Archytas End of Arm Tool Interface Redesign

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Sponsor: Archytas, Robert Caswelch

Summary

Robot arms use end of arm tooling (EOAT) to automate various tasks, with an EOAT corresponding to a specific purpose (grippers, cameras, etc.) Therefore, **EOAT universal compatibility and tool swap speed is valuable.**

Archytas' EOAT interface is lacking in several areas:
- Not compatible with most EOAT ecosystems.
- Time consuming process of bolting in 3 stakes.
- Flimsy and inconvenient electrical connection.
- Weak motor.

We improve their interface by implementing the following features:
- Largely 3d printed.
- Improved swap speed and convenience.
- Interface with stakes.
- Compatibility with UR3e and ISO-standard EOAT.
- Power delivery.
- Housing for larger motor.
- 1 kg maximum payload.

The most significant aspect of this project was designing a locking mechanism that is robust against 3d printing errors, convenient to use, and secure enough to support a 1 kg payload. Our external lock and channel design fulfilled those requirements.

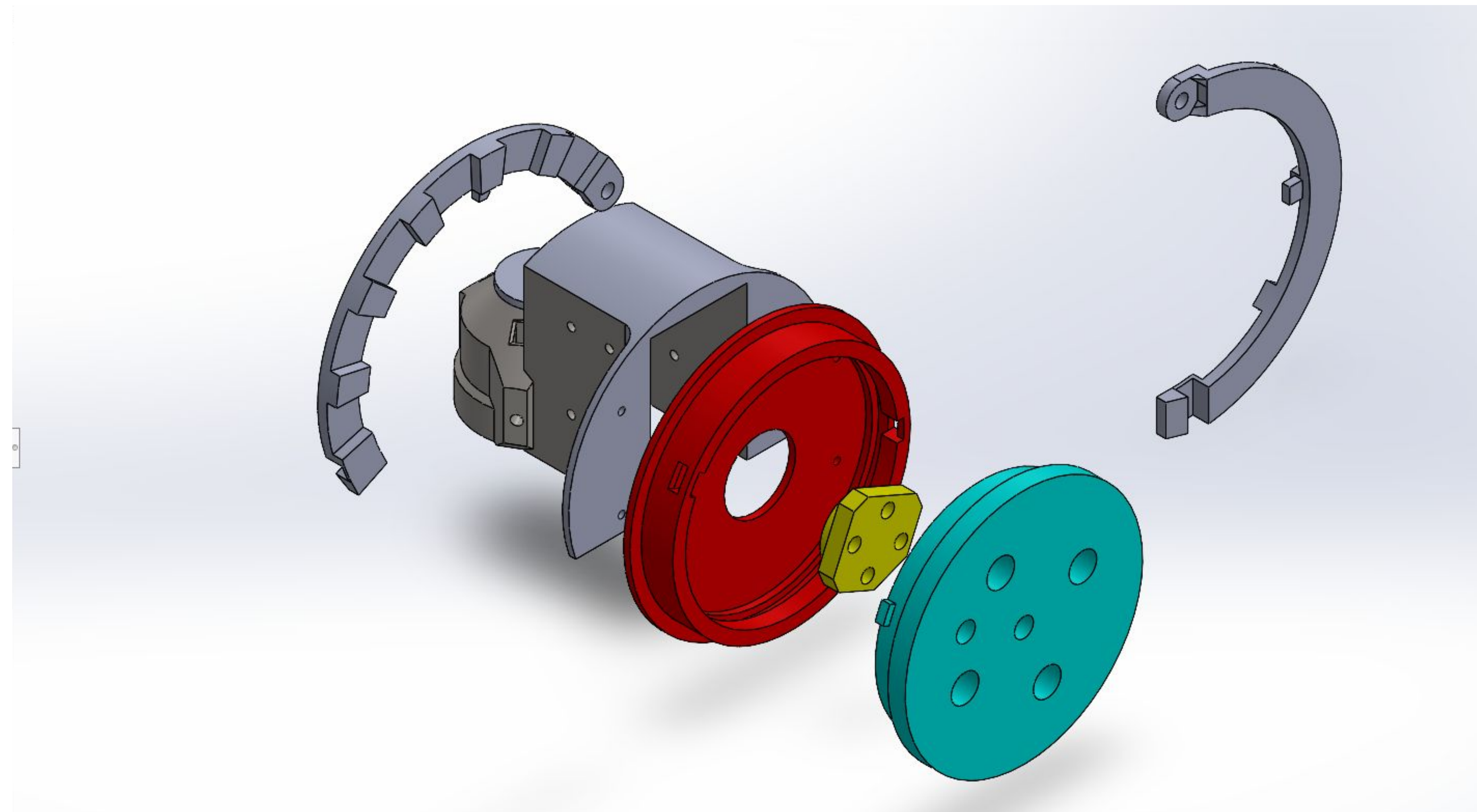

Fig 1. Full Assembly in an exploded isometric view

The full assembly features just 6 parts and is completely 3D-printed. The motor key enables the motor to transmit power to the swappable ISO plate. The locking mechanism, which closely resembles a handcuff, first slides into the locked position from the right side and then closes down to engage the tabs on the arms of the handcuff. Notches at each end of the arms snap together to secure the lock while being easy to unlock by simply twisting them apart with finger strength.

Engineering Analysis

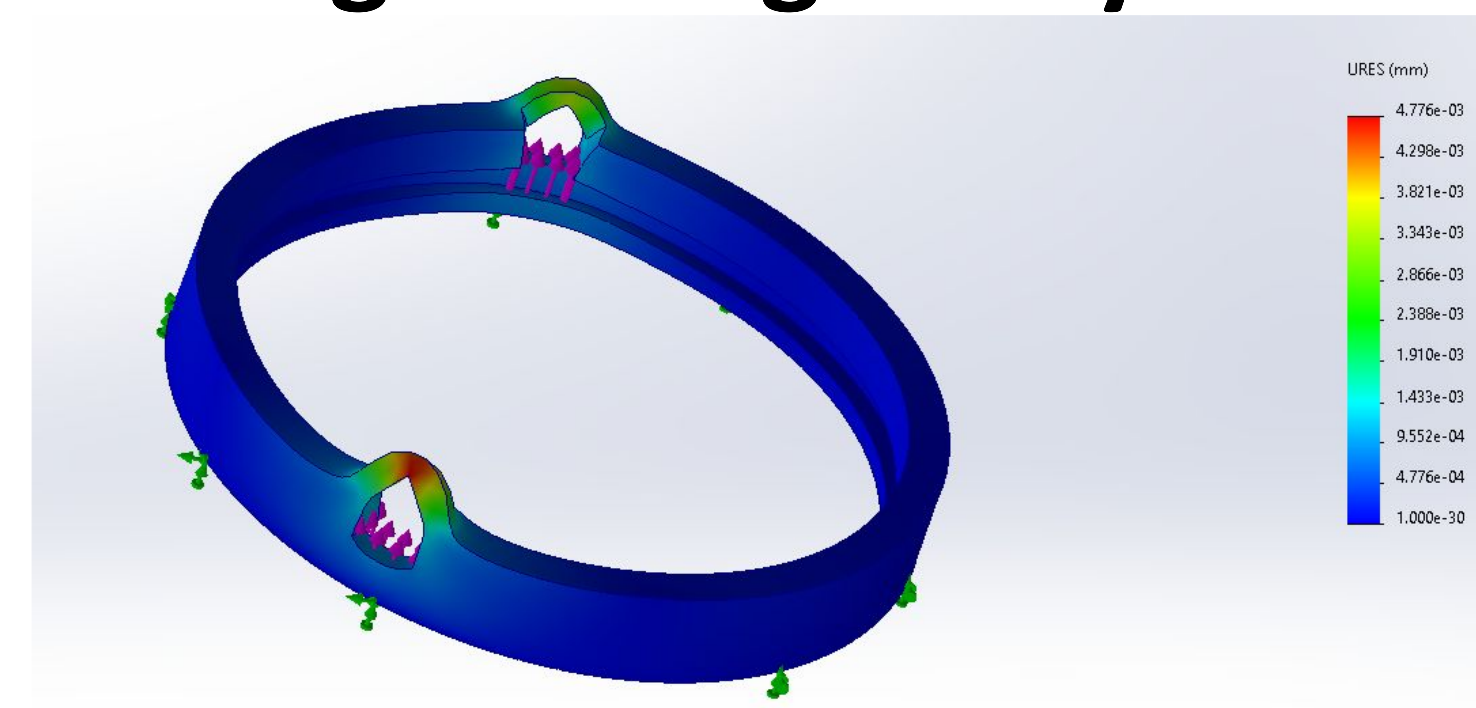

Fig 6. An FEA analysis of 9.8 N total loading on the thin strip above the lock holes in the channel part.

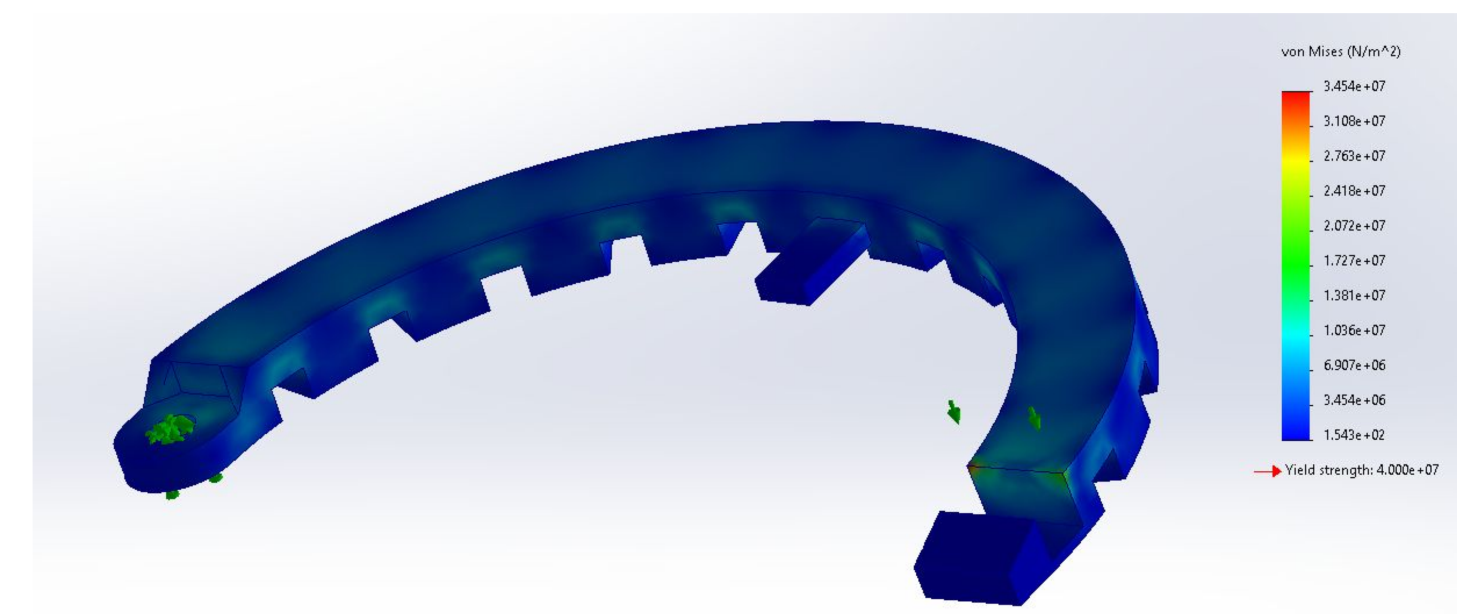

Fig 7. An FEA analysis of one arm of the locking mechanism, simulated to have the notch end deflect 4 mm down.

FEA analysis was a critical part of our design and verification steps. Simulating loads or predicted deformations and confirming the stresses were within the standard factor of safety was essential to validating the reliability of our parts and optimizing core aspects such as flexibility and strength.

Stake and Motor Housing

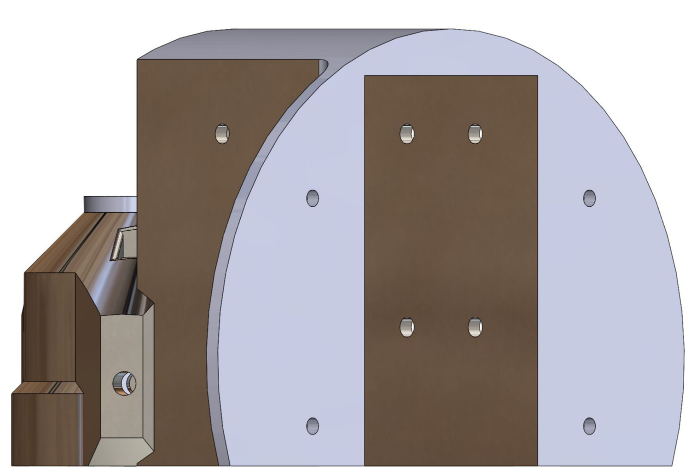

Fig 2. Motor Housing and Stake Interface

The stake and motor housing is held onto the robotic arm through 3 screws located around the cylindrical face. The motor is fully encapsulated within its housing, protecting it from outside dangers. The channel is attached through the four screw holes found on the front face of the motor housing.

Channel and Lock

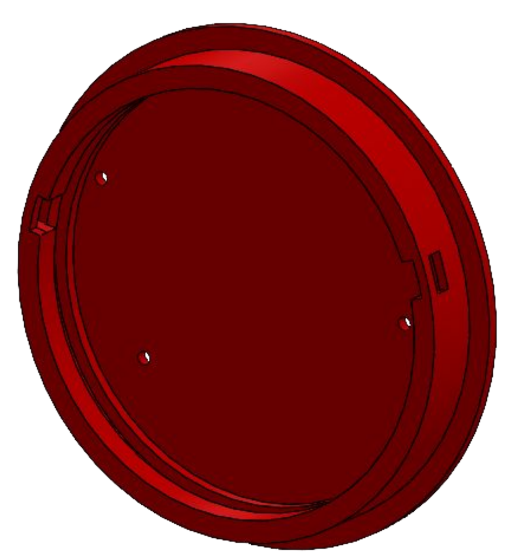

Fig 3. Channel

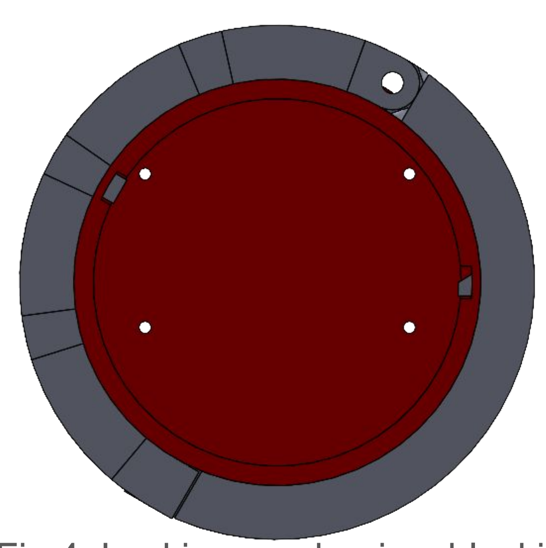

Fig 4. Locking mechanism blocking entrances

The channel is attached to the motor housing and has openings that allows for ISO plate to be inserted easily. After the plate is inserted, an external lock used to block the entrances and prevent the tool from exiting. After the lock is attached, the ISO plate is able to spin a full 360 degrees without any interruptions.

ISO Plate

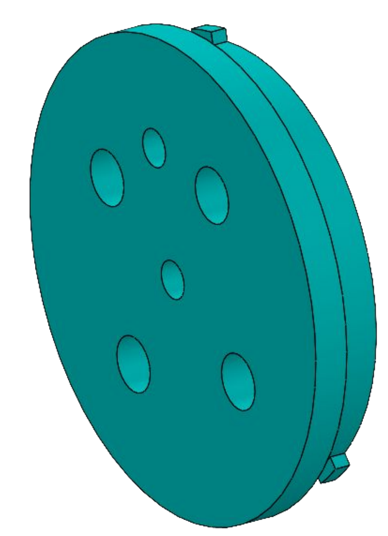

Fig 5. ISO plate

Our ISO plate uses a standard connection design pattern, ISO-9409-1-50-4-M6, which is the attachment method of many UR3e end of arm tools. This plate allows for those tools to be used in conjunction with Archytas's robotic arm along with having a faster swap time since only the plate needs to be taken out to swap a tool instead of the whole interface assembly.

Future Improvements

We plan to improve our design in the future so that the robotic arm can automatically swap between tools. We also hope to find areas in the assembly where the volume can be reduced to minimize the production cost of our interface.

Acknowledgements

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