Volumetric Covering Prints-Paths for Additive Manufacturing of 3D Models

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In additive manufacturing (AM), slicing is typically used to manufacture 3D models, one layer after another. Yet, in recent years quite a few hardware platforms were introduced toward the use of multi-axes AM with general 3D curves as print-paths. We present algorithms for the generation of general print-paths that can potentially be used to synthesize superior 3D models using AM. In slicing, a 3D model is decomposed into a series of parallel planar sections, which in turn are (usually) decomposed into a set of piecewise linear curves used as print-paths in the AM process. The methods we propose ease this restriction, namely the print-paths are no longer limited to parallel planes. Like slicing, the methods we propose achieve a complete covering of a general volume with print-paths expressed as general curves. However, and unlike slicing, the created print-paths can conform better to the 3D model, its properties, and even user input. We expect that the added flexibility and freedom in the specification of AM print-paths, as opposed to limiting them to planar curves, will enable the synthesis of 3D models (using AM) with superior properties (such as mechanical strength and surface finish). As a proof of concept, we also present examples of 3D models manufactured with a full 3-axis low-end AM hardware and using the algorithms described.

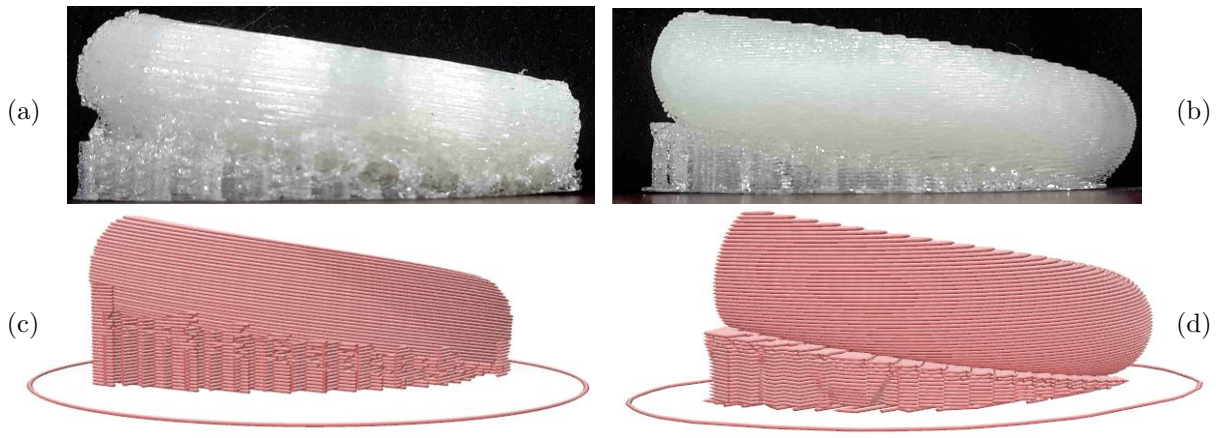

Figure 1: A comparison between slicing and print-paths that conform to the model geometry. In (a), the model is printed using curves that conform to geometry of the model. In (b), traditional slicing is used. In (c) and (d), simulated previews of the printing results (based on the print-paths) are shown for (a) and (b), respectively. The model in both cases is a short section (a quarter of a cycle) from a helical model, and is shown with the generated support structure.

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