EPAM

Electrically Printable Additive Manufacturing

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Abstract:

This project focuses on developing a custom powder-layering printer architecture designed to support Electrically Printable Additive Manufacturing (EPAM) in future work. The goal was to engineer a system capable of executing the mechanical sequence required for EPAM: controlled powder deposition, uniform layer preparation, precision motion, and software synchronization. The resulting platform integrates a hopper, recoater, roller, and electrode positioning system within a custom firmware and G-code pipeline that enables timed, step-by-step operations compatible with future pulse-based metal printing processes.

Theory/Concept:

EPAM fuses metal powder using short, high-current electrical pulses delivered between two electrodes. These pulses create localized heating that bonds particles, enabling selective layer-by-layer fusion when combined with uniform powder spreading and precise electrode positioning.

Electronics:

- Control Board: BigTreeTech Manta V2.2 + CB1
- 400W 24V Power Supply
- 5x NEMA 17 Stepper Motors
- 2x NEMA 11 Stepper Motors
- 6x Momentary Micro Limit Switches

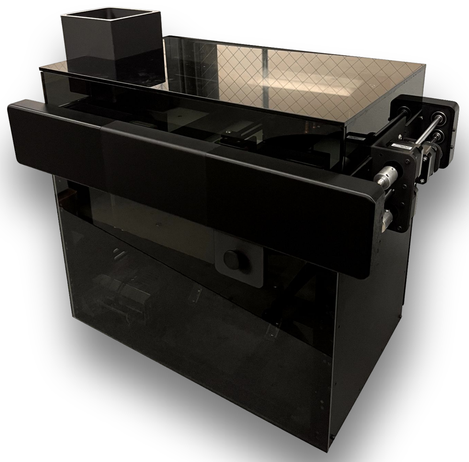

Figure 1. Final Design

Final Design:

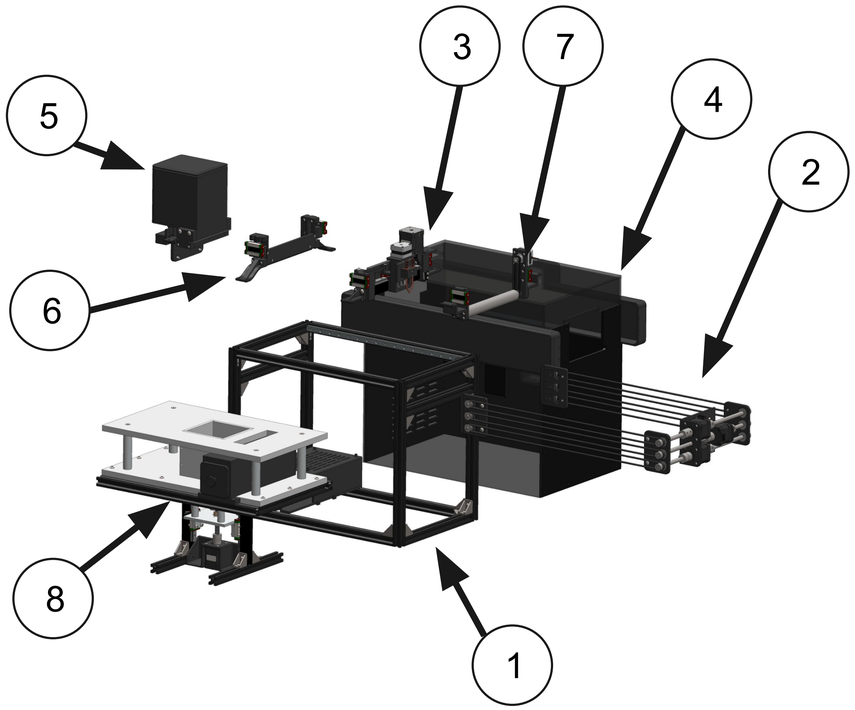

Figure 2. Exploded View

Motion and Control System

Components	
(1) Frame	Rigid 2020 aluminum extrusion structure supporting all subassemblies.
(2) Belt System	Triple-gantry X-axis belt drive for precise electrode positioning and powder deposition
(3) Electrode Gantry	Moves paired electrodes along the G-code path to fuse powder.
(4) Enclosure	Sealed chamber isolating powder from the external environment.

Together, these components provide a motion framework for precise electrode positioning for future high part resolution.

Powder Deposition System:

Components	
(5) Hopper	Controls powder flow using a slide gate mechanism.
(6) Recoater	Distributes a thin, even powder layer across the powder bed.
(7) Roller	Compacts distributed powder to improve density and inter-particle contact.
(8) Powder Bed	PTFE-insulated powder bed prevents unintended electrical conduction

Together, these components establish mechanically conditioned layers suitable for electrically induced neck-formation in future experiments.

Future Work:

The system will eventually integrate the EHT Integrated Power Module (IPM) to enable electrical nano-pulsing during deposition. The IPM will be used to solidify and fuse powder layers in real time, allowing the process to produce neck-formations between the particles, ready for full part consolidation through sintering.

Figure 3. Eagle Harbor Technologies Integrated Power Module (IPM)

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