

Design and manufacturing solutions for robustness of Crater Observing Bio-inspired Rolling Articulator (COBRA)

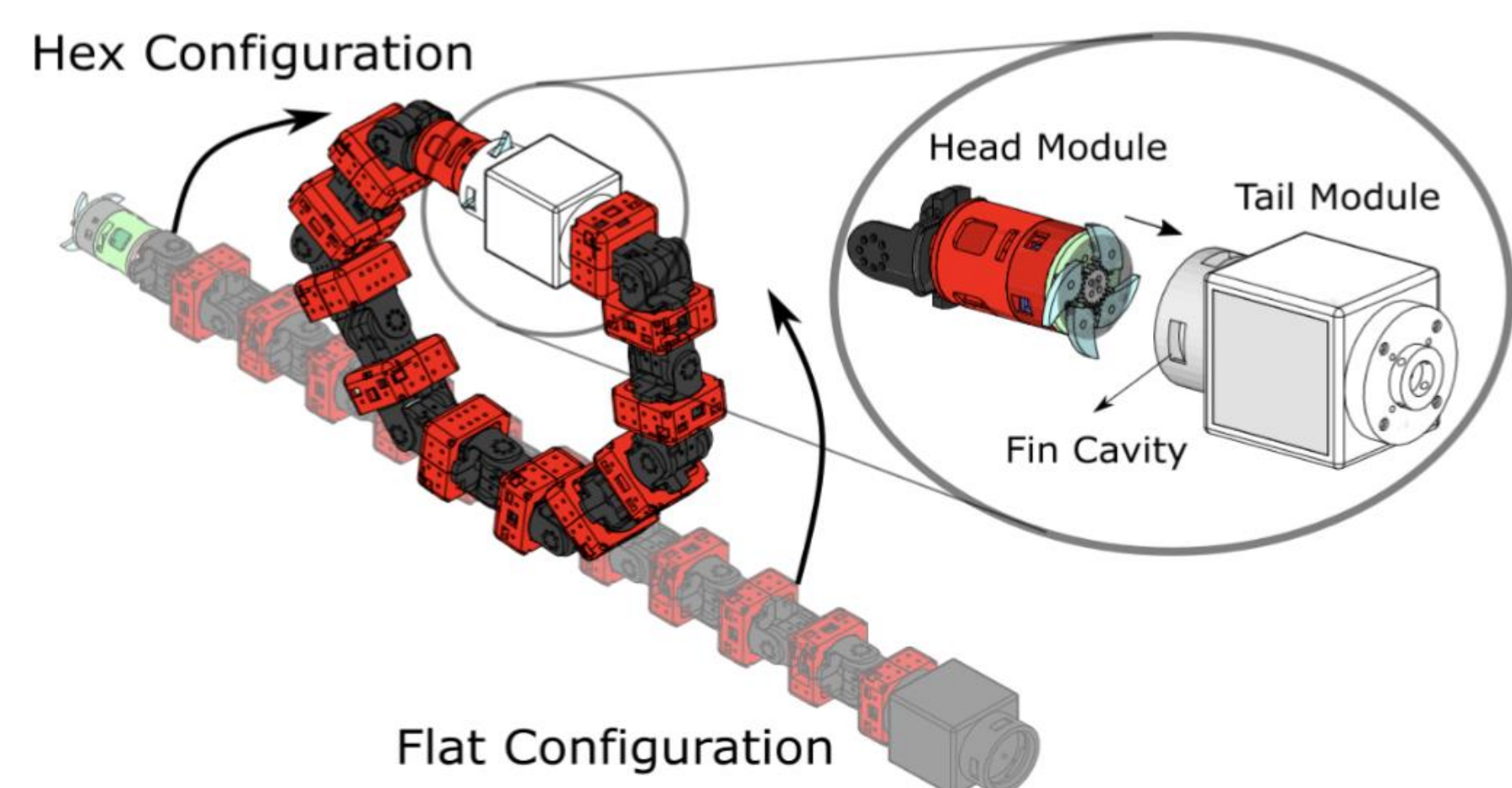
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Abstract

COBRA is designed to traverse craters on the moon, through multiple mediums such as tumbling in a rolling configuration and slithering. Traveling through rough terrain in space, dust is very prone to interfere with electronics and cause short circuiting and overheating. Especially in the head module, which connects to the tail to form the rolling configuration. In our project we ensure that COBRA is structurally robust through design, and that wire management and access to electronics are protected and convenient. All to ensure that the head module of COBRA is sealed, protected, and easy to assemble. These components work together to ensure that the crucial electronics and components are protected, discrete, and accessible; for safe and reliable function.

Background

- COBRA is based on a snake, and is multi-modal
 - The head and tail can connect into a hex configuration
 - A sidewinding motion to slither terrain
- The head module contains the most electronics, including a servo, multiple motherboards, and a battery
 - The 11 modules are all daisy chained and connect to one motor controller in the head



Materials Used

Software:
 SolidWorks, Onshape, Bambu Studio
Equipment used:
 Bambu X1 Carbon, Thermoplastic Polyurethane (TPU), Carbon Fiber Infused Polylactic Acid (CF-PLA)

Goal

The head module contains vital electronics and peripherals for COBRA. So we want it to be both:

- Durable and free of potential debris and dust from the environment
- Organized and manageable; for ease of accessing electronics and spacious

Methods

- Different infill patterns with CF-PLA have different effects on strength
- Designed a clip (based off a pen clip), that wraps wires for better management
- Designed seals that would go in between top and bottom housing, for dust mitigation
- Designed different mounting solutions for electronics

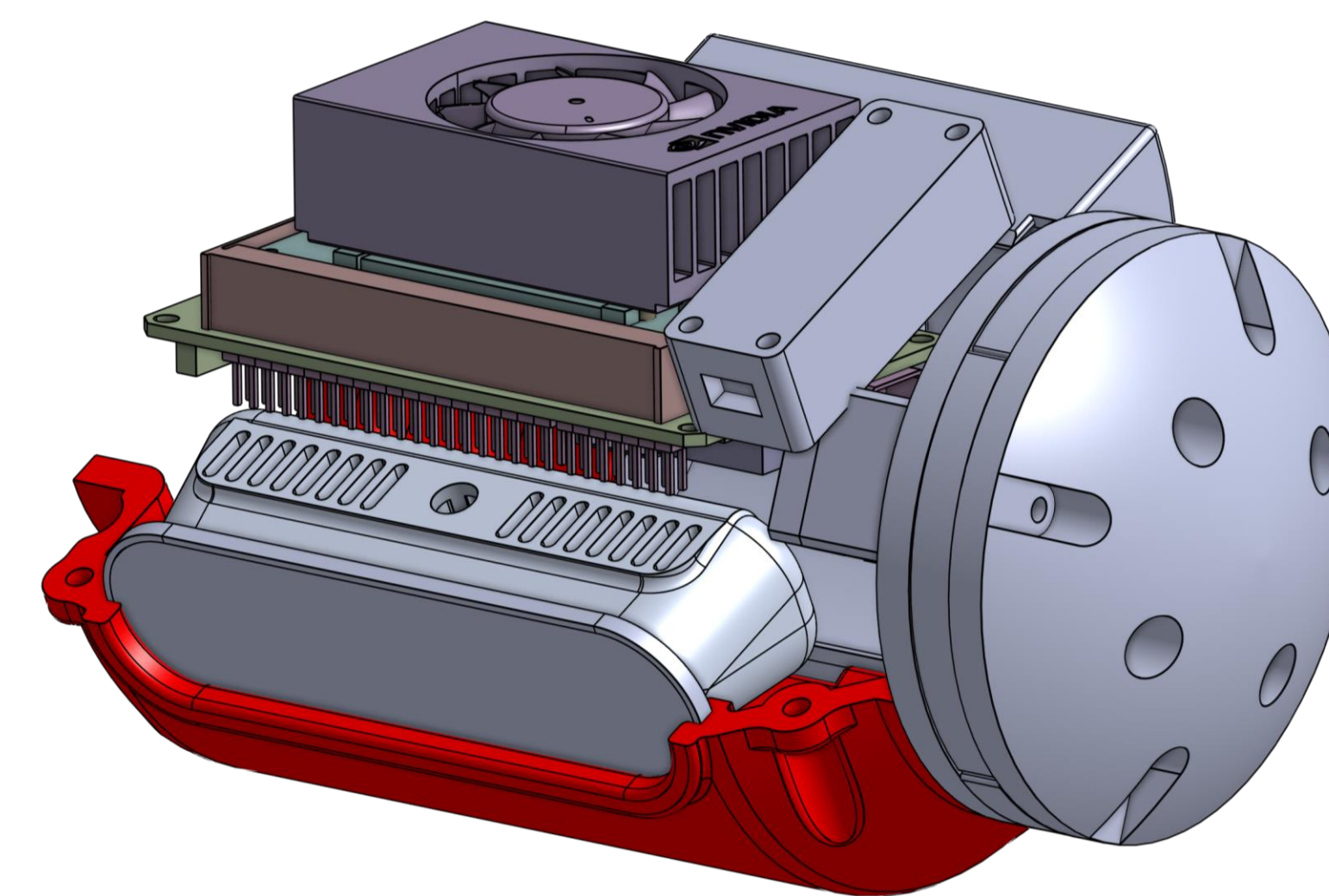


Figure 1: Original COBRA head (pins on camera)

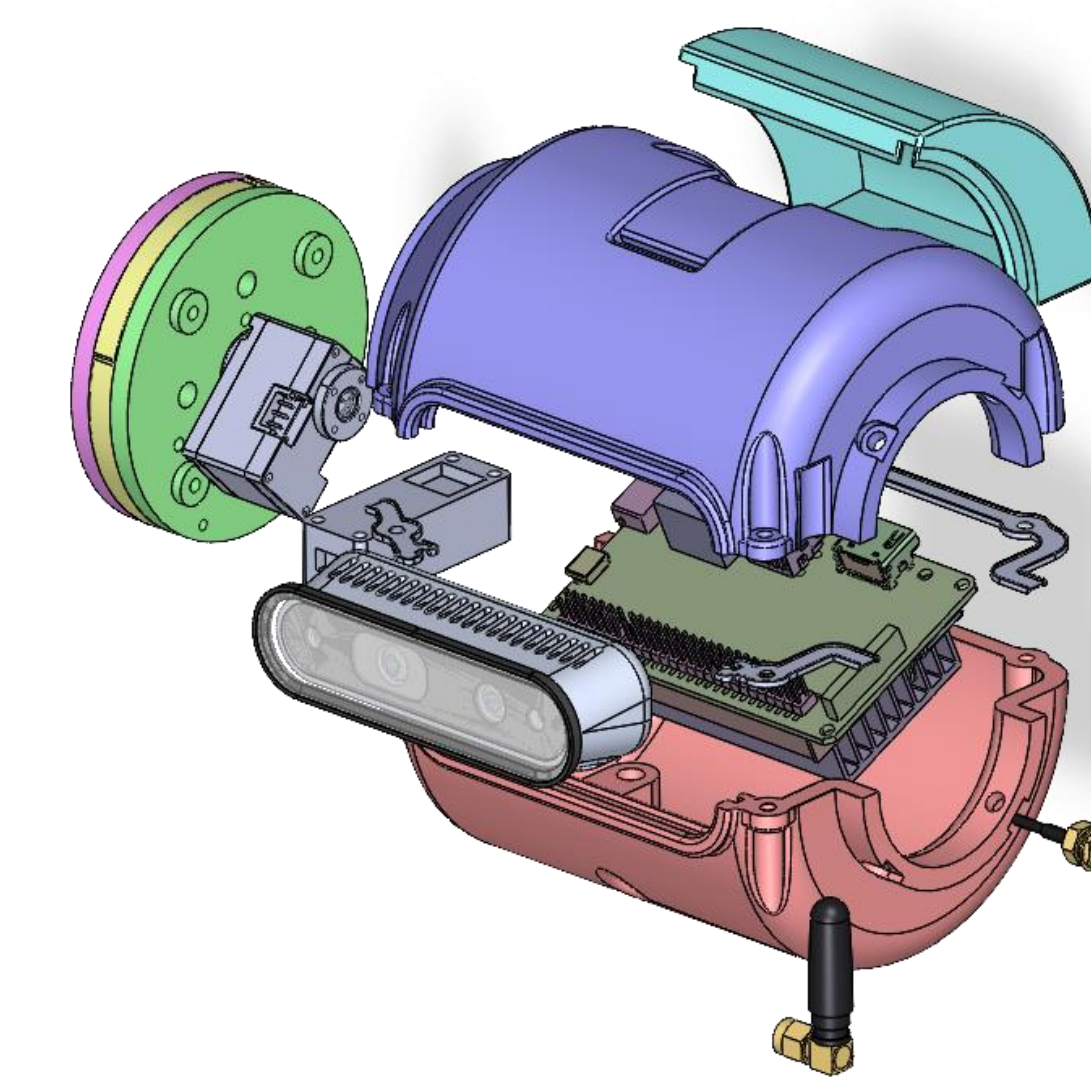


Figure 2: Seals for head module

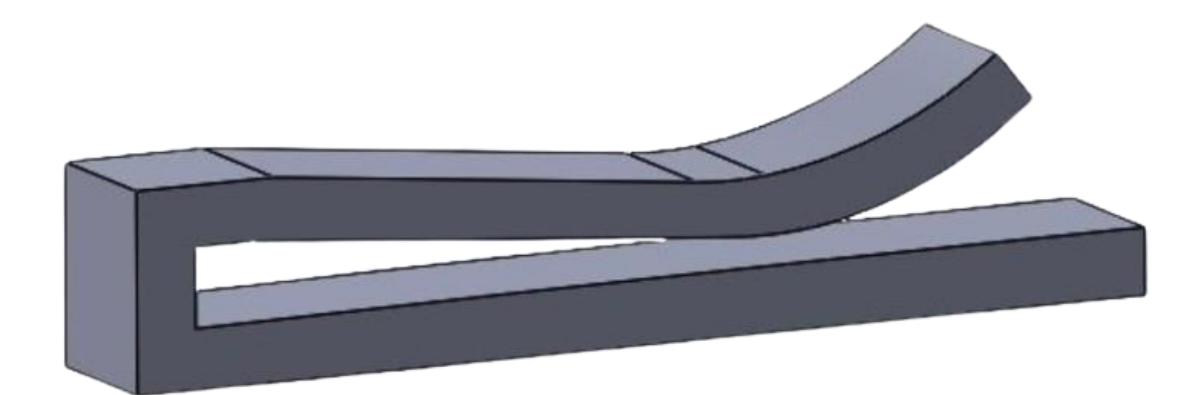


Figure 3: Clip design in CAD

Results

New COBRA Head module design:

- New TPU peripheral cover for easy access to ports, while also protecting them and blocking dust from entering
- The peripheral seal is around 3 mm longer than the actual hole on the module, since TPU is flexible, it'll naturally expand into the module
- We've also printed our head module in CF-PLA

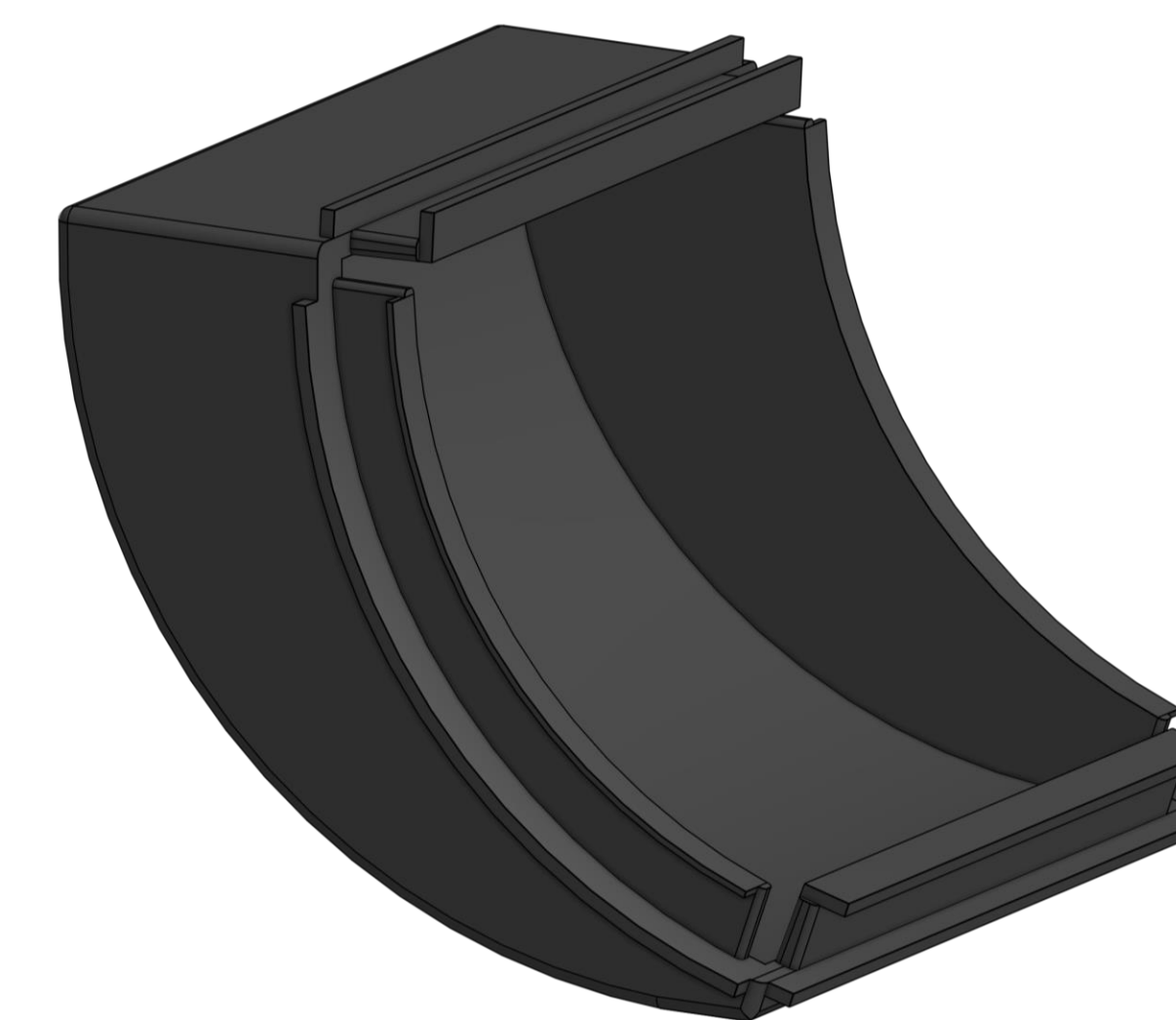


Figure 4: Peripheral seal with lips on the module



Figure 5: Peripheral seal on module

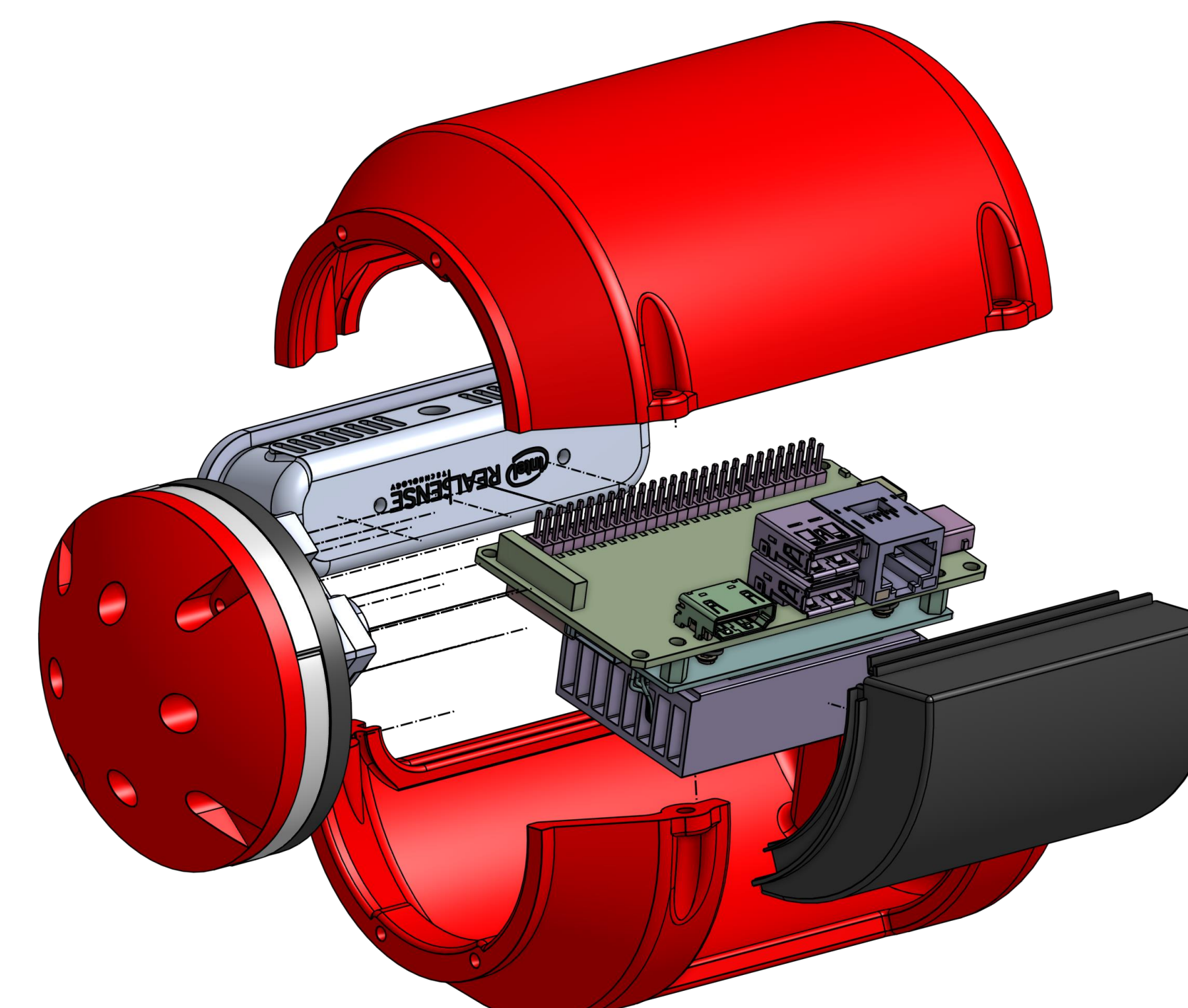


Figure 6: Final head module CAD (without seals)

Conclusion and Future Steps

Conclusion: The COBRA robot is now more fit to do what it was originally made for, addressing the dust problem through the use of seals, wire access/arrangement with a redesign of the head module and clips, and specifications for more durable 3D prints.
Future steps: Testing the head module in a dust and sand environment, with and without the seals to see where further improvements can be made.

Acknowledgements

Silicon Synapse Lab
 Alireza Ramezani, Associate Professor, Computer & Electrical Engineering
 Kaushik Venkatesh, Computer Engineering
Center for STEM Education
 Claire Duggan, Executive Director
 Jennifer Love, Associate Director
 Ahmed Othmen & Victoria Berry & Dmitra Mukasa, YSP Coordinators
 Nicolas Fuchs, Program Manager
 Mary Howley, Administrative Officer
 A. Salagame *et al.*, "How Strong a Kick Should be to Topple Northeastern's Tumbling Robot?," Archive pre-print