HAMR Time: Customized Anthropomorphic End-Effectors, Where Biology and Engineering Go Hand in Hand

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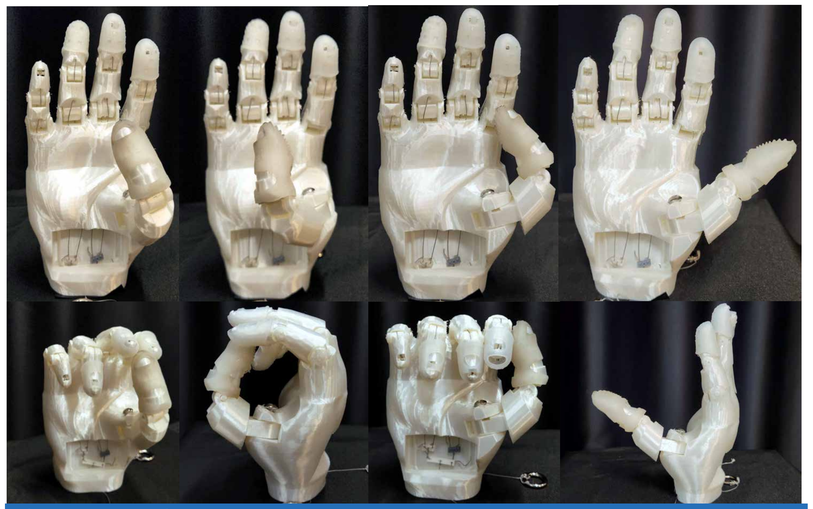
Motivation

Individuals with limb loss often choose prosthetic devices to support activities of daily living (ADLs). High abandonment rates persist due to uncomfortable and unreliable designs.

Introduction

The Human-inspired Actuator Modeling and Reconstruction (HAMR) process uses digital fabrication to create tendon-actuated hands that mimic human movement and offer versatile grip types.



The HAMR Process

HAMR Process Steps	
1	Identify the Limb
2	Cast the limb in alginate and fill with plaster
3	Scan with a Revopoint Pop 3D Scanner
4	Edit model to add joints, tendon paths
5	3D print and assemble the hand

Figure 2 The HAMR Process which uses alginate and plaster to form a model of a limb, scans that limb to generate an editable mesh which can then be customized into an end effector. The HAMR Process can be adapted for a variety hand geometries including partial limb loss. Materials can be expanded to rigid materials like PLA or PC Carbon fiber, or flexible materials of varying shore hardness like TPU to increase both comfortability and fit.

Phase I: Non-Amputee

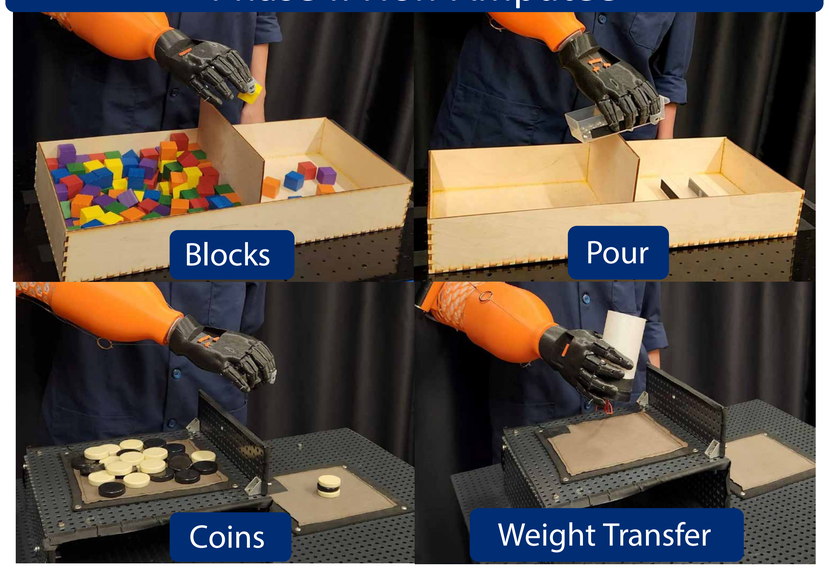


FIGURE 3 Task performance with TAPH was evaluated across four ADLs encapsulating power, lateral, and pinch grasping types in a within subjects study involving six participants.

Phase II: Partial Hand Amputee

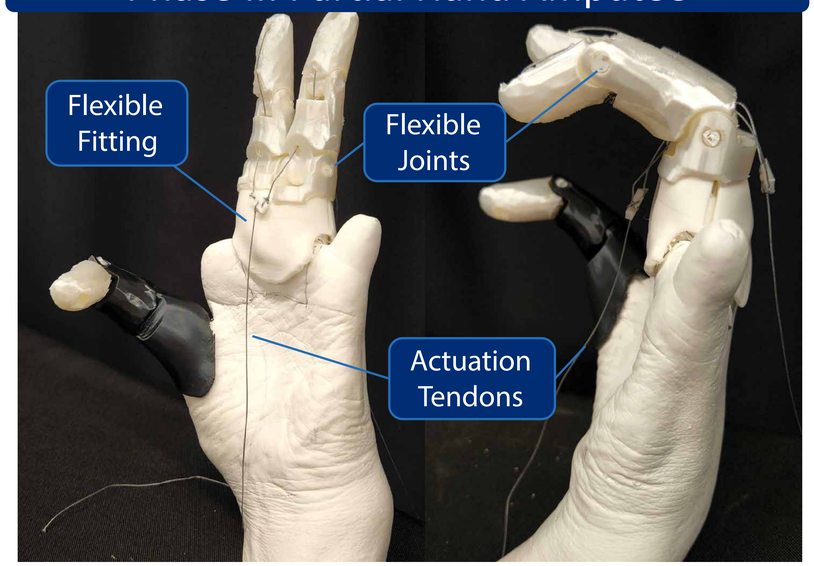


FIGURE 4 The HAMR Process was employed to generate a tendon actuated partial hand prosthesis with Colorfab Varioshore TPU used to fit around the residual limb, and PLA used to construct the joints.

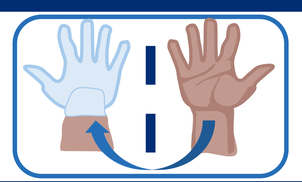
Preliminary Results

Hand	Blocks	Pinch	Stack	P.E.(%)	T.E.(%)
BSH	4.40	1.00	0.71	23.7	90.7
TAPH	5.42	1.75	1.33	29.5	95.4

TABLE 1 Results from the TAPH Evaluation study Pour Efficiency (P.E.) and Transfer Efficiency (T.E.) calculated by the ratio of total completed pours and transfers over the total number of transfers or pours.

Future Work

1. Evaluate the partial hand design (ADLs)
2. Use the HAMR process to mirror a limb
3. Expand to flexible materials



Acknowledgements

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