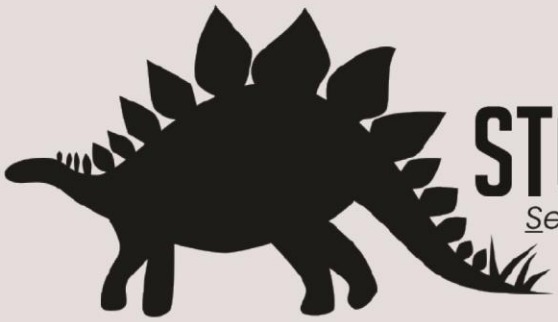
INITIAL SEARCH

Exoskeleton with Sensors (Wearables)



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Exoskeleton with Sensors (Wearables)

What is an Exoskeleton with Sensors (Wearables)?
Exoskeleton with sensors (wearables) enhance human capabilities via robotics and engineered solutions. There are two main groups of exoskeletons, active and passive.
Active exoskeletons employ the use of robotics and electronics. Among these are hard and soft exoskeletons. Harvard is working with active "Soft Exosuits" intended to "augment the capabilities of healthy individuals (e.g., improved walking efficiency) in addition to assisting those with muscle weakness or patients who suffer from physical or neurological disorders." Soft Exosuits have "…several advantages: the wearer's joints are unconstrained by external rigid structures, and the worn part of the suit is extremely light. These properties minimize the suit's unintentional interference with the body's natural biomechanics and allow for more synergistic interaction with the wearer."

Passive exoskeletons are currently more commercial and easier to use. Examples of these are used in assisted lifting (Laevo) and sports (ski support assistance). Devices that assist, enhance or augment the natural bodies capabilities giving support and stability not utilizing robotics.

It is the active exoskeletons with sensors that will be the focus of this initial investigation. Sensors are the best opportunity for 3D printing.

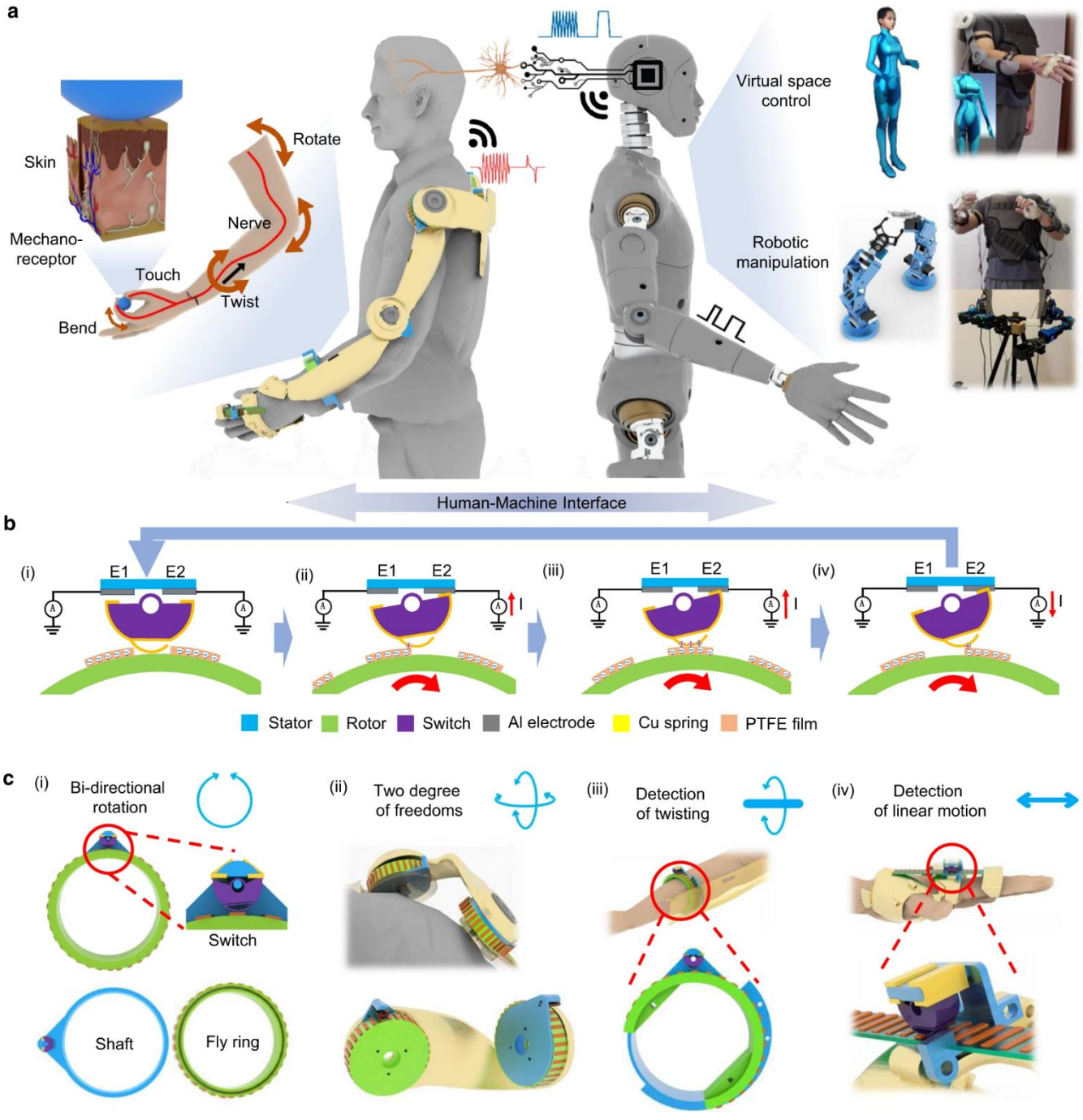

Figure 1: 1 × 2 optical switch based on spoiling the total internal reflection with a fluid. (Insets) Cut-out view showing the electrostatic membrane actuator in the Through and Cross states (adapted from [65], Chollet, 2016, https://doi.org/10.3390/mi7020018, licensed under CC BY 4.0

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What are the possibilities?
Exoskeleton wearables have the potential to augment a person's capabilities, improve muscle movement degenerated from accident or disease or neural impairments.
Augmenting a person's capabilities have applications in among others, manufacturing, and the military augmenting lifting and extended duration movement. This could extend the working hours reducing fatigue.

Applications in Additive Manufacturing/3D Printing
Exoskeleton with sensors (wearables) are less bulky than the initial Exoskeleton mechanisms. They provide more flexibility and customization to the individual. As such it opens a market for customizable (3d printed) components.

Current Challenges & Weaknesses
Given the variety of 3d materials and printing techniques, there are few weaknesses or challenges to printing the components needed for the exoskeleton wearables. The challenges are with the design of the mechanism. Harvard's design seems more advanced. Partnership with these pioneers would be the first step. Another challenge is the market. If there is more than a niche market for this type of technology.

Market Overview & Technology Game Changers
It has potential if marketing can be worked to make the exoskeletons something that will be adopted by the military, medicine, or public. If adopted by the public and/or military with success it could be big.

Time to Technical Confirmation & Time to Market Introduction
Currently there are Exoskeletons for controlling robots and helping with mobility concerns. One producer Laevo has exoskeletons geared for Agriculture, Warehouse, Healthcare and Military. These passive exoskeletons are more for redistribution of load on the body.

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