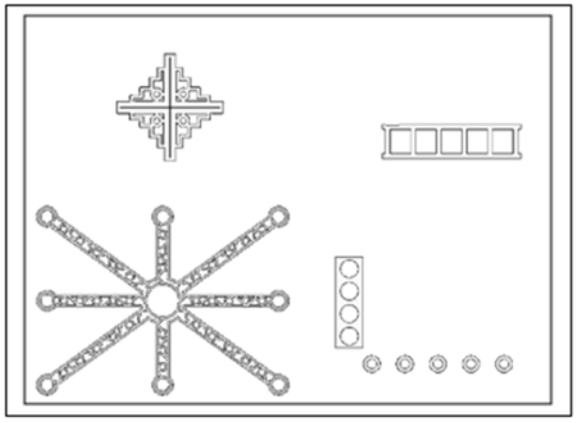

Figure 1: Current layer to be printed.

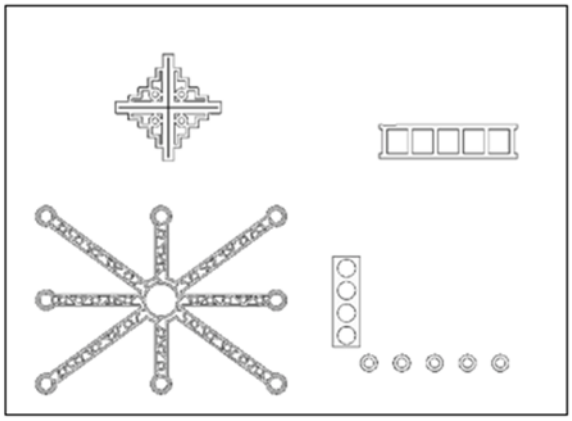

Figure 2: First pass of the current printing layer where the user parts are printed as usual, according to the print-mode selected by the user when submitting the job.

Figure 3: Second pass for the current layer where the build envelope is processed in a different manner than the user parts using a different printing configuration.

The user-defined parts and the internally generated ones are different types of parts, and each one of them has a unique identifier. We use these 2 attributes to separate the content that will be printed in each one of the passes. We could extend this to any amount of types and the corresponding amount of print passes. Then, when the content of each pass is separated, we can apply different algorithms according to different printing configurations to achieve different physical properties for the parts printed in each pass. In particular, we print the build envelope using a printing configuration to minimize the agents and powder consumption while preserving a stable thermal behavior along the bed.

The process of printing a build envelope for external cooling follows these steps:

1. The user chooses specific printing and cooling profiles and submits a job through the external software. The cooling profile of type “extract” requires the generation of a build envelope to enclose the build, preserving part quality and thermal conditions that allow the external cooling. After early extracting the powder unit is ready to be used even when the printed bucket is still being cooled.
2. During the printing process of each layer, the 3D printing pipeline produces the content images of a complete layer, which is separated in 2 different images: one for the user parts and another one for the build envelope.

3. Each image is processed according to the required printing configuration for its type of parts, generating a set of halftoned images ready to be printed in different print passes. As an example, images with data related to the build envelope will be printed in pass forward while, images containing user parts data will be printed in pass reverse.
4. Then, each halftoned image is printed in a different print pass, and after all the passes the system heats the bed to achieve the melting temperature for the material.
5. The process is repeated until all the layers that form the build are printed.
6. Finally, the printed warm bucket is ready to be extracted from the build unit.

Note that the same approach can also be applied to any amount of part types, just by defining new printing profiles for each type of part and increasing the number of passes needed to print a layer.

Note also that the types of parts can be user defined or internally defined by the FW (e.g. according to the different purposes of the internally generated parts).

The invention provides a way to achieve different physical properties on parts that are printed all together in the same printing process, while keeping the thermal stability of the printing process. In particular, this solution can be applied to print a build envelope with low quality requirements, hard enough to keep the build under control, but easy to break, while preserving the high quality of the user parts.

In addition, the solution implies splitting the content of a single layer in different images which are printed in different print passes, which can be used to mitigate nozzle health issues because their work load will be distributed across the different passes.

Note that the solution can be customized per material. While the build envelope requirements are the same across materials, the way of achieving them can be different for the different materials due to the different thermal behaviors and material properties. The printing profile to process the build envelope can be designed differently according to the material needs and particularities.

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