Design and Implementation of the Exo-Skin Soft Robotic Rehabilitation Exoskeleton

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Smart motor housings

- Wearable technology shows great potential to assist hand specialists in improving range of motion, strength, and function while reducing costly clinic visits.
- Hand augmentation technology also has potential to reduce recovery times as greater adherence may be achieved with the required exercise program.

Rehabilitative interface

- The Exo-Skin soft exoskeleton provides a remote link between the patient and clinician.
- Hand kinematic data can be collected and analyzed in real time.
- A web-based interface allows for cohesive patient-clinician monitoring and interaction.

Current Tech Limitations

- Current solutions rely on bulky rigid mechanical structures to deliver forces to the fingers.
- All solutions are extremely expensive and non-portable.
- Variation in shape and size of hands remains unaccounted for.

Smart motor housings

- 3D printed motor housings are capable of sensing tendon length and tension. The artificial tendon pathway is illustrated by the red line in the figure below.
- The data gathered from these housings is processed and used to reconstruct a kinematic model of the patient’s hand. The modular system can be assembled to include any number of fingers and fit virtually any hand.

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Knit technologies

- The soft Exo-Skin is fabricated using Shima Seiki 3D knitting technology. The ability to knit single-piece structures cuts assembly time and allows for a seamless transition to industrial production.
- Hi-tech thermoplastic yarns are used to give the glove’s semi-rigid segments structure. Malleable nylons are employed over the knuckles to allow for finger flexion. High-strength dyneema is used as artificial tendon wire.
- Extremely complex knit structures can be constructed using the machine’s programming language.

Future Applications

- A haptic interface for data exploration.
- An assistive device for strength augmentation.
- 3D control for virtual reality gaming.