DIW Printing of Magnetic Hydrogel Robots

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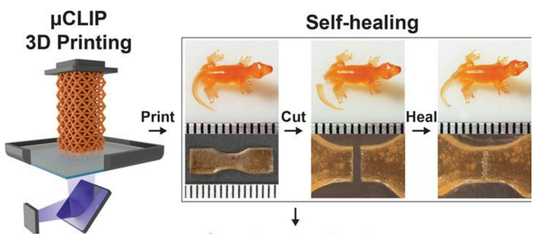
Objective and Research question:

This project explores the viability of Direct Ink Writing (DIW) 3D printing to manufacture robots with hydrogels and controlling these robots with magnets

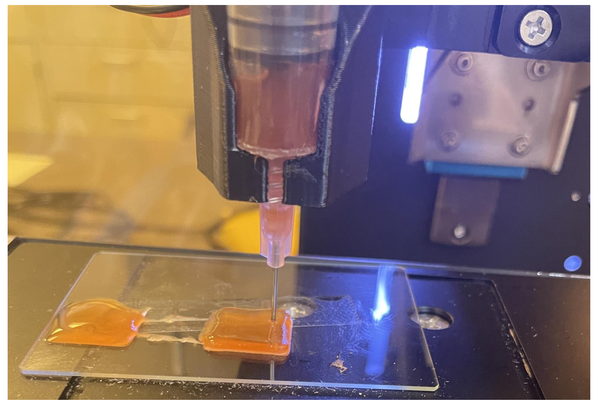
Background:

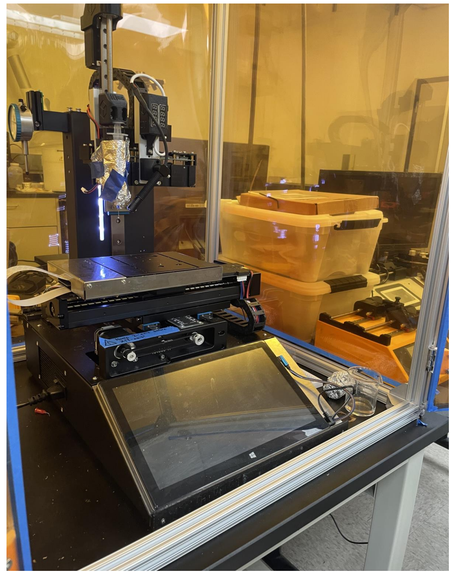
- 3D printing is a powerful manufacturing tool that allows for flexible part design and very little waste material.
- The Chen Research Group, the developers of the hydrogel-based resin, used Micro continuous liquid interface production (µCLIP) to produce parts with the hydrogel.
- However, µCLIP printing is expensive and requires a lot of equipment.
- The purpose of this project is to develop a new way to print these parts using DIW, a far cheaper and easier printing option.

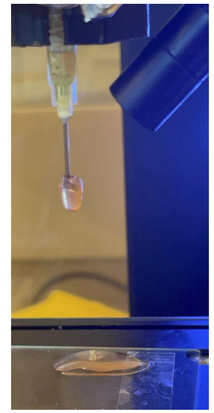


Methods, Instruments, Materials

- Photopolymerizable hydrogel resin:
  - Supplementary Information, Section 2
- 3D Printer:
  - Hyrel 3D Engine HR
- Methods:
  - Load the syringe with the resin
  - Customize g-code to level the Z-axis and perform the correct UV pen operation
  - Load glass slides on the build plate







Problems

- Viscosity and homogeneity vary with time
- Resin cures and solidifies at the needle tip
- Each needle tip requires specific flow rate
- Low viscosity make overhangs challenging
- Resin leaks out of the syringe

Solutions/Future work

- Print right after creating the resin
- Tweak flow rate, layer height, and UV pen intensity
- Formulate an equation that relates needle size, flow rate, and age of the resin
- Tweak retraction distance in the g-code
- Conclusion: Need more time to determine DIW's viability

Literature Cited
Wang, W., Liu, S., Liu, L., Alfarhan, S., Jin, K., & Chen, X. (2023). High-Speed and High-Resolution 3D Printing of Self-Healing and Ion-Conductive Hydrogels via µCLIP. *ACS Materials Letters*, *5*(6), 1727–1737. https://doi.org/10.1021/acsmaterialslett.3c00439

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