

3D Printhead for Composite Materials

Department of Mechanical & Manufacturing Engineering

April 2022

The Idea

Increase the strength and geometric intricacy of 3D printed components via:

- Composite filaments (polymers reinforced with continuous carbon fibers)
- 6-axes of printing flexibility by mounting printhead on a robotic arm

Together, composite filaments and 6-axes of freedom:

- Combine the strength of carbon fiber and optimally placed shear planes
- Enable printing over double-curved surfaces and around metallic inserts

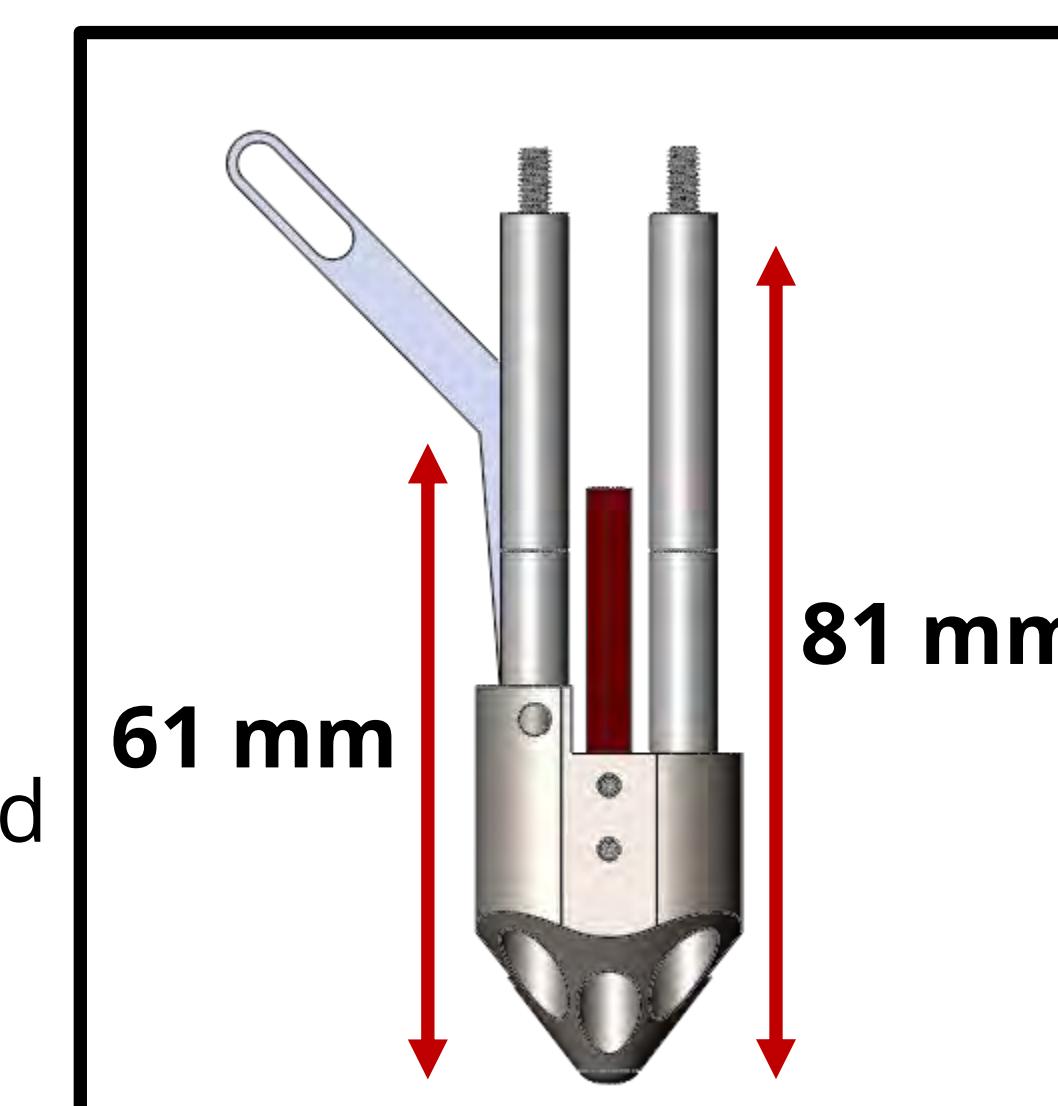
High-performance applications include:

- Automotive Industry & Aerospace Industry
- Components requiring ultra-high strength-to-weight ratios
- Prosthetics, Bike Frames, Drone Chassis

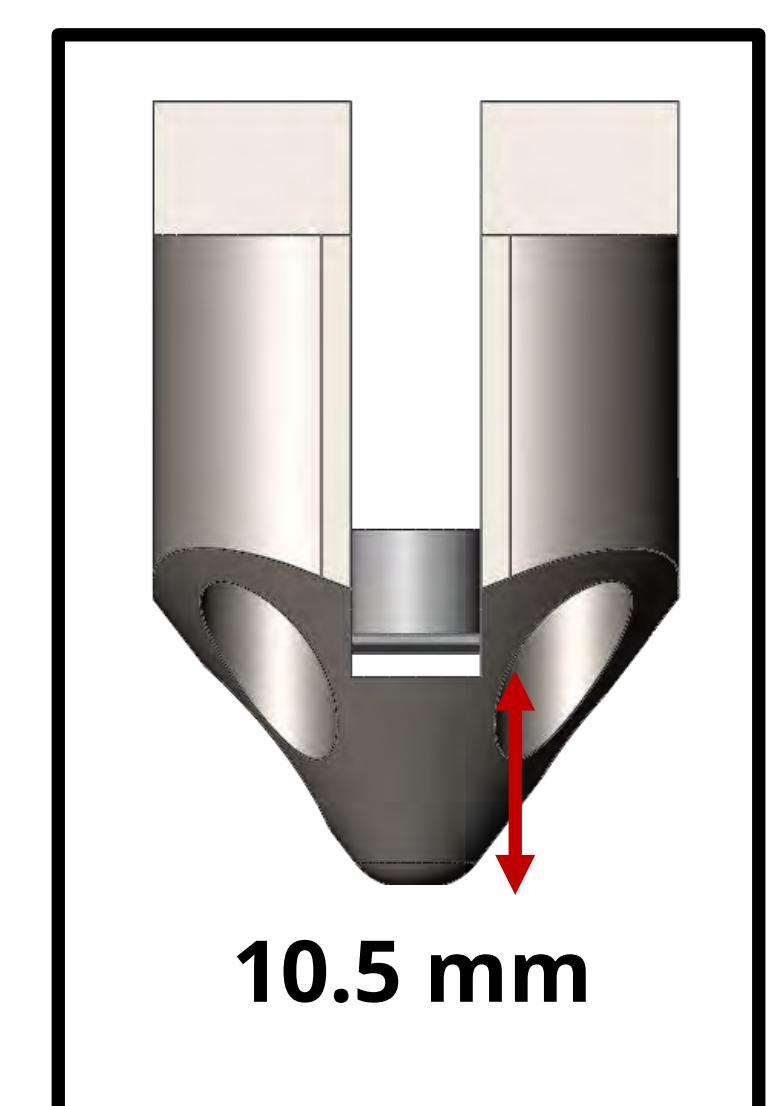
Design Constraints & Goals

Key Considerations

- Maximize effective length
- Minimize cut length
- Ensure heat dissipation
- Minimize jam points
- Include jam detection
- Include disengageable feed roller
- Minimize overall mass



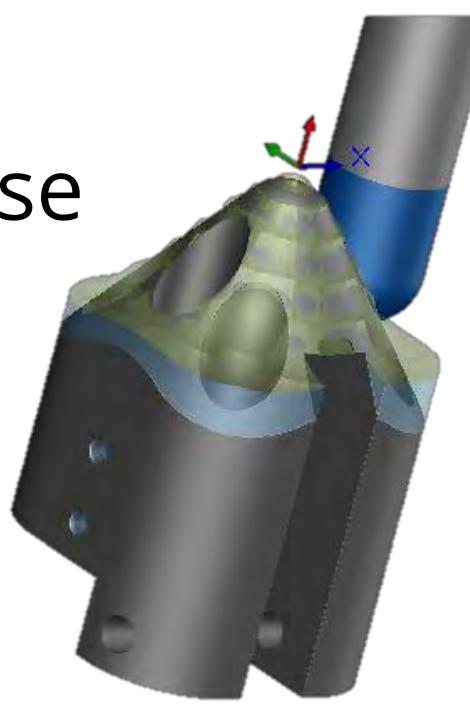
Effective Length



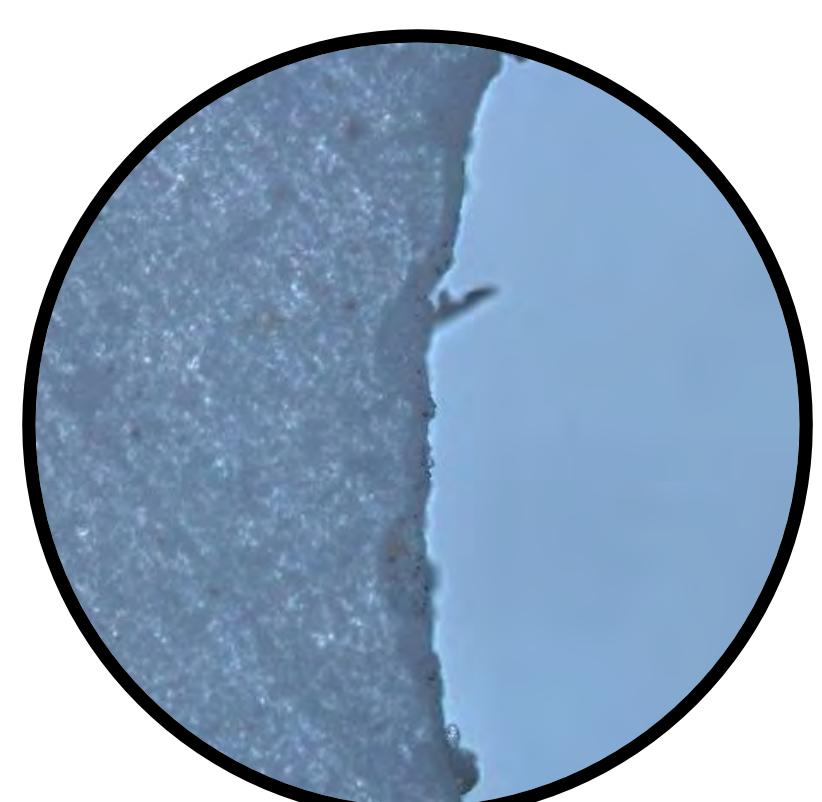
Cut Length

Manufacturing

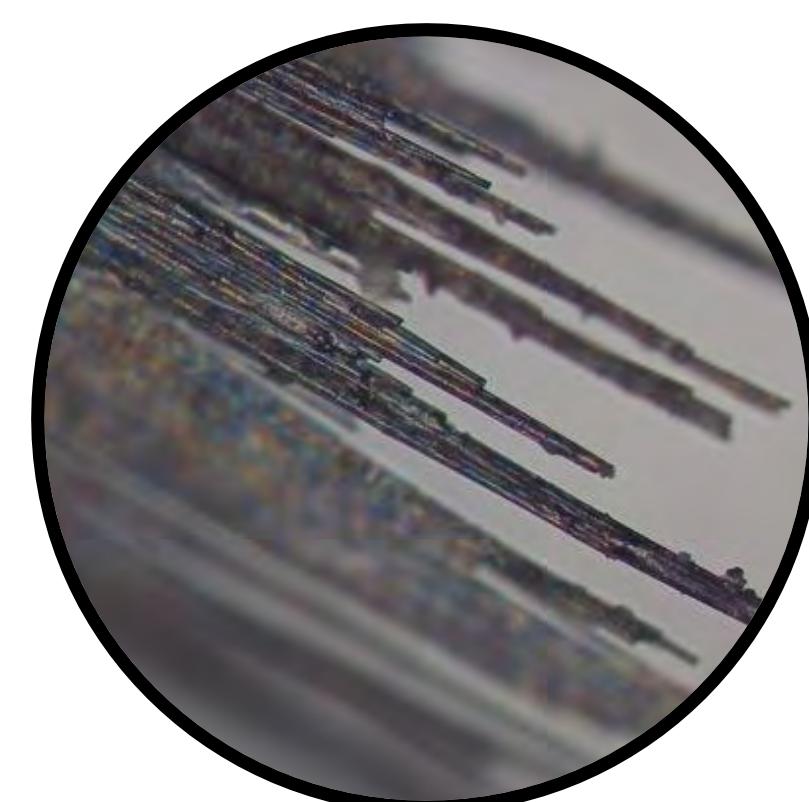
- 54 unique components
- 12 components machined in-house
- Custom tapered nozzle
 - H13 tool steel
 - Machined using CNC
 - Hardened



Microscopy



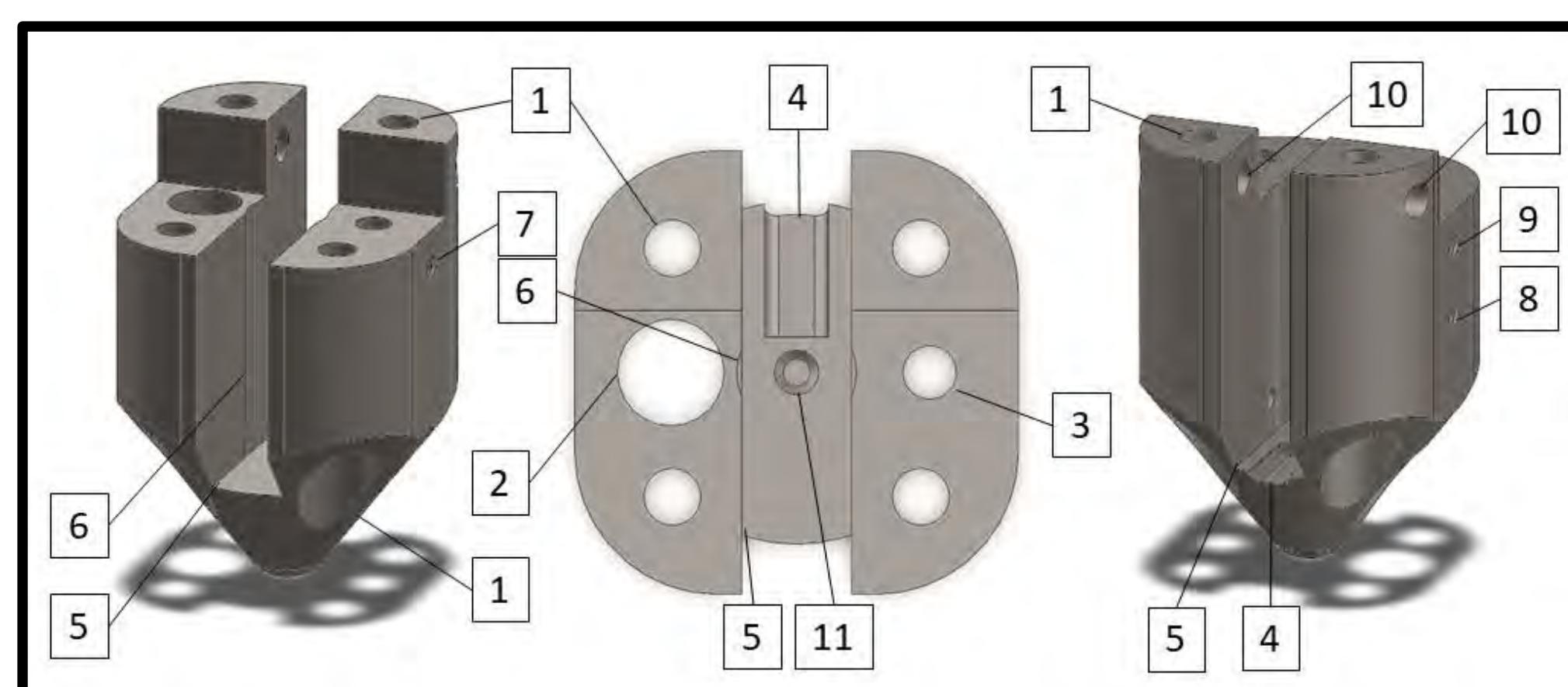
Machined Slot in Blade
Smooth finish to minimize wear on cutting link



Edge of Cut Filament
Clean cut to minimize fraying of filament

Nozzle Details

- | | |
|-------------------------|----------------------------|
| 1) Support bolts | 6) Ceramic spacer groove |
| 2) Heating cartridge | 7) Set screw (Temp. sen.) |
| 3) Temperature sensor | 8 & 9) Set screws (Heater) |
| 4) Path for cutter link | 10) Cutter link pivot |
| 5) Guide for blade | 11) Filament path |



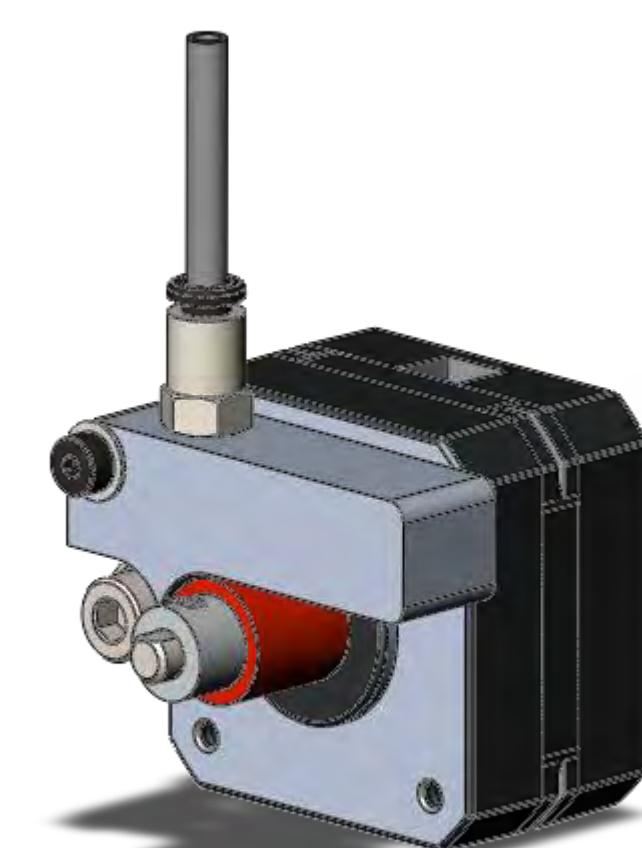
Acknowledgements & References

We would like to thank Dr. Joanna Wong, Nicholas Elderfield, Hussam Tawfik, Sean Mason, and the Laboratory of Engineering Materials.

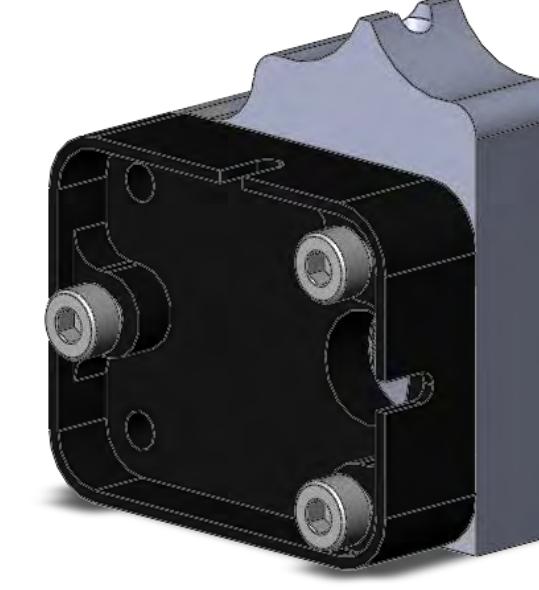
[1] "Product manual IRB 1200" ABB. 2014-2021.

Final Design

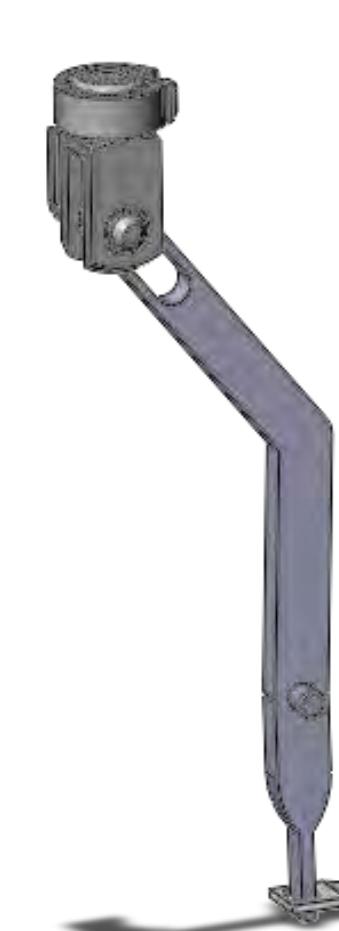
Filament Feed Motor



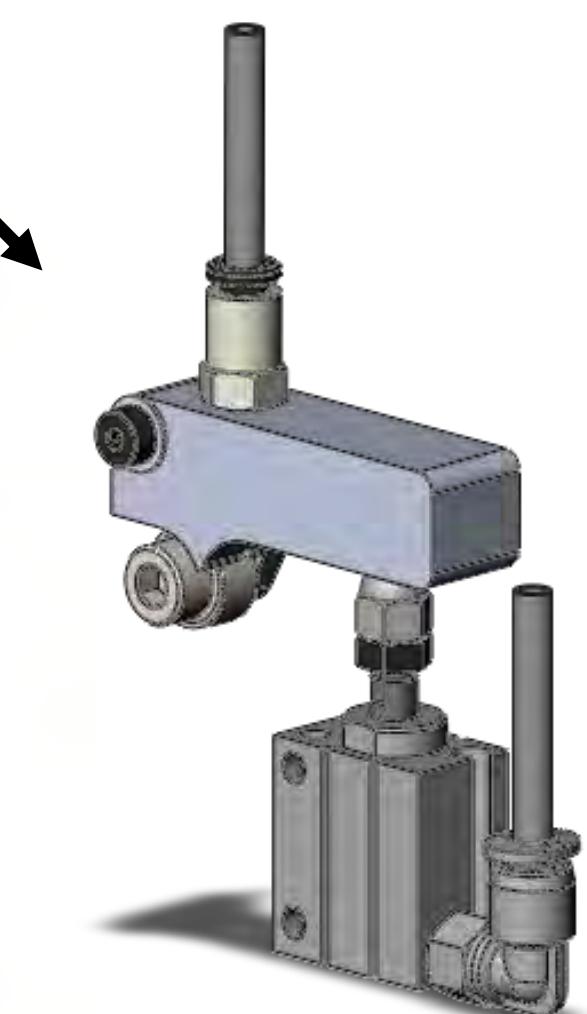
Jam Detection



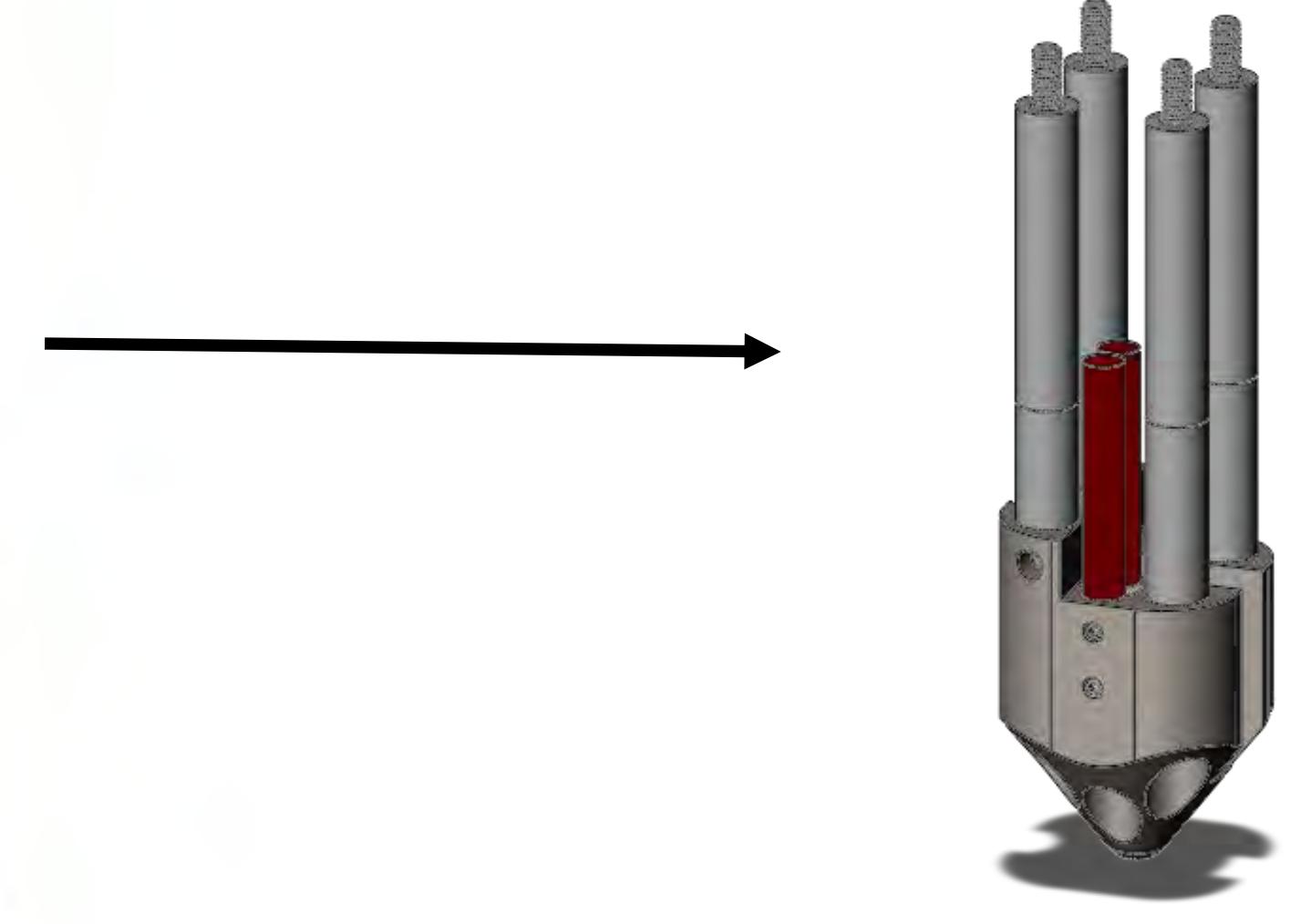
Filament Cutter



Disengageable Feed Roller



Custom Nozzle



Printhead placement on ABB Robotic Arm

