Fundamental Mathematical Model for Direct Write Additive Manufacturing

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Advantages and disadvantages of direct write technology

Advantages
- Can print 3D objects or on 3D surface
- High resolution applications
- Theoretical wide range of printable materials and temperatures

Challenges
- Slow deposition rates
- Limited testing of scale up
- Not commercially available material
- Printing materials based primarily on heavily researched material

Model development

Bead Extrusion

\[ A = \frac{Q}{v} \]

Model Assumptions
- Constant cross sectional area (approx. as rectangle)
- Newtonian Viscosity Model
- Incompressible Flow

Model results

Model predicts spreading behavior as expected for water on several different substrates

Model shows viscosity dependence that mirrors what is intuitively expected

Research need

Material and Process Design
- Developed empirically from commonly known systems
- Many models depict droplet spreading, limited bead spreading models
- Current material design does not include input from desired application specifications
- My model allows design of material based from specific application parameters

Lewis et al. 2001