Measurements and simulations of the cross-section of the printed strands in fused filament fabrication

We measure and simulate the shape of an extruded strand in Fused Filament Fabrication; an additive manufacturing method where a solid thermoplastic material is melted and extruded through a nozzle in order to create a layered three-dimensional object. The prediction of the strand shape is essential in order to estimate the porosity, the surface roughness, and the dimensional accuracy of the fabricated parts. Using optical microscopy, we quantify the dimensions of the strand cross-sections, for different printing conditions. For the first time, we compare experimental measurements of the strand cross-section with numerical results of three-dimensional computational fluid dynamics simulations. The numerical model predicts the effect of change of the layer height on the strand morphology and shows good agreements with the measurements.

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