

RESEARCH ARTICLE

Painting bio: A vector-based method for precise G-code generation across scales in biofabrication

Supplementary file

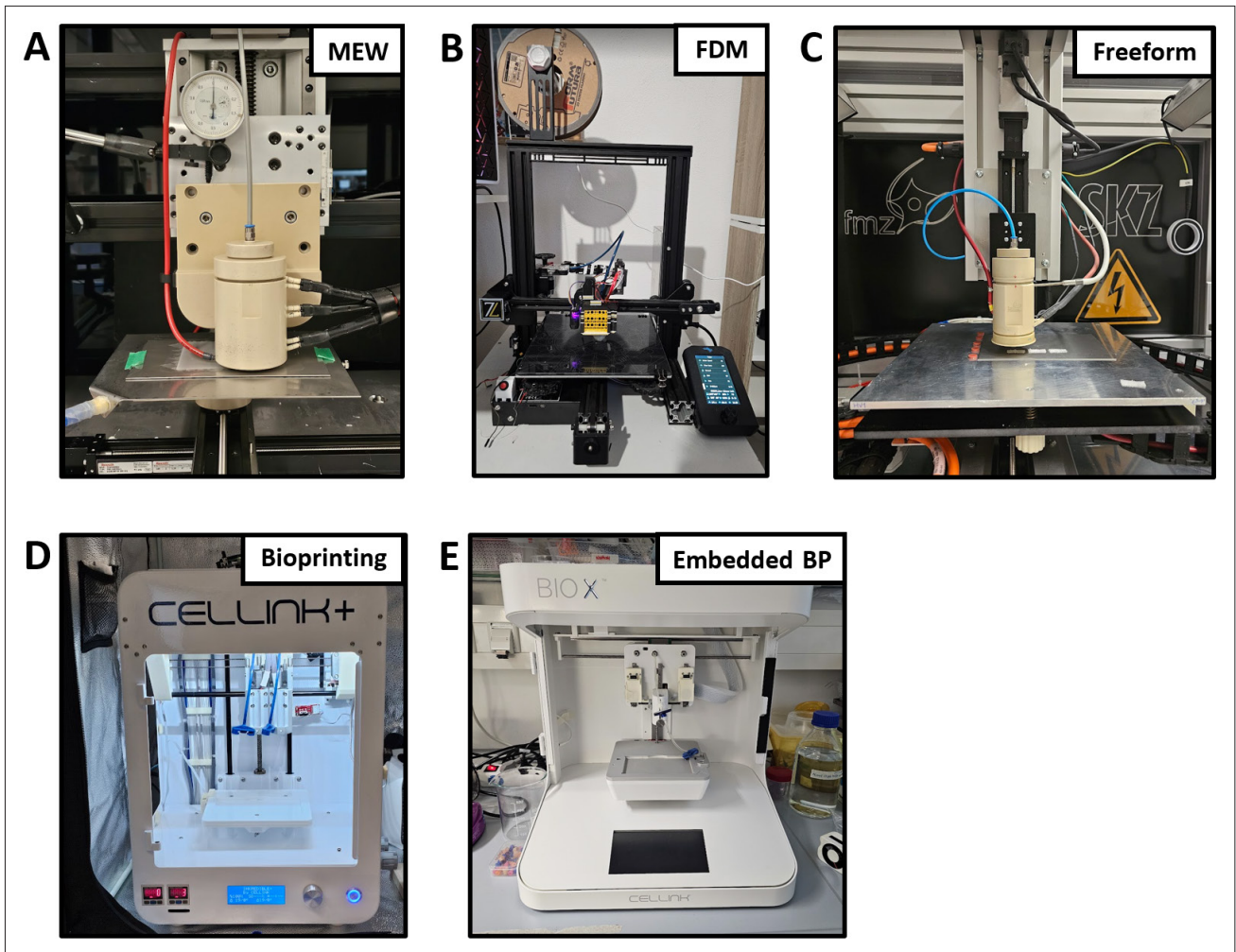


Figure S1. The machines used throughout the work. (A) In-house built MEW machine. (B) Ender 2 Pro customized by the authors, used for FDM printing. (C) In-house built MEW machine/freeform printer, used for freeform printing. (D) Cellink Incredible+, used for 2D and 3D bioprinting. (E) Cellink BioX used for embedded bioprinting. Abbreviations: BP, bioprinting; FDM, fused deposition modeling; MEW, melt electrowriting.

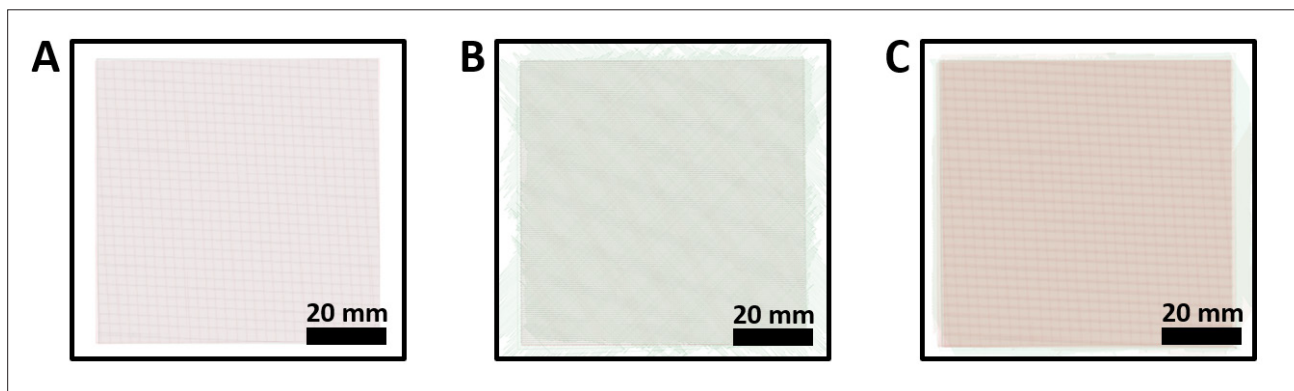


Figure S2. Scaffolds from Figure 1 zoomed out to their full view.

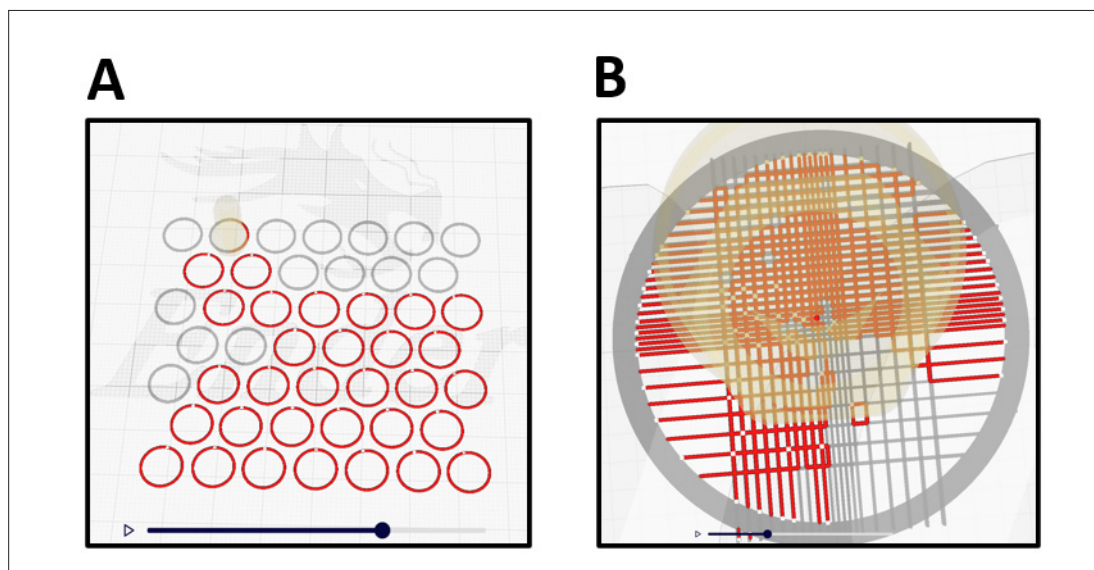


Figure S3. Scaffolds are sliced with a commercial slicer, similar to those shown in Figure 4A and B. (A) The reinforcing circles are shown three-quarters of the way through the print, illustrating the random sequence in which the rings are printed. (B) A small grid structure is simulated during the printing process, with segments beginning in the center of the cross-sections. This prevents continuous printing, making it unfeasible under these conditions.

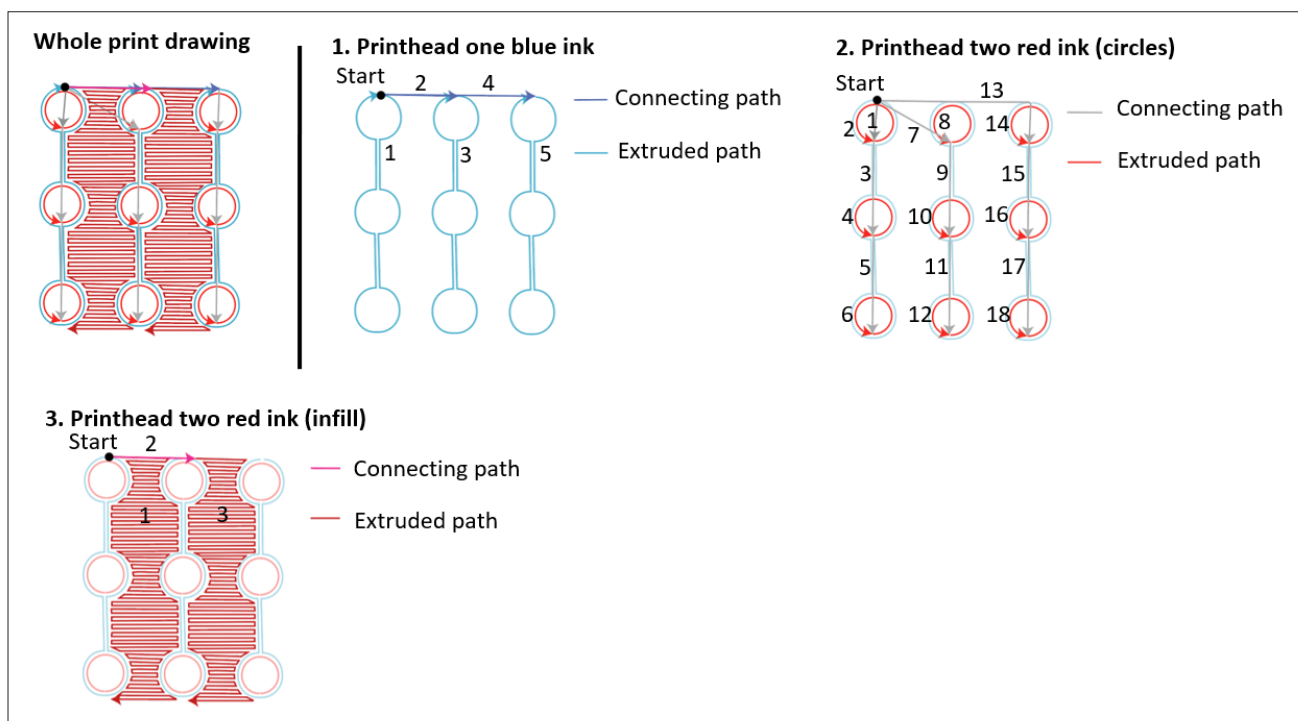


Figure S4. The print pattern shown in **Figure 5D** is deconstructed into separate printing steps. The sequence starts with the printhead one equipped with the blue ink and then switches to printhead two in the second sequence. The paths (arrows) are numbered in the sequence they are printed by the printer, with extruded and nonextruded (connecting) paths annotated with distinct colors.

Easy DXF stack generator

This project utilizes a custom tool that enhances the DXF2Gcode project with features optimized for single-layer 3D printing and specific G-code modifications. It adapts DXF files for additive manufacturing, especially melt electrowriting, includes height and extrusion calculations, and provides tools for organizing G-code blocks.

Features

DXF to G-code Conversion: Converts DXF files to G-code for single-layer 3D printing. **Extrusion and Height Calculations:** Automatically calculates extrusion rates and height values based on specified factors. **G-code Inversion:** Reverses G-code vectors and order to make the machine move from the end position back to the start. **Block Management:** Ensures correct G-code block structures, preventing nested, and overlapping blocks. **Configuration Management:** Automatically copies custom configuration files to the user's .config directory.

Installation

Clone the Repository:

```
git clone https://github.com/Anercomp/Easy-DXF-stack-generator.git
```

This build already comes with dxf2gcode. Notepad++ is not needed but recommended, as well as NCnetic. Every tool and resource can be checked with the top-right button. This will take care of Notepad++ recognition, NCnetic installation, and a gcode block UDL.

Usage

G-code Editing:

Open your G-code in the provided editor. Use the "Insert Extrusion Block" feature to add custom extrusion blocks. The program ensures each block is well-structured, with proper start and stop markers and no nesting issues.

Adjusting Extrusion and Height: The parameters after a block start override the value specified in the up-down boxes. Modify the extrusion factor or block height that will be inserted using the up-down boxes, automatically applying height increments based on the block's length.

G-code Visualization: The program displays G-code paths visually in a PictureBox, allowing zoom and pan

adjustments. Arrow markers with adjustable size show the direction of each G-code segment with the last path being marked with a yellow arrow.

Invert G-code Path: Reverse the G-code path and vectors to have the machine retrace its path in reverse order.

Configuration: The program uses `postpro_config.cfg` and `config.cfg` files for settings. These should be

located in your `.config\dxfgcode` directory after installation.

Troubleshooting: Configuration File Location: Verify that the configuration files are correctly copied to the user's `.config` directory.

This project makes use of `dxfgcode` from <https://sourceforge.net/projects/dxfgcode/>.