A Non-Standard Slicing Pattern for 3D-Printing of Structural Components

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ABSTRACT

Fused Filament Fabrication (FFF), although introduced for rapid-prototyping applications, has outgrown its intended purpose. Now, with the availability of high-performance materials and the high-level control of the process, FFF is now being explored for its potential to fulfil the manufacturing needs of the industries. However, some limitations in the exploitation of FFF technology still exists: for example, the deposition paths used to fill the geometry to be printed can follow only certain defined patterns like rectilinear, honeycomb, concentric etc., implemented in the current slicing software, thus preventing an enhanced deposition strategy of the material. The inherent anisotropic nature of the 3D-printed parts along with such predefined patterns may not attribute to the structural performance in most applications. Hence a load-oriented slicing is used in this work. Such concept of designing the fiber paths suited to the applied loading have shown improved structural performance and is well established in the field of composites. But very few works in 3D printing literature have used load-oriented slicing [1, 2]. A recent work by Khan et al. [1], demonstrated the improvement in the mechanical strength of a 3D printed open-hole plate when its filaments are oriented to the load paths. However, only an analytical approach was used in which the curvilinear filament paths were found from the analogy of fluid-flow equations around a cylinder. The present work makes a step forward developing a robust, generally valid deposition technique for any two-dimensional structural application. Several components with relatively complex geometries are simulated in a commercial FE software package. From the resulting principal stress field, the filament paths are then generated by performing integration. The developed algorithm could generate paths allowing for a user-specified overlap to occur and fills relatively large voids in between the filaments.

REFERENCES

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