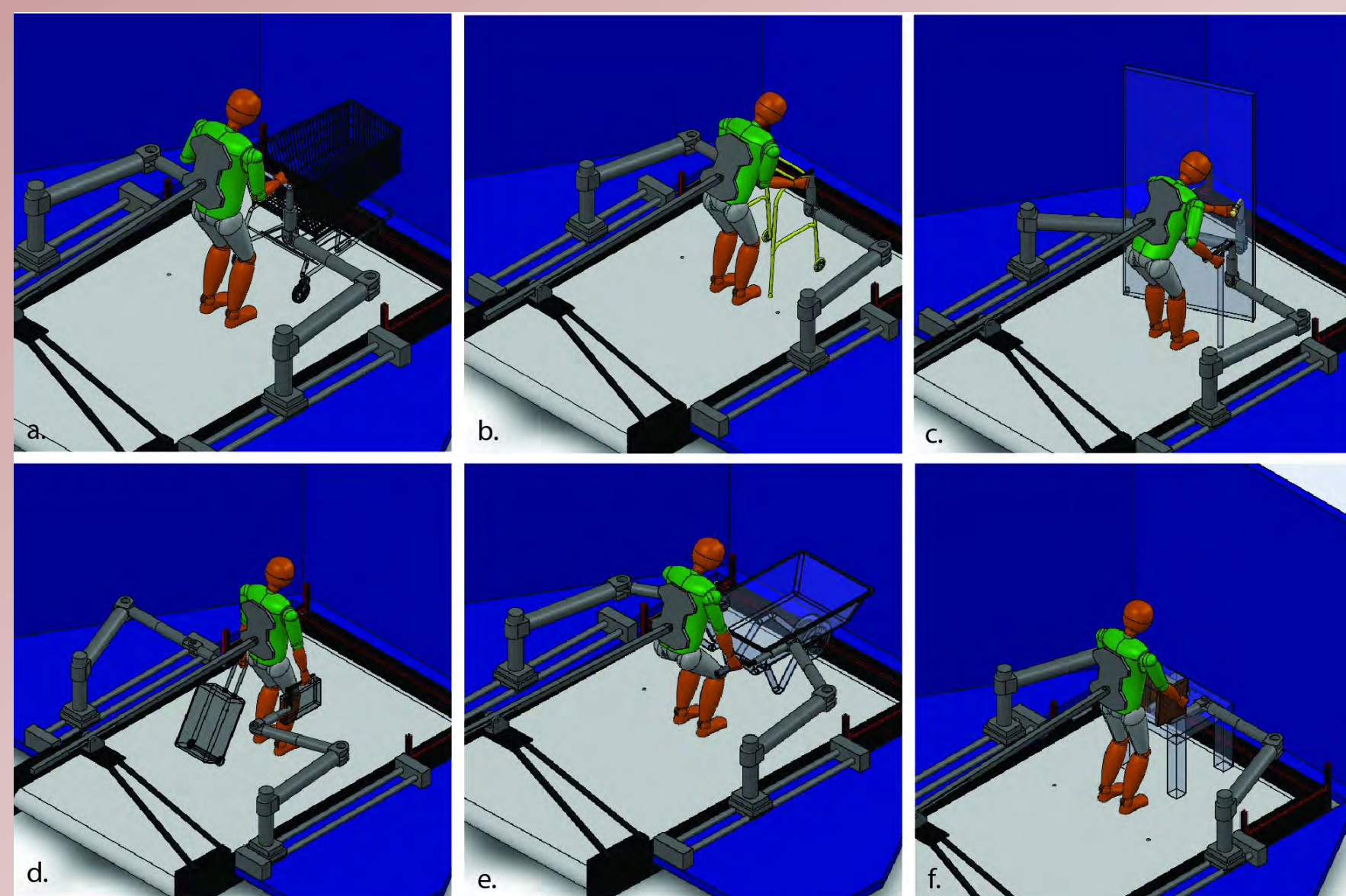


Haptic Interfaces for Real World Objects

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 Advised by Dr. Mark Minor

Introduction:

This project is to support ongoing research by the Cyber Human Systems (CHS) research team under Dr. Mark Minor. This project has developed a CAVE (Cave Augmented Virtual Reality) environment which utilizes multiple human senses for a more realistic simulation. The current iteration of the project is to develop robotic arms that create haptic feedback, the sense of feel, in the environment, such that a user can physically manipulate an object in the virtual world. The senior design team is tasked to create end-effectors, tools mounted on the end of a robotic arm, mimicking real-world objects and a mounting scheme to quickly mount/unmount each from the two robotic arms.

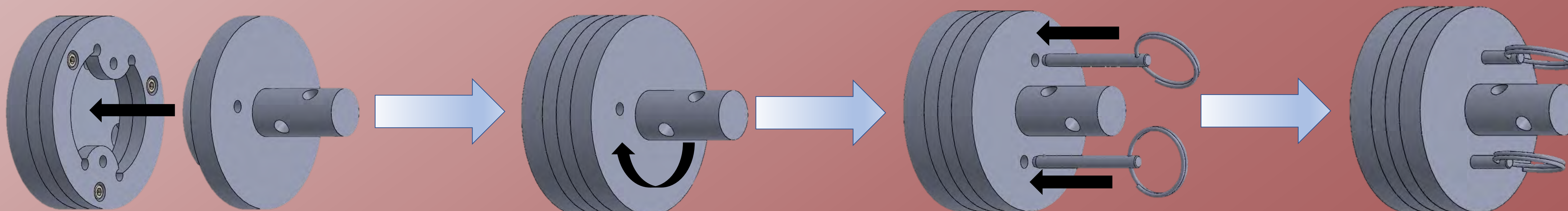


Simulated CAVE environment showing shopping cart (a), walker (b), doorknob and cane (c), suitcase and briefcase (d), wheelbarrow (e) and box (f)

End Effector Objects:

- Cane
- Walker
- Wheelbarrow
- Shopping Cart
- Doorknob/Handle
- Suitcase
- Briefcase
- Box

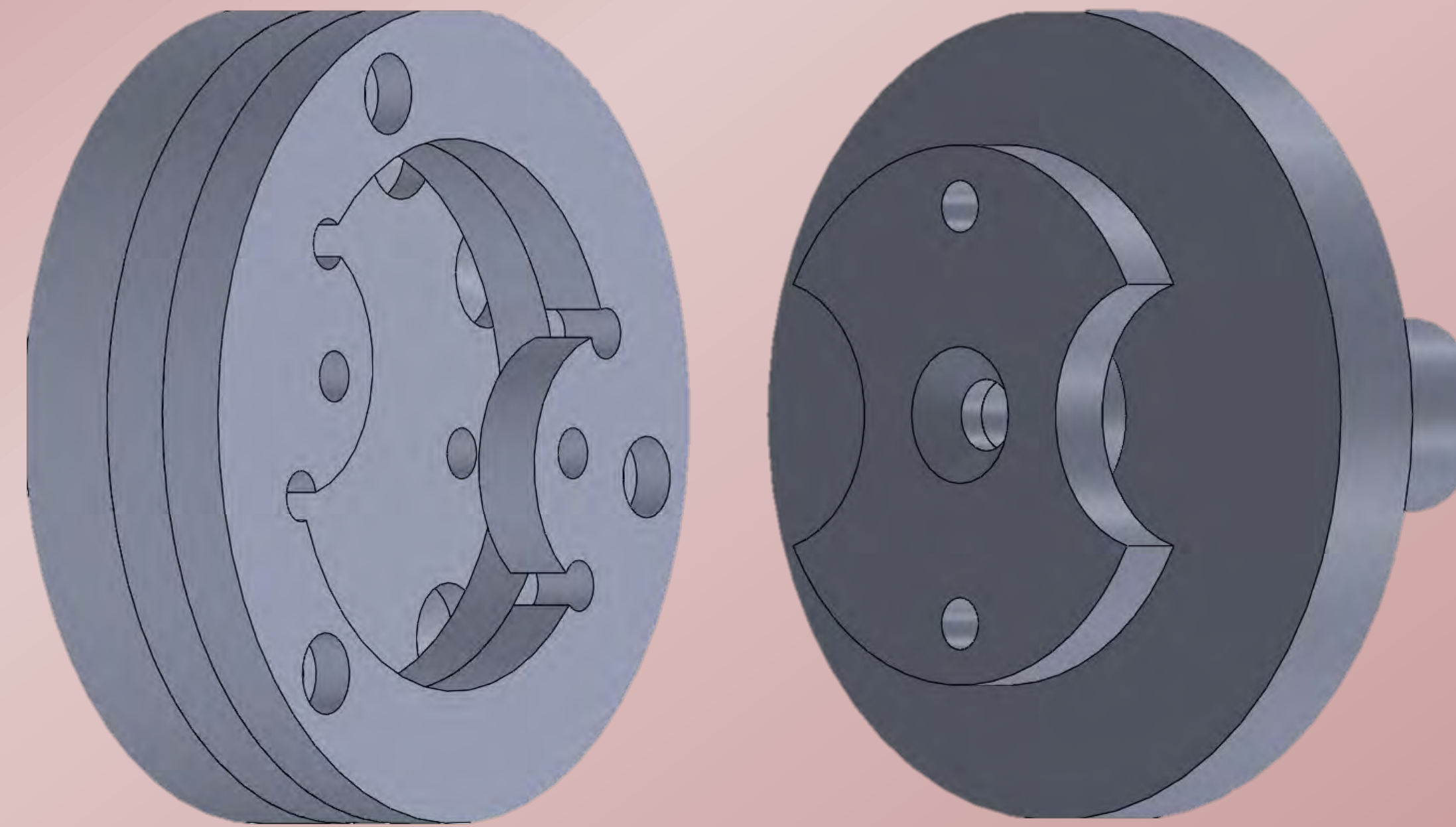
Installation Flow:



User Timing:

Installation Time: 9.8 seconds
 Uninstallation Time: 1.7 seconds

Prototyping:



Design Goals:

- Maximize Rigidity
- Accurately Replicate Dynamics
- Simple Mounting
- Durability
- Compactness
- Minimize Weight
- Simple Fabrication
- Minimize Cost

Design Requirements:

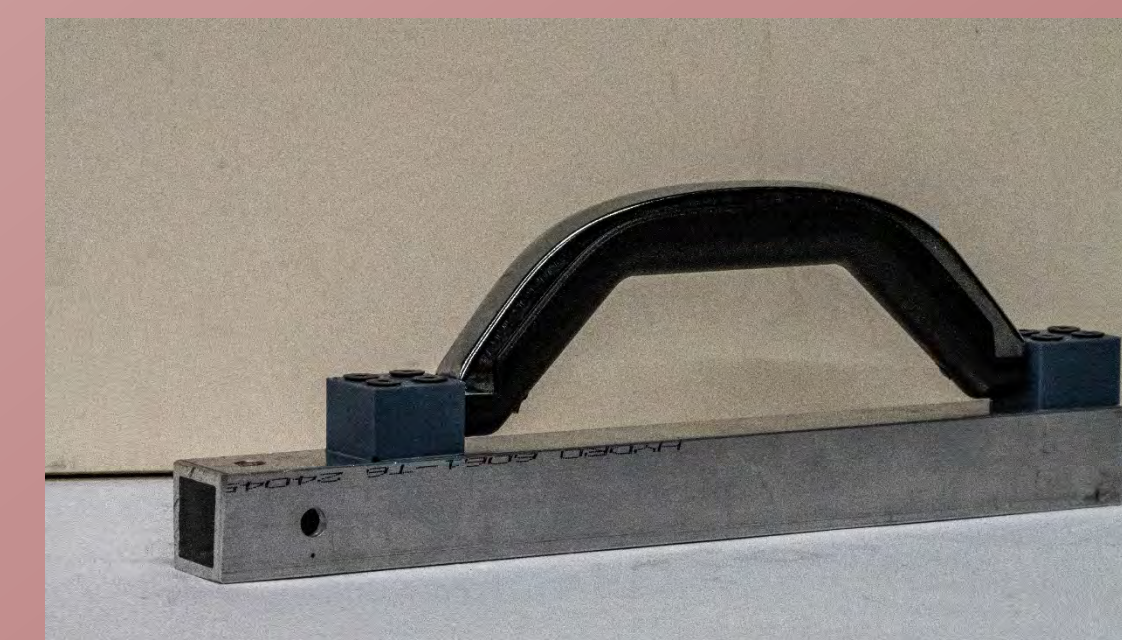
- Must withstand a 25 lb. design load at the intended loading point
- Must create a torque less than 25 lb-ft at the load cell to prevent damage to the robot



Final manufactured tool changer mounted to walker handle/interface



Wheelbarrow end effector and 3D printed tool changer



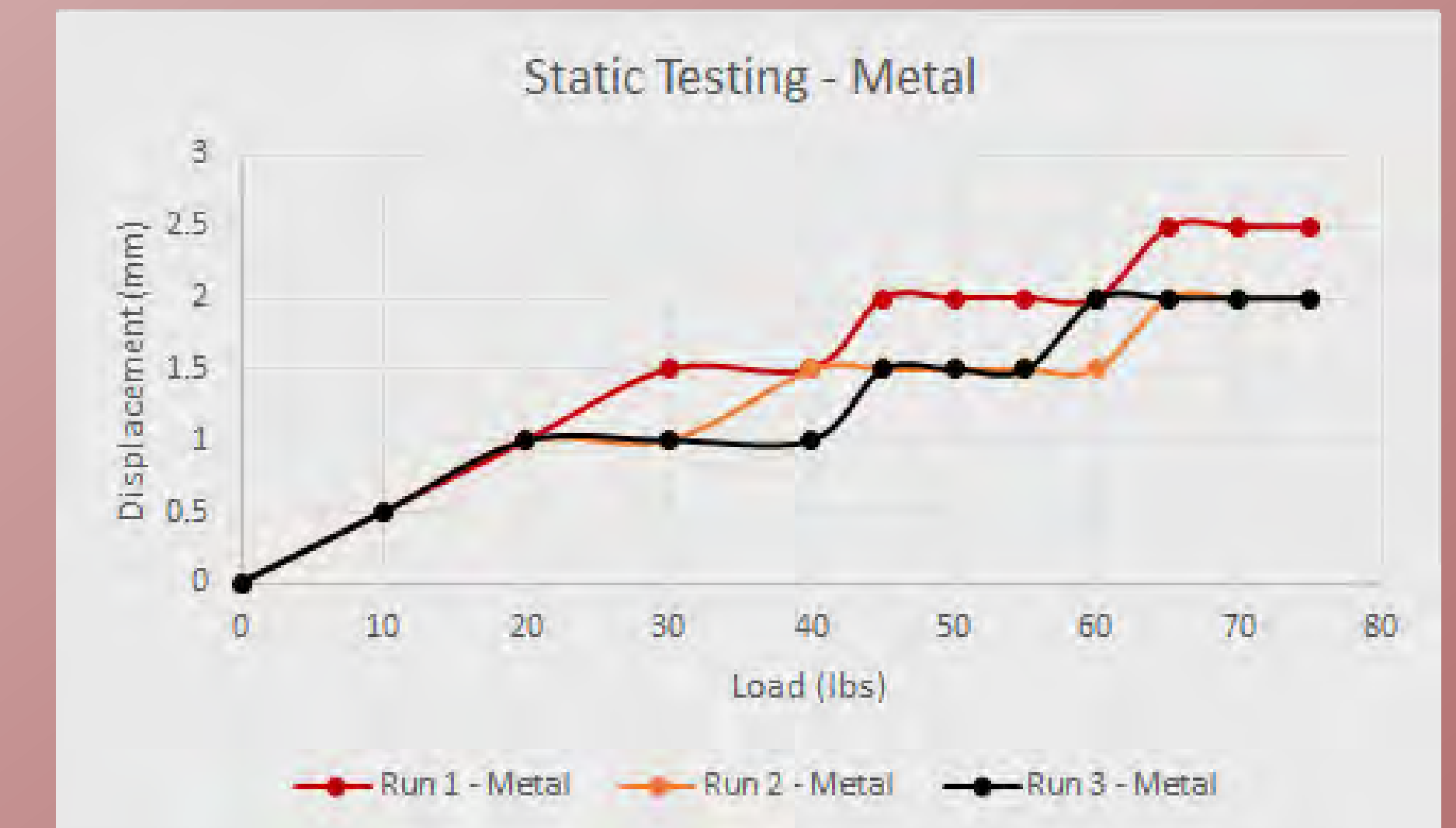
Briefcase end effector



Final manufactured tool changer

Results:

Static load strength testing was used to verify manufactured prototypes satisfy Dr. Minor's design requirements. Displacement testing was done simultaneously to verify rigidity requirements.



Strength and Displacement testing on manufactured aluminum and PLA tool changers when loaded with an approximate 1" lever arm, and no connected end effector. Both withstand the 25 lb. design load with similar displacements.

