

CONFORMABLE 3D PRINTED
PROSTHETIC SOCKET FOR
HAPTIC FEEDBACK
INTEGRATION

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THE MOTIVATION



- iLimb Quantum:
 - Hand only: \$30,000
 - Full arm prosthetic: \$80,000 - \$120,000

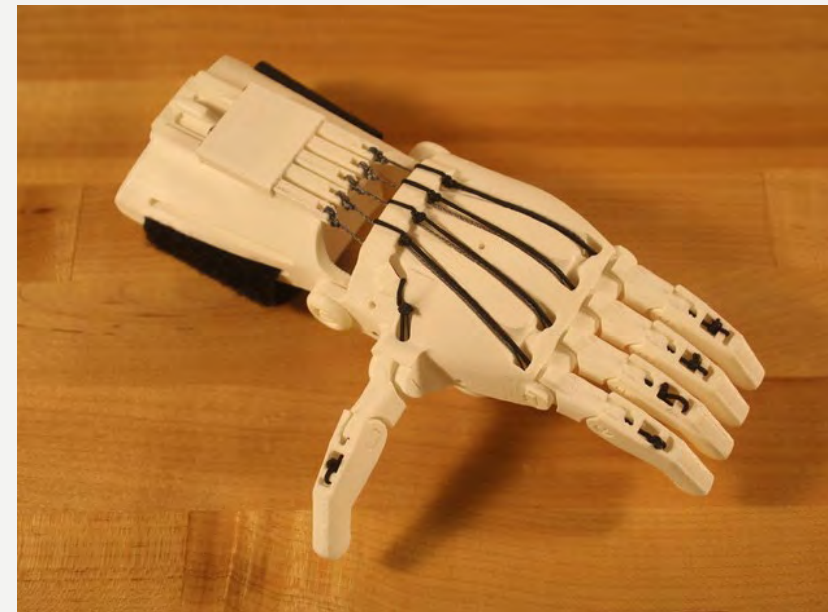


- Open Bionics Hero Arm:
 - Full arm prosthetic: ~\$7,000
 - 3-D Printed Components
 - UK Clinical trial (NHS)



- Limbless Solutions Arm:
 - Full arm prosthetic: \$350
 - 3-D Printed Components
 - US Clinical Trial (UCF-OHSU)

e-NABLE (Enabling the Future) is an online, open source community that makes prosthetic and orthotic devices using 3D Printing







RESEARCH

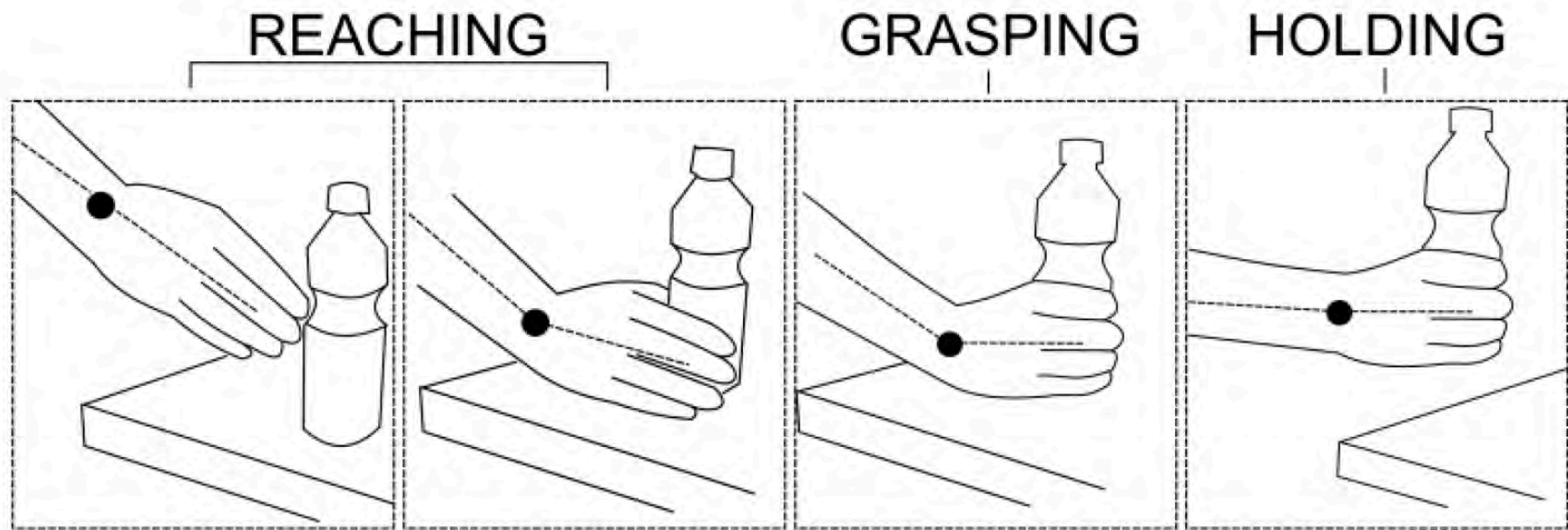


Fig. 6 Typical manipulation sequence when using the compliant wrist.

3-D Scanning



Computer Assisted Design



3-D Printed Prototyping



Processing & Custom Fitting



iLimb Quantum Test

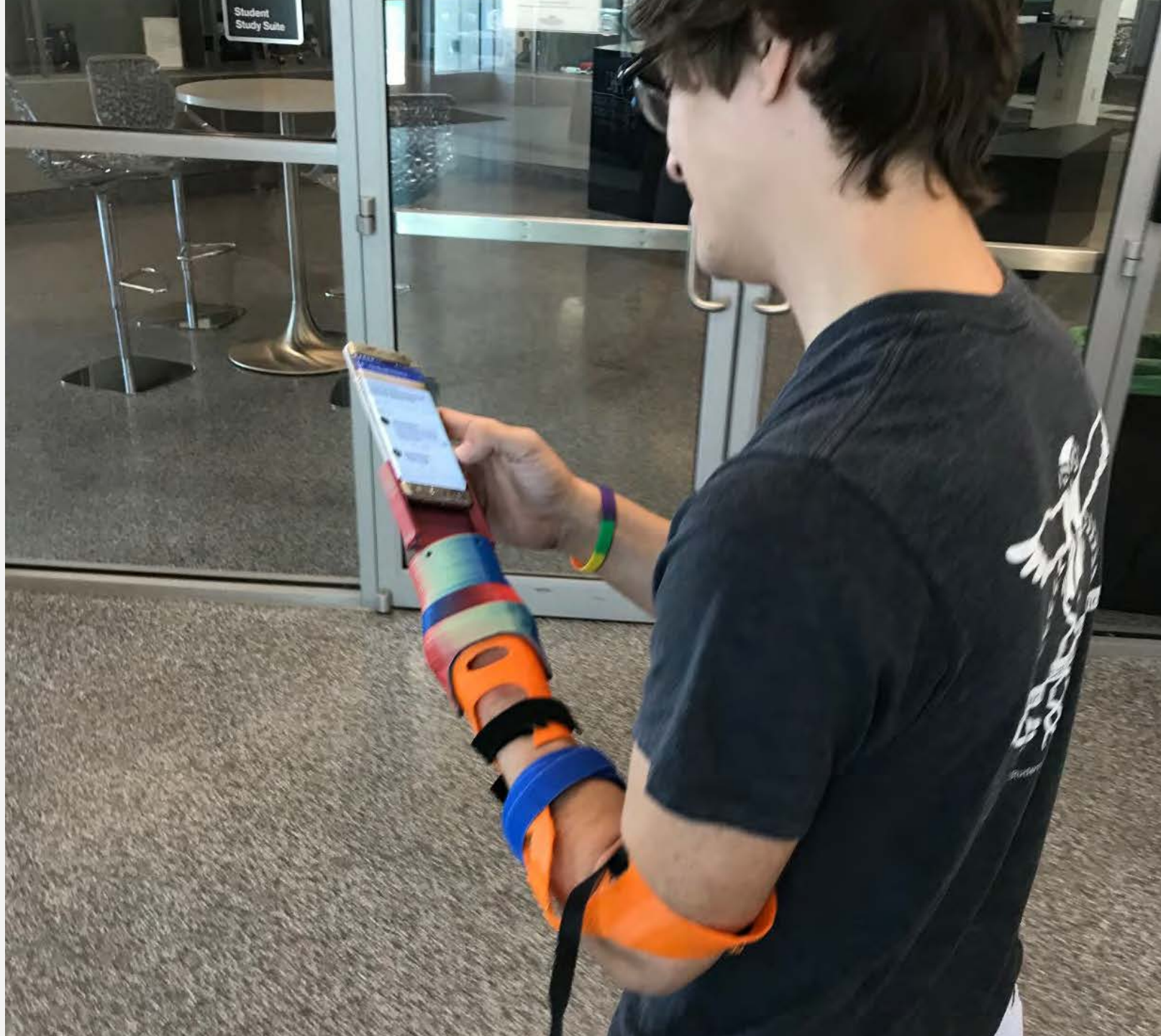


Haptic Feedback Integration











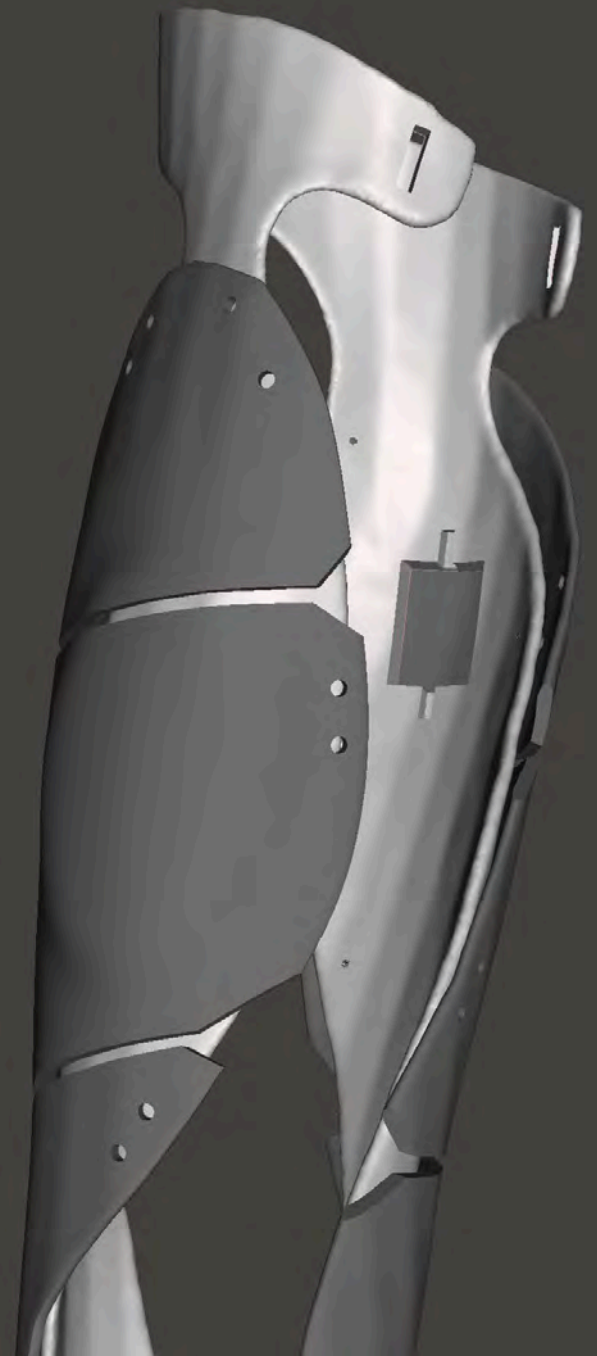
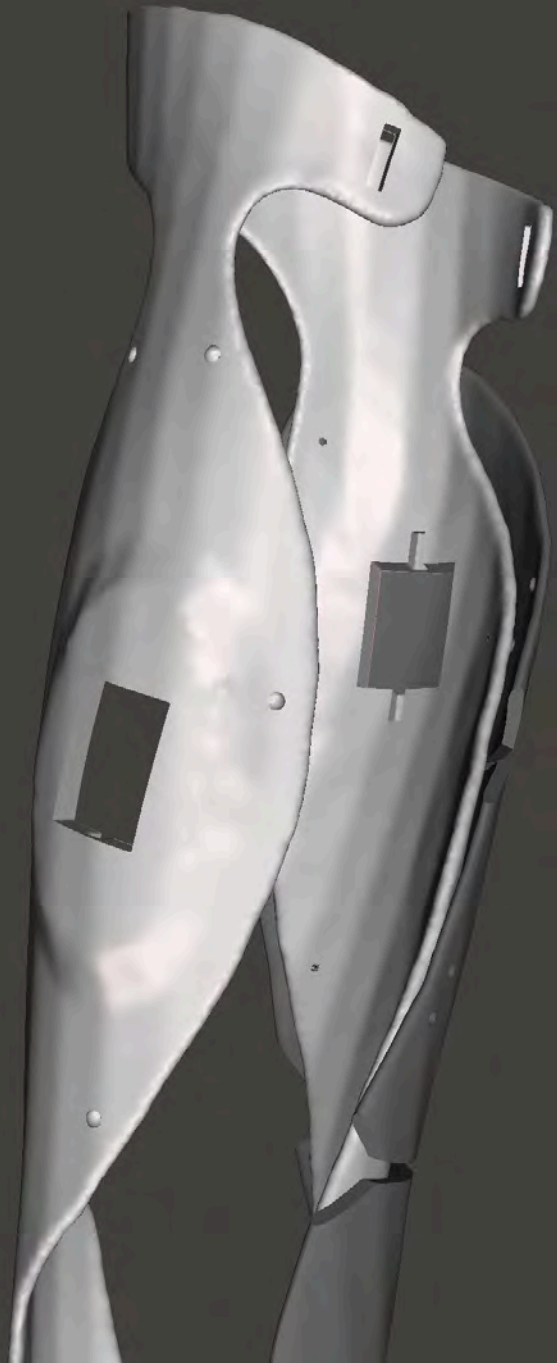
Challenges

- Printing a flexible socket proved challenging, and required very fine tuning of the print settings
- A special 'slicer' software, Simplify3D, was needed to implement specific print settings
- Flexibility of arm must be maintained, various revisions had to be made to optimize the user movements









Conclusion

- We made a highly conformable prosthetic socket with an interlocking external shell to accommodate a standard iLimb Quantum Hand with integrated tactile haptic feedback.
- Allow for greater access to custom prosthetics through the use of 3D printing and scanning
- Overall cost of production:
 - ~\$50 for flex
 - \$10 for shells
 - ~\$20 for BOA system
- Overall: >\$100 for prosthetic socket

SOURCES

- <http://www.sun-sentinel.com/features/fl-bionic-hand-woman-20150807-story.html>
- <https://all3dp.com/open-bionics-releases-3d-printed-affordable-hero-arm/>
- Kanitz, Gunter, et al. "Compliant prosthetic wrists entail more natural use than stiff wrists during reaching, not (necessarily) during manipulation." *IEEE Transactions on Neural Systems and Rehabilitation Engineering* (2018).