3D Printing of parts with non-uniform layer infill patterns

J. Giannatsis, A. Vassilakos, V. Dedoussis

A great number of Additive Manufacturing systems worldwide, both commercial and industrial grade, are based on extrusion 3D Printing technology and its several variations. In extrusion 3D Printing, material (usually polymer, but also ceramic and metal) in a liquid or semi-liquid state is forced through a nozzle, depositing thereby continuous strings/traces that form the perimeter of each layer and fill the corresponding interior area following specific patterns, such as zig-zag or contour. In conventional practice, the infill density for each layer is controlled through the adjustment of pattern parameters, such as the air-gap between neighboring extrusion strings. This way a uniform infill density for each layer may be achieved, it is not however possible to construct layers with locally variable infill density. In the present work a new methodology for the construction of parts composed of layers that have locally variable infill density is presented. The proposed methodology employs voxel modeling techniques for the representation and definition of local density within each layer, and quasi-random fill patterns for the fill of the corresponding areas. The basic elements of the methodology are presented and discussed in detail through representative cases and examples.