AI DRIVEN IDENTIFICATION AND PARAMETER ADJUSTMENT OF SELF-SUPPORTING DIRECT-WRITE FEATURES

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Key Words: Direct write, spanning structures, closed-loop optimization

Direct-ink-write provides the capability to produce self-supporting “spanning” features however, the range of print parameters that lead to an acceptable spanning geometry vary with the geometry of the gap to span (i.e. width, height) and material. To analyze spanning segments, an image processing routine is developed and applied to a set of training samples to obtain a set of standardized image representation of the deviation from the ideal span. This standardized representation allows for classification of any linear spanning segment regardless of gap geometry or filament thickness. Principal Component Analysis (PCA) is applied to the standardized images to produce a low-dimensional representation of the spanning geometry space which is upon which a classifier is built. A total of 4 archetypal spanning geometries are defined: good, slumped, broken and sinusoidal. This classification tool is combined with domain knowledge of the relationship between span geometry and print parameters to automate the parameter tuning and discovery process for a “good” span. The results show that iteratively applying an increase (slumps) or decrease (breaks) to the print speed or an increase to the nozzle offset (sinusoids) will converge on acceptable parameters (Fig. 1). The results also demonstrate the capability of the classification tool to extend to practical situations such as classifying the upper layer of a 3D periodic structure. Finally, the results demonstrate the versatility of the classification tool to FDM spanning structures with a similar parameter adjustment scheme to obtain a “good” spanning structure.

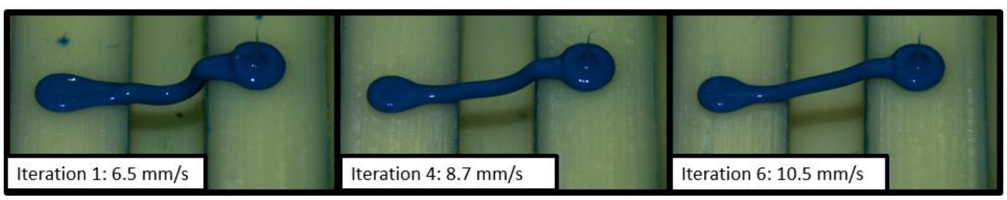

Figure 1 – Closed-loop parameter adjustment trial from “slumped” to “good” spanning geometry with 10% adjustments to speed per iteration.